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# Searching for the Nano-needle in a Green Haystack: Researching the Environmental, Health, and Safety Ramifications of Nanotechnology

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# ARTICLE

# Searching for the Nano-needle in a Green Haystack: Researching the Environmental, Health, and Safety Ramifications of Nanotechnology

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The magic of our modern-day, shrouded in mystery, invisible to the naked eye, and empowered with the potential to re-shape our world, nanotechnology[1]—or the manipulation of matter at the nanoscale level (one-billionth of a meter)[2]—stands as a force capable of both tremendous beneficence and unimaginable destruction. The benefits of nanotechnology have increased exponentially over the last decade as groundbreaking research has led to revolutions in medicine, agriculture and manufacturing. However, similar to the casting of a wizard's spell, and as popular works of fiction[3] and the grey goo theory warn,[4] there is significant uncertainty to the potential harmful

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1. For the purposes of this Article the terms "nanotechnology" and "nanotech" are used interchangeably.

2. JEFFREY H. MATSUURA, NANOTECHNOLOGY REGULATION AND POLICY WORLDWIDE 9 (2006).

3. *See, e.g.*, GREG BEAR, SLANT (2012); HARRY STEINMAN, LITTLE DEADLY THINGS (2012); J.C. LANSING, THE BOOK OF KUR (2011); R. DAVID KING, NANOMECH (2011); MICHAEL CRICHTON, PREY (2008); ROBERT LUDLUM, THE LAZARUS VENDETTA (2004); NEAL STEPHENSON, THE DIAMOND AGE (1995).

4. K. ERIC DREXLER, ENGINES OF CREATION: THE COMING ERA OF NANOTECHNOLOGY 172-73 (1984) [hereinafter DREXLER, ENGINES OF CREATION]; *see also* Joel Rothstein Wolfson, *Social and Ethical Issues in Nanotechnology: Lessons from Biotechnology and Other High Technologies*, 22 BIOTECHNOLOGY L.

effects of nanotechnology on our environment, ranging from the air we breathe, to the water we drink, to the food we eat. And as nanotechnology becomes even more pervasively integrated into agriculture, industrial processes and the manufacture and design of consumer goods, the risk of harm becomes more acute. With this unique juxtaposition of explosive scientific advancement coupled with uncertain harm—a double edged sword if you will[5]—the one certainty that we can be assured of is that nanotechnology is here, and it is here to stay. Which for attorneys means nanotechnology is coming; and it is headed to an environmental litigation department near you.[6]

As such, this Article will attempt to serve as a primer by demystifying the process of how to efficiently locate resources discussing the environmental health and safety (EHS) impacts of nanotechnology in the United States (U.S.). Part I of this Article begins with an examination of basic strategies for conducting research in the EHS nanotech field. Part II focuses on traditional legal resources such as texts, treatises, encyclopedias, as well as law review and journal articles. Part III examines such non-legal resources as reports, scientific studies, internet sites and other current awareness services. This last section is followed by a brief conclusion.

## I. RESEARCHING NANOTECHNOLOGY

As a modern phenomenon, researchers interested in investigating the EHS issues implicated in nanotechnology are

REP. 376, 377-82 (2003), *available at* http://www.dejlaw.com/siteFiles/Publications/5B17637895210814D3535F1276C22B89.pdf.

5. JOHN F. SARGENT, JR., CONG. RESEARCH SERV., NANOTECHNOLOGY AND ENVIRONMENTAL, HEALTH, AND SAFETY: ISSUES FOR CONSIDERATION 4 (2011), *available at* http://www.fas.org/sgp/crs/misc/RL34614.pdf [hereinafter SARGENT, JR., NANOTECHNOLOGY AND ENVIRONMENTAL, HEALTH, AND SAFETY] (quoting E. Clayton Teague, Director of the National Nanotechnology Coordination Office).

6. Jean M. Eggen, *Nanotechnology and the Environment: What's Next?*, 26 NAT. RESOURCES & ENV'T 51, 51 (2012) (noting that nanotechnology is "not yet in the daily vocabulary of attorneys practicing in the area of environmental law, [but it] soon will be").

faced with a true Thalia-Melpomene dichotomy.[7] On the positive, the theoretical underpinnings of nanotechnology[8] only originated in the late 1950s with first the work of Richard Feynman,[9] and later the work of K. Eric Drexler,[10] with the technical capability to observe and manipulate atoms only emerging in the late 1980s with the work of IBM.[11] Therefore, since the birth of the field of nanotechnology coincides so closely with the founding of the Internet age, there is a tremendous amount of relevant material available on nanotechnology in the form of authoritative, up-to-date, searchable, electronic resources. However, to the negative, researchers can likewise drown in the breadth of field and be easily frustrated by a lack of generalized or nonresponsive documents.[12]

Moreover, in surveying the literature, several themes emerge that complicate research in this field. First, and foremost, nanotechnology is rarely cited to as a pressing environmental concern as nanotech EHS apprehensions have typically flown below the public's metaphorical radar despite some scares in the

7. Referencing the muses represented in the theater masks of comedy and tragedy. M.A. DWIGHT, GRECIAN & ROMAN MYTHOLOGY 200 (1860) (noting Thalia was the Muse of "comic and lyric poetry" and Melpomene of tragedy).

8. It should be noted that even the term "nanotechnology" is recently new–only being coined by Norio Taniguchi of the University of Tokyo in his 1974 paper. *See* Norio Taniguchi, *On the Basic Concept of 'Nano-Technology*,' JAPAN SOC'Y OF PRECISION ENG'G, 1974, at 18-23.

9. Chris Toumey, *Tracing and Disputing the Story of Nanotechnology*, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES 46, 47 (Graeme A. Hodge et al. eds., 2010). Although there is some dispute regarding the origins of nanotechnology, most believe the field began on December 29, 1959, as a result of comments made during Richard Feynman's talk, *There's Plenty of Room at the Bottom,* at a meeting of the American Physical Society at the California Institute of Technology. *See* Richard P. Feynman, *There's Plenty of Room at the Bottom*, 23 ENGINEERING & SCI. 22, 22 (1960), *available at* http://calteches.library.caltech.edu/1976/1/1960Bottom.pdf (reprint of the original lecture).

10. *See* Toumey, *supra* note 9, at 50-52; DREXLER, ENGINES OF CREATION, *supra* note 4.

11. Toumey, *supra* note 9, at 52-54.

12. *See, e.g.*, Search results for the term "nanotechnology", GOOGLE, https://www.google.com/ (last visited Nov. 24, 2012) (listing "[a]bout 130,000,000 results"); Search results for the term "nanotechnology", BING, http://www.bing.com (last visited Nov. 24, 2012) (listing "6,800,000 results").

popular press.[13] As a result, searching for nanotech EHS materials is comparable to looking for a nano-needle in a haystack. Referred to as the "largely invisible, hidden, revolution,"[14] the lack of urgency and quality resources in this area can also be attributed in part due to the size of the materials involved. Meanwhile, other disarming factors appear to stem from the fact that existing nanotech developments are used to improve already existing materials by transforming their innate properties to enhance performance, durability, and even flexibility.[15]

Second, there is a considerable amount of open debate on the threshold issue regarding the language and definitions used within the field of nanotechnology, as there is currently no universally accepted standard or definition.[16] Generally, nanotechnology as a term is broad, multi-disciplinary that refers to two distinct types of science, "the manipulation of matter at the scale of one-billionth of a meter or smaller . . . identified as one nanometer (nm),"[17] (commonly referred to as molecular

13. *See* Tracy D. Hester, *Quiet So Far: A Muted Response to Allegations of the First Human Fatalities Linked to Nanoparticles*, 40 ENVTL. L. REP. 10007 (2010) (discussing an incident in China); Volker Tűrk & Christa Liedtke, *Invisible but Tangible? Societal Aspects and Their Consideration in the Advancement of a New Technology*, *in* NEW GLOBAL FRONTIERS IN REGULATION THE AGE OF NANOTECHNOLOGY 67, 72 (Graeme A. Hodge et al. eds., 2007) (discussing newspaper coverage of the April 2006 German case of Nano Magic); Nicole Abramowitz, *The Dangers of Chasing Youth: Regulating the Use of Nanoparticles in Anti-Aging Products*, 2008 U. ILL. J.L. TECH. & POL'Y 199 (discussing the use of nanoparticles in sunscreen, lotions, and anti-aging products).

14. MATSUURA, *supra* note 2, at 19.

15. *Id.* (noting that nanomaterials "help to create paint that does not peel, clothing fabrics that do not stain, and sports equipment that is stronger and lighter . . . .").

16. *See* JO ANNE SHATKIN, NANOTECHNOLOGY: HEALTH AND ENVIRONMENTAL RISKS 14-16 tbls. 1.1 & 1.2 (2d ed. 2012) (listing definitions of nanomaterials); *TC 229 Nanotechnologies*, ISO, http://www.iso.org/iso/iso_technical_committee?commid=381983 (last visited Nov. 30, 2012) (proposing nanotechnology standards); *see also* John Miles, *Nanotechnology Captured*, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES, *supra* note 9, at 83 (discussing the open differences in terminology, nomenclature and ontology).

17. MATSUURA, *supra* note 2, at 9.

nanotechnology (MNT))[18] or the "designing and building [of] machines in which every atom and chemical bond is specified precisely"[19] (otherwise known as Drexlerian nanotechnology).[20] As the robotic assembler applications of nanotechnology are still mostly theoretical,[21] references to nanotechnology today primarily implicate the three major types of nanoparticles:

> natural, incidental, and engineered. . . . Naturally-occurring nanomaterials such as volcanic ash, ocean spray, magnetotactic bacteria, mineral composites and others exist in our environment. Incidental nanoparticles . . . are produced as a result of some industrial processes. The third category of nanoparticles is engineered nanoparticles . . . [which are] material[s] [that have] been specifically designed for function . . . .[22]

Thus, for purposes of nanotech EHS research it is these last two categories, industrial and engineered nanomaterials that are of most concern.

Moreover, aside from peoples' penchant for creating new words by adding the prefix nano-,[23] another trial that researchers must overcome involves that of language or keywords as nanotechnology, nanotech, nanoscience, nanomaterials,

18. Paul C. Lin-Easton, *It's Time for Environmentalists to Think Small–Real Small: A Call for the Involvement of Environmental Lawyers in Developing Precautionary Policies for Molecular Nanotechnology*, 14 GEO. INT'L ENVTL. L. REV. 107, 108 (2001).

19. J. STORRS HALL, NANOFUTURE WHAT'S NEXT FOR NANOTECHNOLOGY 21 (2005).

20. *See* DREXLER, ENGINES OF CREATION, *supra* note 4, at 172-73.

21. *See* K. ERIC DREXLER ET AL., UNBOUNDING THE FUTURE THE NANOTECHNOLOGY REVOLUTION (1991) [hereinafter DREXLER ET AL., UNBOUNDING THE FUTURE]; HALL, *supra* note 19, at 11-15; WILLIAM ILLSEY ATKINSON, NANOCOSM, NANOTECHNOLOGY AND THE BIG CHANGES COMING FROM THE INCONCEIVABLY SMALL 7 (2003) (noting that "there are strong signs that a workable nanotechnology is at last being born").

22. INST. OF MED. NAT'L ACAD., IMPLICATIONS OF NANOTECHNOLOGY FOR ENVIRONMENTAL HEALTH RESEARCH 1-2 (Lynn Goldman & Christine Coussens eds., 2005), *available at* http://www.nap.edu/catalog.php?record_id=11248 (paraphrasing Vickie Colvin, Rice University).

23. *See Nanotechnology Glossary N*, NANOTECH.NOW, http://www.nanotechnow.com/nanotechnology-glossary-N.htm (last visited Jan. 31, 2013) (listing seventy-three entries beginning with the prefix nano-).

nanoparticles, and engineered nanoparticles (ENMs) are just a few of the terms used to describe this technology. Furthermore, as science progresses, researchers may also be confronted with new relevant terms such as nanoregulation, nanopollution, nanotoxicology, and nanohazards. Accordingly, research plans should factor-in this diversity of language by either keeping track of a core list of terms or by creating targeted search strings by using the term "nano" with a root expander.[24]

Third, researchers should be aware that the cognizable environmental ramifications of nanotechnology are largely unknown.[25] While the potential EHS impacts of nanotechnology have begun to receive increased scrutiny over the last few years,[26] concrete impacts are few. This issue is best reflected in the literature as commentators typically describe the potential EHS effects of nanotechnology with a high level of "uncertainty,"[27] or in such vague terms as to render any

24. *See, e.g.*, Westlaw's use of (!) and LexisNexis's use of (*).

25. It is notable that nanotechnology is not mentioned in three of the most authoritative discussions of what constitutes the field environmental law. *See generally* Todd S. Aagaard, *Environmental Law as a Legal Field*, 95 CORNELL L. REV. 221 (2010); A. Dan Tarlock, *Is There A There There in Environmental Law?*, 19 J. LAND USE 213 (2004); David A. Westbrook, *Liberal Environmental Jurisprudence*, 27 U.C. DAVIS L. REV. 619 (1994).

26. SARGENT, JR., NANOTECHNOLOGY AND ENVIRONMENTAL, HEALTH, AND SAFETY, *supra* note 5, at 11 (noting an increase in U.S. EHS research funding requests for 2006-2011).

27. A sampling of language in this area is uniquely illustrative. *See* MATSUURA, *supra* note 2, at 76 (observing how "regulators do not yet know precisely how nanotechnology is currently affecting the environment and living organisms"); MARSHALL S. SHAPO, EXPERIMENTING WITH THE CONSUMER: THE MASS TESTING OF RISKY PRODUCTS ON THE AMERICAN PUBLIC 188 (2009) (noting that "[t]he language of various reports and commentaries on the subject is revealing, laden as it is with 'could's,' 'may's,' 'it is likely's,' 'uncertainty's,' and 'it appears's.'"); Brian Priesty & Andrew Harford, *The Human Health Risk Assessment (HHRA) of Nanomaterials*, *in* NEW GLOBAL FRONTIERS IN REGULATION THE AGE OF NANOTECHNOLOGY, *supra* note 13, at 134 (describing how "[t]he potential for nanoparticles to represent a health risk . . . is largely unknown . . . ."); Albert C. Lin, *Public Nuisance: A Potential Common Law Response to Nanotechnology's Uncertain Harms*, *in* THE NANOTECHNOLOGY CHALLENGE CREATING LEGAL INSTITUTIONS FOR UNCERTAIN RISKS 225 (David A. Dana ed., 2012) (employing the term "toxic ignorance" to refer to the "poorly understood . . . health and environmental effects" of nanotechnology); JEFFERY T. MORRIS, RISK LANGUAGE, AND POWER THE NANOTECHNOLOGY ENVIRONMENTAL

conclusions nonsensical. Also to be considered, in contrast to more traditional frameworks for environmental regulation preventing pollution in air, water, and soil, nanotech EHS issues also center on such areas as food, medicine, and consumer products.[28] Here, the scientific mechanism of EHS harm is dependent upon

> [t]he concentration of nanomaterial in the environment . . . such as the nature and amount of material released, physical and chemical conditions, and time. Once a nanomaterial is dispersed, biological or environmental systems may be exposed to the nanomaterial. Such contact may or may not lead to uptake by the system, resulting in an internal dose that may, in turn, cause a biological response and/or an ecological effect.[29]

In addition, scientific expertise becomes a significant barrier when researching this issue as most of the materials available are written at an extremely sophisticated level for an advanced research and academic audience. The lack of context in the articles combined with chemical formulae and other technical jargon makes it difficult to understand the underlying takeaways and consequently renders the material incomprehensible to the average laymen. Moreover, while the "potential risks of nanoparticles to human health and the environment, are mentioned in most studies, differences in the coverage of aspects remain considerable."[30] However, as a "partially emerged technology"[31] there is also a growing body of work addressing the possible EHS impacts of nanotechnology via a discussion of risk.[32] Consequently, researchers must become accustomed to a unique

POLICY CASE 7 (2012) (articulating how "the impacts of nanotechnology [on the environment] . . . so far remains largely inchoate and unsettled").

28. MATSUURA, *supra* note 2, at 75. *See generally* JOSH SCHONWALD, THE TASTE OF TOMORROW DISPATCHES FROM THE FUTURE OF FOOD (2012); PATRICK M. BOUCHER, NANOTECHNOLOGY LEGAL ASPECTS 100 (2008) (discussing the origins of "Frankenfood").

29. NAT'L NANOTECHNOLOGY INITIATIVE, STRATEGY FOR NANOTECHNOLOGY-RELATED ENVIRONMENTAL, HEALTH, AND SAFETY RESEARCH 4 (2008), *available at* http://www.nano.gov/sites/default/files/pub_resource/nni_ehs_research_strategy.pdf?q=NNI_EHS_Research_Strategy.pdf.

30. Tűrk & Liedtke, *supra* note 13, at 78.

31. MORRIS, *supra* note 27, at 12.

32. *See generally* MORRIS, *supra* note 27.

conundrum: an absence of material on concrete EHS impacts; a growing body of resources examining the risk of EHS impacts; against a sea of readily available materials that extol the virtues[33] of nanotech to solve such environmental problems as biohazards and pollutants, salinity, and waste.[34]

This underlying scientific uncertainty has also impacted litigation as causation has proved a difficult hurdle to overcome resulting in a dearth of case law. Although commentators speculate that nanotechnology may follow public nuisance[35] or the likes of "toxic torts in the areas of both private . . . and public law,"[36] nanotech EHS case law currently remains in its infancy.[37] To illustrate this point, as of 2009, *Black's Law Dictionary* does not as yet have an entry for "nanotechnology."[38] Westlaw's *Words and Phrases* does not yet define "nanotechnology," "nanomaterial," or "nanoparticle"[39] nor do they yet have a key number for any aspect of nanotechnology.[40] This lack of case law is most in evidenced by a recent search for all state and federal cases.

33. *See, e.g.*, ADVANCES IN NANOTECHNOLOGY AND THE ENVIRONMENT viii (Juyoung Kim ed., 2012) (examining nanotech solutions for "soil remediation, wastewater treatment, and air purification"); ENVIRONMENTAL CHEMISTRY FOR A SUSTAINABLE WORLD, VOLUME 1: NANOTECHNOLOGY AND HEALTH RISK (Eric Lichtfouse et al. eds., 2012) (the first five articles of Part I Nanotechnology); THOMAS FAUNCE, NANOTECHNOLOGY FOR A SUSTAINABLE WORLD (2012) (discussing a global artificial synthesis project); YURI N. SHUNIN, NANODEVICES AND NANOMATERIALS FOR ECOLOGICAL SECURITY (2012); ENVIRONMENTAL APPLICATIONS OF NANOMATERIALS: SYNTHESIS, SORBENTS AND SENSORS (Glen E. Fryxell & Guozhang Cao eds., 2d ed. 2012); NANOTECHNOLOGY FOR ENVIRONMENTAL DECONTAMINATION (Manoj K. Ram ed., 2011); NANOTECHNOLOGY APPLICATIONS FOR CLEAN WATER: SOLUTIONS FOR IMPROVING WATER QUALITY (Nora Savage et al. eds., 2009); DREXLER ET AL., UNBOUNDING THE FUTURE, *supra* note 21 (noting Chapter 9–Restoring the Environment, and Chapter 10–Nanomedicine).

34. MICHAEL WILSON ET AL., NANOTECHNOLOGY BASIC SCIENCE AND EMERGING TECHNOLOGIES 246-47 (2002).

35. Lin, *supra* note 27, at 225.

36. JEAN MACCHIAROLI EGGEN, TOXIC TORTS IN A NUTSHELL 70 (4th ed. 2010).

37. *See infra* tbl. 1 (noting a dearth of nanotechnology cases).

38. BLACK'S LAW DICTIONARY (9th ed. 2009).

39. *Words & Phrases*, WESTLAWNEXT, http://wwww.westlawnext.com (last visited Feb. 14, 2013).

40. *West's Key Number System*, WESTLAWNEXT, http://wwww.westlawnext.com (last visited Feb. 14, 2013).

| | **Cases** | | |
|---|---|---|---|
| Term | WestlawNext[41] | LexisAdvance[42] | Bloomberg Law[43] |
| Nanotechnology | 53 | 38 | 35 |
| Nanomaterial | 22 | 0 | 0 |
| Nanoparticle | 20 | 2 | 2 |
| Nano | 333 | 244 | 166 |

Table 1: Search for all state and federal cases.

41. WestlawNext search for Nanotechnology, WESTLAWNEXT, http*://* www.westlawnext.com (last visited Feb. 14, 2013) (select all state and federal jurisdiction; then follow "cases" tab; then search "nanotechnology"); WestlawNext search for Nanomaterial, WESTLAWNEXT, http*://*www. westlawnext.com (last visited Feb. 14, 2013) (select all state and federal jurisdiction; then follow "cases" tab; then search "nanomaterial"); WestlawNext search for Nanoparticle, WESTLAWNEXT, http*://*www.westlawnext.com (last visited Feb. 14, 2013) (select all state and federal jurisdiction; then follow "cases" tab; then search "nanoparticle"); WestlawNext search for Nano, WESTLAWNEXT, http*://*www.westlawnext.com (last visited Feb. 14, 2013) (select all state and federal jurisdiction; then follow "cases" tab; then search "nano").

42. LexisAdvance search for Nanotechnology, LEXISADVANCE, http://www. lexisnexis.com/en-us/products/lexis-advance.page (last visited Feb. 14, 2013) (select "all jurisdictions"; then select "cases" under content tab; then search "nanotechnology"); LexisAdvance search for Nanomaterial, LEXISADVANCE, http://www.lexisnexis.com/en-us/products/lexis-advance.page (last visited Feb. 14, 2013) (select "all jurisdictions"; then select "cases" under content tab; then search "nanomaterial"); LexisAdvance search for Nanoparticle, LEXISADVANCE, http://www.lexisnexis.com/en-us/products/lexis-advance.page (last visited Feb. 14, 2013) (select "all jurisdictions"; then select "cases" under content tab; then search "nanoparticle"); LexisAdvance search for Nano, LEXISADVANCE, http://www.lexisnexis.com/en-us/products/lexis-advance.page (last visited Feb. 14, 2013) (select "all jurisdictions"; then select "cases" under content tab; then search "nano").

43. Bloomberg BNA search for Nanotechnology, BloombergBNA, http:// about.bloomberglaw.com; Bloomberg BNA search for Nanomaterial, BloombergBNA, http://about.bloomberglaw.com (last visited Feb. 14, 2013); Bloomberg BNA search for Nanoparticle, BloombergBNA, http://about. bloomberglaw.com (last visited Feb. 14, 2013); Bloomberg BNA search for Nano, BloombergBNA, http://about.bloomberglaw.com (last visited Feb. 14, 2013).

## II. RESOURCES

### A. Regulation

Nanotechnology, similar to other historic examples of rapid technological innovation[44] is currently experiencing a "regulatory lag."[45] This deficiency is magnified by an absence of comprehensive regulation both in the United States and abroad.[46] To many commentators this lag is beyond worrisome as many consider "[d]eveloping these controls [to be] even more urgent than developing the technologies themselves."[47] The chief concern here is that "[e]ngineered nanoparticles are likely to have health effects similar to well-characterized ultrafine particles with similar physical and chemical characteristics."[48] However, the science backing these causalities has not achieved acceptance as most studies lack a concrete connection to human health. As such, the only existing law explicitly dealing with nanotechnology at the federal level is the 21st Century Nanotechnology Research and Development Act[49]—a purely research based statute.

Despite this lack of direct legislation, the consensus within the legal community is that "existing environment laws and their implementing regulations generally are well equipped—in the abstract—to encompass nanomaterials in the context of their

44. *See, e.g.*, Katharine A. Van Tassel & Rose H. Goldman, *The Growing Consumer Exposure to Nanotechnology in Everyday Products: Regulating Innovative Technologies in Light of Lessons from the Past*, 44 CONN. L. REV. 481, 523-25 (2011) (discussing the history of such products as asbestos, PCBs, DES, Thalidomide, medical X-rays, and Benzene).

45. SHAPO, *supra* note 27, at 191.

46. *Id.* at 191-210 (providing an excellent brief overview of the ups and downs of nanotech regulation).

47. Lester W. Milbrath, *Fears and Hopes of an Environmentalist for Nanotechnology*, *in* NANOTECHNOLOGY RESEARCH AND PERSPECTIVES 300 (B.C. Crandall & James Lewis eds., 1989).

48. NAT'L INST. FOR OCCUPATIONAL SAFETY & HEALTH, CTRS. FOR DISEASE CONTROL & PREVENTION, APPROACHES TO SAFE NANOTECHNOLOGY: AN INFORMATION EXCHANGE WITH NIOSH 11 (2005), *available at* http://www.cdc.gov/niosh/topics/nanotech/pdfs/ Approaches_to_Safe_Nanotechnology.pdf.

49. 21st Century Nanotechnology Research and Development Act, Pub. L. No. 108-153, 117 Stat. 1923 (2003) (codified at 15 U.S.C. §§ 7501-09 (2006)).

respective missions."[50] Therefore, nanotechnology regulation is currently being adapted[51] from existing environmental statutes including:

- Consumer Product Safety Act, 15 U.S.C. §§ 2051-2089 (2006); Consumer Product Safety Improvement Act, 15 U.S.C. § 1278a *et seq*; Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S.C. §§ 136-136y (2006); Federal Food Drug and Cosmetic Act, 21 U.S.C. §§ 301-399d (2006); Federal Hazardous Substances Act, 15 U.S.C. §§ 1261-1278 (2006); Occupational Safety and Health Act, 29 U.S.C. §§ 651-678 (2006); Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6992k (2006); and the Toxic Substances Control Act, 15 U.S.C. §§ 2601-2695d (2006).[52] In terms of future legislation researchers should monitor the House Committee on Science, Space, and Technology[53] (in particular the Subcommittees on Technology[54] and Environment[55]) and the Senate Committee on Commerce, Science, and Transportation[56] (Subcommittee on Science and Space[57]). In contrast,

50. AM. BAR ASS'N, NANOTECHNOLOGY ENVIRONMENTAL LAW, POLICY AND BUSINESS CONSIDERATIONS 2 (Lynn L. Bergeson ed., 2010) [hereinafter ABA NANOTECHNOLOGY].

51. *See, e.g.*, Pesticides; Policies Concerning Products Containing Nanoscale Materials; Opportunity for Public Comment, 76 Fed. Reg. 35,383 (July 17, 2011), *available at* http://www.gpo.gov/fdsys/pkg/FR-2011-06-17/pdf/2011-14943.pdf.

52. PCRRTK PRACTITIONER'S E-LIBRARY REFERENCE: NANOTECHNOLOGY POLICY 3-4 (2011) [hereinafter NANOTECHNOLOGY POLICY], *available at* http://meetings.abanet.org/webupload/commupload/NR351500/relatedresources/aba_nano_policy.pdf.

53. U.S. HOUSE COMM. ON SCI., SPACE, & TECH., http://science.house.gov/ (last visited Mar. 6, 2013).

54. *Subcommittee on Technology,* U.S. HOUSE COMM. ON SCI., SPACE, & TECH., http://science.house.gov/subcommittee-technology-and-innovation (last visited Mar. 6, 2013).

55. *Subcommittee on Environment,* U.S. HOUSE COMM. ON SCI., SPACE, & TECH., http://science.house.gov/subcommittee-environment-0#overlay-context= (last visited Mar. 6, 2013).

56. U.S. SENATE COMM. ON COMMERCE, SCI., & TRANSP., http://commerce.senate.gov/ public/ (last visited Mar. 6, 2013).

57. *Science & Space*, U.S. SENATE COMM. ON COMMERCE, SCI., & TRANSP., http://commerce.senate.gov/public/index.cfm?p=ScienceandSpace (last visited Mar. 6, 2013).

proposed legislation can be tracked by using such sites as Thomas.gov,[58] Congress.gov,[59] or GovTrack.[60]

### B. Texts & Treatises

On account of the newness of subject matter and the speculative nature of the science involved, there are few texts and treatises published to date that address nanotechnology. Here, West/Thomson Reuters,[61] American Bar Association (ABA),[62] and the Environmental Law Institute (ELI)[63] products dominate the market as few other legal publishers have as yet ventured into this area. This includes the two major legal encyclopedias, *Corpus Juris Secundum*[64] and *American Jurisprudence 2d*[65] as neither has of yet included distinct entries related to any aspect of nanotechnology.

The leading generalist treatise in the area of nanotechnology is John C. Monica, Jr.'s[66] *Nanotechnology Law*.[67] First published

58. THOMAS.GOV, http://thomas.loc.gov/home/thomas.php (last visited Mar. 6, 2013) (select bills and resolutions using a general words/phrase search).

59. *Search for "nanotechnology",* CONGRESS.GOV, http://beta.congress.gov/search?Legislative_Source=Legislation&q=nanotechnology (last visited Mar. 6, 2013).

60. GOVTRACK, http://www.govtrack.us/ (last visited Mar. 6, 2013) (currently GovTrack does not have a search filter for nanotechnology).

61. THOMSON REUTERS, http://thomsonreuters.com/ (last visited Jan. 31, 2013).

62. AM. BAR ASS'N (ABA), http://www.americanbar.org/aba.html (last visited Jan. 31, 2013).

63. ENVTL. L. INST., http://www.eli.org/ (last visited Jan. 31, 2013).

64. WestlawNext search for Nanotechnology Law in Corpus Juris Secundom, WESTLAWNEXT, http://www.westlawnext.com (last visited Feb. 14, 2013) (follow "Secondary Sources" tab; then follow "Texts & Treatises"; the follow "Corpus Juris Secundom"; then search "Nanotechnology Law").

65. WestlawNext search for Nanotechnology Law in American Jurisprudence, WESTLAWNEXT, http://www.westlawnext.com (last visited Feb. 14, 2013) (follow "Secondary Sources" tab; then follow "Texts & Treatises"; the follow "American Jurisprudence 2d"; then search "Nanotechnology Law").

66. *John C. Monica, Jr., People*, PORTER WRIGHT, http://www.porterwright.com/john_monica/ (last visited Jan. 31, 2013).

67. JOHN C. MONICA, JR., NANOTECHNOLOGY LAW (2012 ed.) [hereinafter NANOTECHNOLOGY LAW (2012 ed.)]. This treatise is also available as an online subscription database from Westlaw.com and WestlawNext using the database code (NANOTECH).

in 2009[68] and updated with a second edition in 2012, this text "provides a comprehensive treatment of the law related to nanotechnology with an emphasis on the environment, health, and safety. It [also] provides comprehensive coverage of . . . [the] potential risks and pitfalls of . . . nanoscale material[s]. . . ."[69] As a general work, the text includes information on the origins, standards, and nomenclature of the field as well as discussing the current federal and state regulatory framework. Despite its classification under the category of Intellectual Property Law,[70] over three quarters of this text is dedicated to nanotech EHS issues including Chapter Three: Potential Nano-Related Environmental Health and Safety Concerns, Chapter Four: Nanotechnology Environmental Regulatory Issues, Chapter Five: Nano-Related Food and Drug Regulatory Issues, and Chapter Six: Nanoscale Materials in the Workplace.[71] As a benefit to researchers, "[w]ebsite addresses are included [in both the print and online versions] to minimize research time"[72] and research references are included at the beginning of each entry to provide access to other relevant Westlaw resources. However, it should be noted that one of the greatest assets of this work, its Table of Cases, is only available in the print versions of the book, and is otherwise available in the database format.[73]

68. JOHN C. MONICA, JR., NANOTECHNOLOGY LAW (2009 ed.) [hereinafter NANOTECHNOLOGY LAW (2009 ed.)].

69. *Nanotechnology Law 2012 ed.*, WESTLAW STORE, http://store.westlaw.com/nanotechnology-law-2012/179738/40630354/productdetail (last visited Jan. 31, 2013).

70. *See generally id.* For purposes of accessing this treatise on Westlaw.com and WestlawNext, this text is similarly classified under the category of intellectual property law.

71. NANOTECHNOLOGY LAW (2012 ed.), *supra* note 67.

72. *Id.*

73. *See generally* NANOTECHNOLOGY LAW (2009 ed.), *supra* note 68; NANOTECHNOLOGY LAW (2012 ed.), *supra* note 67; *Nanotechnology Law*, WESTLAWNEXT, https://1.next.westlaw.com/Browse/Home/SecondarySources/IntellectualPropertySecondarySources/IntellectualPropertyTextsTreatises/NanotechnologyLaw?originationContext=AutoComplete&contextData=(sc.Search)&transitionType=CategoryPageItem (last visited Jan. 30, 2013).

In 2010, the ABA Section of Environment, Energy, and Resources (SEER),[74] as the culmination of its Nanotechnology Project,[75] produced the most comprehensive review of federal regulation of nanotechnology entitled, *Nanotechnology: Environmental Law, Policy, and Business Considerations*.[76] Edited by Lynn L. Bergeson, managing director of Bergeson & Campell, P.C.,[77] and Project co-chair, the articles included in this text were generated from a series of briefing papers authored by SEER members as part of a 2007 offer "to brief representatives of the . . . (EPA) Office of General Counsel . . . on legal and regulatory issues arising in connection with the application of existing statutory and regulatory authorities available to EPA to engineered nanoscale materials."[78] Originally focused on "identify[ing the] key legal and regulatory issues EPA can be expected to encounter as it considers how best to address issues likely to arise in connection with nanotechnology,"[79] the papers generally concluded that the existing environmental regulatory framework "provide[d] EPA with sufficient legal authority to address" the foreseeable risks and legal challenges presented by nanotechnology.[80] Structurally, the first part of the text discusses the Clean Air Act (CAA), Clean Water Act (CWA), Comprehensive Environmental Response, Liability & Compensation Act (CERCLA), Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), Endangered Species Act (ESA), and the National Environmental Policy Act

74. *Section of Environment, Energy, and Resources*, ABA SEER, http://www.americanbar.org/groups/environment_energy_resources.html (last visited Jan. 24, 2013).

75. *Nanotechnology Project*, ABA SEER, http://www.americanbar.org/groups/environment_energy_resources/projects_awards/nanotech.html (last visited Jan. 24, 2013).

76. ABA NANOTECHNOLOGY, *supra* note 50.

77. BERGESON & CAMPBELL, P.C., http://www.lawbc.com/ (last visited Jan. 24, 2012).

78. *Nanotechnology Project*, ABA, http://www.americanbar.org/groups/environment_energy_resources/projects_awards/nanotech.html (last visited Jan. 24, 2012).

79. *Id.*

80. *Id.*

(NEPA),[81] while the second half deals with issues of governance, standardization, and risk assessment.[82] For ease of reference, the text also contains an index and a series of mini-glossaries for each environmental statute covered.

Although a bit dated now, ELI's *Nanotechnology Deskbook*[83] is also a staple for researchers in this area. The *Deskbook*, like all ELI variations, includes a seventy-four page article discussing the patchwork of federal "Environmental Regulation of Nanotechnology;" this article is then followed by a series of five appendices.[84] The supplemental documents here include foundational EPA materials as well as a joint "Nano Risk Framework"[85] developed by Environmental Defense Fund[86] and DuPont.[87] The remaining appendix is for an international audience reflecting the United Kingdom Department for Environment, Food and Rural Affairs'[88] voluntary reporting scheme for ENMs.[89]

Aside from the works discussed above, several texts and treatises include chapters or sections of note related to the legal implications of nanotech EHS. Below please find a brief description of the most relevant resources:

- JO ANNE SHATKIN, NANOTECHNOLOGY: HEALTH AND ENVIRONMENTAL RISKS (2d ed. 2012). Shatkin's newly released work focuses on the science and risk of nanotechnology. In its second edition, this work provides

81. ABA NANOTECHNOLOGY, *supra* note 50, at chs. 1-8.

82. *Id*. at chs. 9-12; *see also Nanotechnology: Environmental Law, Policy, and Business Considerations*, ABA WEBSTORE, http://apps.americanbar.org/abastore/index.cfm?section=main&fm=Product.AddToCart&pid=5350186B (last visited Jan. 24, 2013).

83. *See* LYNN L. BERGESON & TRACY HESTER, NANOTECHNOLOGY DESKBOOK (2008).

84. *Id.*

85. NANO RISK FRAMEWORK, http://www.nanoriskframework.com/ (last visited Mar. 1, 2013).

86. ENVTL. DEFENSE FUND, http://www.edf.org/ (last visited Mar. 1, 2013).

87. DUPONT, http://www2.dupont.com/home/en-us/ (last visited Mar. 1, 2013).

88. *Department for Environment, Food & Rural Affairs*, GOV.UK, https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs (last visited Mar. 1, 2013).

89. U.K. DEP'T FOR ENV'T, FOOD & RURAL AFFAIRS, UK VOLUNTARY REPORTING SCHEME FOR ENGINEERED NANOSCALE MATERIALS (2008).

accessible descriptions of complex scientific concepts as well as key definitions. One of the greatest strengths of this resource is its variety of tables and lists of references at the end of each article.

- LORNA BRAZELL, NANOTECHNOLOGY LAW BEST PRACTICES (2012). Practitioner oriented and direct, Brazell's work provides an excellent overview of nanotech EHS regulatory issues. These first four introductory chapters are then followed by others dedicated to international initiatives, regulation in the EU, and beyond.[90] Of note to researchers, the book also includes four appendices with key nanotech EU documents, a Bibliography, and Table of Cases.
- INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES (Graeme A. Hodge et al. eds., 2010). As its title implies, this work discusses the concepts and foundations, framework, and future of nanotechnology regulation on an international scale. Comprised of twenty-six articles, researchers should focus on the U.S. and U.K. EHS risk and environmental case studies included in Part III.[91]
- GOVERNING UNCERTAINTY, ENVIRONMENTAL REGULATION IN THE AGE OF NANOTECHNOLOGY (Christopher J. Bosso ed., 2010). This short work examines the broad issue of

90. LORNA BRAZELL, NANOTECHNOLOGY LAW BEST PRACTICES x-xi (2012) (discussing regulation in the United States, Canada, Australia, Japan, and China).

91. *See* Oliver Tassinari et al., *The Evolving Nanotechnology Environmental, Health, and Safety Landscape: A Business Perspective*, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES, *supra* note 9, at 177; Robert J. Aitken, *Regulation of Carbon Nanotubes and Other High Aspect Ratio Nanoparticles: Approaching this Challenge from the Perspective of Asbestos*, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES, *supra* note 9, at 205; Markus Widmer & Christoph Meili, *Approaching the Nanoregulation Problem in Chemicals Legislation in the EU and US*, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES, *supra* note 9, at 238; Anna Gergely et al., *Regulatory Perspectives on Nanotechnologies in Foods and Food Contact Materials*, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES, *supra* note 9, at 321; Linda K. Breggin & John Pendergrass, Regulation of Nanoscale Materials Under Media-specific Environmental Laws, *in* INTERNATIONAL HANDBOOK ON REGULATING NANOTECHNOLOGIES, *supra* note 9, at 342.

nanotechnology regulation in the United States. The seven articles included here pose key questions that largely remain unanswered today including what an effective regulatory scheme should look like, and the roles of such key players and the EPA, the states, and business.

- NANOTECHNOLOGY AND GLOBAL SUSTAINABILITY (Donald Maclurcan & Natalia Radywyl eds., 2009). Contains articles dedicated to the environment, agriculture, food, and human health as well as four articles under Part IV Governance discussing international and global regulation.
- DAVID NAIDU, BIOTECHNOLOGY & NANOTECHNOLOGY REGULATION UNDER ENVIRONMENTAL, HEALTH, AND SAFETY LAWS (2009). Despite its textbook format, this work (authored by an attorney) contains comprehensive chapters dedicated to risk and regulation of: transgenic plants and animals, food, drugs, cosmetics, consumer products, and chemicals.
- NANOPARTICLES IN MEDICINE AND ENVIRONMENT: INHALATION AND HEALTH EFFECTS (J.C. Marijnissen & Leon Gradon eds., 2009). Provides an in-depth analysis and evaluation of the chief harm of nanoparticles—inhalation. Reviews dosage, toxicity, and contact principles.
- KATHLEEN SELLERS ET AL., NANOTECHNOLOGY AND THE ENVIRONMENT (2008). This approachable work provides an excellent overview of the science of nanotechnology's impacts on the environment: the work includes discussions of the manufacturing process, transportation of nanoparticles, treatment in wastewater, potential ecological hazards, and toxicology risks.

### C. Law Review and Journal Resources

Within roughly ten years of its introduction, references to nanotechnology quietly began to appear in legal scholarship.[92]

92. *Law Review Articles Mentioning "Nanotechnology" Published from 1990 to 1999*, HEINONLINE, http://www.heinonline.org (last visited Jan. 24, 2013)

First mentioned as part of book reviews or within footnotes, the first law review article addressing nanotechnology as a main topic was Frederick A. Fiedler and Glenn H. Reynolds' article *Legal Problems of Nanotechnology: An Overview*, appearing in the volume three, 1994 publication of the Southern California Interdisciplinary Law Journal.[93] Similarly, to the timeline discussed above with texts and monographs, articles addressing the environmental impacts of nanotechnology only began to appear in the first years of the new century.[94]

A decade later, in 2004 the journal Nanotechnology Law & Business was first published,[95] to "serve [as] a central authoritative source of information and valuable resource for all those involved with [the] legal, business, and investment aspects of nanotechnology": among the topics covered are the "health and environmental risks of nanotechnology."[96] In its ninth volume, the journal is available as a stand-alone print publication[97] but it is also carried by both HeinOnline[98] and Westlaw[99] with full coverage beginning on both sites starting with volume one.[100] Aside from Nanotechnology Law & Business, a few journals have

(search the "Law Journal Library" by conducting a Field Search in Text for the term "nanotechnology;" post filter by the years 1990-1999).

93. Frederick A. Fiedler & Glenn H. Reynolds, *Legal Problems of Nanotechnology: An Overview*, 3 S. CAL. INTERDISC. L.J. 593 (1994).

94. *Compare id.* at 627 n.107 (implying in 1994, that environmental problems may arise from nanotechnology similarly to issues found in the nuclear energy industry), *with* Lin-Easton, *supra* note 18 (devoting an entire article to nanotech EHS).

95. NANOTECHN. L. & BUS., http://www.nanolabweb.com/ (last visited Jan. 24, 2013).

96. Todd Dickinson, *Foreword*, 1 NANOTECH. L. & BUS. 5, 6 (2004).

97. *Nanotechnology Law & Business Subscription Information*, NANOTECH. L. & BUS., https://secure.nanolabweb.com/index.cfm/action/main.default.subscriptions/secureRequest/yes/CFID/5904575/CFTOKEN/50868331/index.html (last visited Jan. 24, 2013).

98. *Nanotechnology Law & Business, List of Libraries*, HEINONLINE, http://home.heinonline.org/content/list-of-libraries/?c=1&t=3548 (last visited Jan. 24, 2013).

99. *Nanotechnology Law & Business*, WESTLAW DATABASE DIRECTORY, http://directory.westlaw.com/ (last visited Feb. 9, 2012) (conduct a search using the term "nanotechnology"; this entry is listed second noting the database code NANOLB).

100. It should be noted that online access on these sites is delayed by approximately one issue.

also issued theme editions discussing issues generally pertaining to nanotech EHS issues, including American University's Spring 2006 edition of Sustainable Development Law & Policy,[101] the Spring 2012 edition of Jurimetrics,[102] and this edition of the Pace Environmental Law Review.[103] Moreover, the ELI's *Environmental Law Reporter* also occasionally runs relevant

101. *Sound Chemicals Management*, 6 SUSTAINABLE DEV. L. & POL'Y 1 (2006), *available at* http://www.wcl.american.edu/org/sustainabledevelopment/documents/SDLP-v6-32006springwithlinks.pdf. The journal focused on the concept of sound chemicals management and featured several articles on nanotechnology including: Lynn Goldman, *Sound Chemicals Management: An Overview of This Issue*, 6 SUSTAINABLE DEV. L. & POL'Y 2 (2006); Cari Shiffman, *The Uncertain Future of MTBE Production: Effects of the U.S. Energy Policy Act of 2005*, 6 SUSTAINABLE DEV. L. & POL'Y 3 (2006); Malcolm D. Woolf, *Why Modernization of the U.S. Toxic Substances Law Is Good for Public Health and Business*, 6 SUSTAINABLE DEV. L. & POL'Y 4 (2006); Jennifer Sass et al., *Nanotechnologies: The Promise and the Peril*, 6 SUSTAINABLE DEV. L. & POL'Y 11 (2006); Sun Young Oh, *Sound Management of Chemicals in Developing Countries under the Rotterdam Convention*, 6 SUSTAINABLE DEV. L. & POL'Y 37 (2006); David A. White, *Chemical Taking: Glyphosate and the Eradication of Due Process in Colombia*, 6 SUSTAINABLE DEV. L. & POL'Y 42 (2006); Karen Florini et al., *Nanotechnology: Getting It Right the First Time*, 6 SUSTAINABLE DEV. L. & POL'Y 46 (2006); Letty Guerra, *Bisphenol-A and Its Harmful Effects on Human Development*, 6 SUSTAINABLE DEV. L. & POL'Y 54 (2006).

102. Based on the March 21, 2011 conference of the same name, *Symposium*: *The Biggest Issues for the Smallest Stuff: Nanotechnology Regulation and Risk Management*, 52 JURIMETRICS J. 239 (2012); *Annual Conference of Jurimetrics: The Biggest Issues for the Smallest Stuff: Nanotechnology Regulation and Risk Management*, ARIZ. ST. U., http://lsi.law.asu.edu/nanoregulation/ (last visited Mar. 6, 2013). Articles included: Blair H. Moses, *Symposium: The Biggest Issues for the Smallest Stuff: Nanotechnology Regulation and Risk Management*, 52 JURIMETRICS J. 239 (2012); Gary E. Marchant et al., *Big Issues for Small Stuff: Nanotechnology Regulation and Risk Management*, 52 JURIMETRICS J. 243 (2012); Kenneth W. Abbott, Gary E. Marchant & Elizabeth A. Corley, *Soft Law Oversight Mechanisms for Nanotechnology*, 52 JURIMETRICS J. 279 (2012); Edward R. Glady, Jr., Gregorio M. Garcia & Blair H. Moses, *Nanotechnology Liability: Do We Steer or Just Go Along for the Ride?*, 52 JURIMETRICS J. 313 (2012); Daniel J. Fiorino, *Matching Solutions to Problems: Strategies for Nanotechnology Oversight*, 52 JURIMETRICS J. 337 (2012); Timothy F. Malloy, *Soft Law and Nanotechnology: A Functional Perspective*, 52 JURIMETRICS J. 347 (2012); Kiril D. Hristovski, *Scientific Challenges of Nanomaterial Risk Assessment*, 52 JURIMETRICS J. 359 (2012); and Elizabeth A. Corley, Youngjae Kim & Dietram A. Scheufele, *Public Challenges of Nanotechnology Regulation*, 52 JURIMETRICS J. 371 (2012).

103. PACE ENVTL. L. REV., http://digitalcommons.pace.edu/pelr/ (last visited Jan. 24, 2013).

columns.[104] Otherwise, nanotech EHS articles can be found in journals of all kinds with such common themes as governance and regulation. Below please find some of the most relevant articles.[105]

- Evisa Kica & Diana M. Bowman, *Regulation by Means of Standardization: Key Legitimacy Issues of Health and Safety Nanotechnology Standards*, 53 JURIMETRICS J. 11 (2012). Discusses the concept of legitimacy in terms of the implications of international standardization efforts as they relate to EHS nanotech standards. Analyzes the issue of transnational regulation in light of new trends towards decentralization of authority.
- Kiril D. Hristovski, *Scientific Challenges of Nanomaterial Risk Assessment*, 52 JURIMETRICS J. 359 (2012). Highlights the scientific obstacles to traditional risk assessment formulas for nanotech EHS. Particularly helpful is the author's breakdown of the three principles of toxicity as they relate to nanotechnology.
- *FDA Regulation of Nanotechnology* (Marc Duvall ed., Feb. 2012) (unpublished manuscript).[106] Edited by a principal of Beveridge & Diamond P.C.,[107] this 141 page article

104. *See, e.g.*, Lynn L. Bergeson, Column, *FIFRA Scientific Advisory Panel Considers Nanosilver*, 39 ENVTL. L. REP. 11143 (2009); John Pendergrass, Column, *Consumer Labeling of Nanomaterials in the European Union and the United States*, 40 ENVTL. L. REP. 10117 (2010).

105. The following articles may also be of interest: Gregory Mandel, *Nanotechnology Governance*, 59 ALA. L. REV. 1323 (2008); David E. Adelman, *The Art of the Unsolvable: Locating the Vital Center of Science for Environmental Law and Policy*, 37 ENVTL. L. 935 (2007); Nathan Block, *The Very Big Fuss Over Very Small Things: Advising on the State of Regulation of Nanotechnologies*, 38 TEX. ENVTL. L.J. 1 (2007); Nicole Abramowitz, *The Dangers of Chasing Youth: Regulating the Use of Nanoparticles in Anti-Aging Products*, 2008 U. ILL. J.L. TECH. & POL'Y 199. The following student notes may also be of interest: Dorothea K. Thompson, Note, *Small Size, Big Dilemma: The Challenge of Regulating Nanotechnology*, 79 TENN. L. REV. 621 (2012); Mark Popovsky, Note, *Nanotechnology and Environmental Insurance*, 36 COLUM. J. ENVTL. L. 125 (2011); Peter J. Tomasco, Note, *Manufactured Nanomaterials: Avoiding TSCA and OSHA Violations for Potentially Hazardous Substances*, 33 B.C. ENVTL. AFF. L. REV. 205 (2006); Lindsay V. Dennis, Note, *Nanotechnology: Unique Science Requires Unique Solutions*, 25 TEMP. J. SCI. TECH. & ENVTL. L. 87 (2006).

106. *Available at* http://www.bdlaw.com/assets/attachments/323.pdf.

107. BEVERIDGE & DIAMOND P.C., http://www.bdlaw.com/index.html (last visited Mar. 7, 2013).

functions as a primer for the law in this area. Although not exclusively a nanotech EHS article, the work discusses the regulation of color additives, food additives, food and animal feed products, drugs, and biologic and combination products.

- Katharine A. Van Tassel & Rose H. Goldman, *The Growing Consumer Exposure to Nanotechnology in Everyday Products: Regulating Innovative Technologies in Light of Lessons from the Past*, 44 CONN. L. REV. 481 (2011). Tracks the ethical, legal, and regulatory issues of (largely unregulated) nanotech products. Compares the introduction of nanomaterials into the consumer marketplace with the unintended consequences of other new technologies with harmful health effects including asbestos, PCBs, Thalidomide, and benzene.
- Douglas A. Kysar, *Ecologic: Nanotechnology, Environmental Assurance Bonding, and Symmetric Humility*, 28 UCLA J. ENVTL. L. & POL'Y 201 (2010). Proposes the market-based idea that environmental assurance bonding is the perfect "middle course" for regulating nanotechnology as it allows for a proscribable level of uncertainty with the corollary consequences of penalties for environmental harms. The author grounds his argument in socio-legal, economic, and scientific reasoning.
- David A. Strifling, *Environmental Federalism and Effective Regulation of Nanotechnology*, 2010 MICH. ST. L. REV. 1131. Focuses on the issue of whether a centralized federal response or individual state management would create the most effective means of regulating emerging technologies such as those created by the EHS impacts of nanotechnology. Also provides key historical background in this debate.
- Susan A. Fuchs, *Is the Toxic Substances Control Act Sufficient to Monitor the Sustainable Use of Nanoscale Zero-Valent Iron for Groundwater Detoxification?*, 40 ENVTL. L. REP. 10502 (2010). Using the example of nanoscale zero-valent iron in the context of TSCA, the author examines the pros and cons of the technology as

well as makes policy recommendations targeting EPA's methodology for promulgating effective regulations that benefit industry while simultaneously protecting human health and the environment.

- Kenneth W. Abbott et al., *A Framework Convention for Nanotechnology?*, 38 ENVTL. L. REP. 10507 (2008).[108] Puts forth the idea of a comprehensive framework convention on climate change that has four basic characteristics: flexibility, innovative, international in scope, and official in nature.
- Albert C. Lin, *Size Matters: Regulating Nanotechnology*, 31 HARV. ENVTL. L. REV. 349 (2007). Comprehensive article advocating new nanotech EHS specific legislation. Dispensing with arguments for concrete science, the author advocates that new legislation is needed now to address the uncertain but real risk associated with nanotechnology.
- Linda K. Breggin & Leslie Carothers, *Governing Uncertainty: The Nanotechnology Environmental, Health and Safety Challenge*, 31 COLUM. J. ENVTL. L. 285 (2006). Sets out guiding principles and speculates on the shape and form of an effective EHS nanotech regulatory structure. The last section also proposes a step-by-step research agenda to effectuate this goal.
- Paul C. Lin-Easton, *It's Time for Environmentalists to Think Small–Real Small: A Call for the Involvement of Environmental Lawyers in Developing Precautionary Policies for Molecular Nanotechnology*, 14 GEO. INT'L ENVTL. L. REV. 107 (2001). Foundational article speculating on the role of the legal community to contribute to the nanotechnology EHS discussion. Focuses on basic science, implications, risk assessment, and the precautionary principle.

108. *See also* Lynn L. Bergeson, Response, *Regulation, Governance, and Nanotechnology: Is a Framework Convention for Nanotechnology the Way to Go?*, 38 ENVTL. L. REP. 10515 (2008); David Rejeski, Response, *Comment on A Framework Convention for Nanotechnology?*, 38 ENVTL. L. REP. 10518 (2008); Brent Blackwelder, Response, *Comment on A Framework Convention for Nanotechnology?*, 38 ENVTL. L. REP. 10520 (2008).

## D. Reports

### a. Foundational Reports and Documents

With the emergence of nanotechnology in the legal scholarship field beginning in the late 1990s other organizations at the federal level, likewise began to take note of nanotech's potential EHS implications. Federal agencies such as the EPA, Food and Drug Administration (FDA) and organizations such as the National Science Foundation and the National Nanotechnology Initiative began to issue relevant reports and briefs. Below, please find a selection of foundational reports and documents that nanotech EHS researchers should be familiar with:

- Environmental Protection Agency
  - *Nanotechnology White Paper*.[109] This paper, authored by members of the EPA's Science Policy Council Nanotechnology Workgroup, lays forth the basic issues and arguments that EPA is still confronting regarding nanotechnology today. From definitions, to benefits, risk assessment, research and recommendations, this document reviews each issue in turn; it also includes an appendix of key EPA policy materials.
  - *Nanomaterial Research Strategy*.[110] Produced by the EPA's Office of Research and Development, this document elaborates on the research needs identified in the EPA's 2007 White Paper. Here, aside from key science questions, the following EHS nanotech research themes were articulated: Human Health and Ecological Effects Research, Developing Risk Assessment Methods, and Preventing and Managing Risks.
- Food & Drug Administration

109. EPA, NANOTECHNOLOGY WHITE PAPER (2007), *available at* http://www.epa.gov/osainter/pdfs/nanotech/epa-nanotechnology-whitepaper-0207.pdf.

110. EPA, NANOMATERIAL RESEARCH STRATEGY (2009), *available at* http://www.epa.gov/nanoscience/files/nanotech_research_strategy_final.pdf; *see also* EPA, DRAFT NANOMATERIALS RESEARCH STRATEGY (NRS) (2008), *available at* http://epa.gov/ncer/nano/publications/nano_strategy_012408.pdf.

- *Nanotechnology, A Report of the U.S. Food & Drug Admin. Nanotech Taskforce*.[111] This report focuses on three distinct areas: 1) assessing the current state of the science of nanotechnology (with respect to biological interactions), 2) policy analysis and recommendations for the science, and 3) policy analysis and recommendations for regulation.

- National Nanotechnology Initiative[112]
  - *Nanotechnology and the Environment*.[113] This report is part of a series of materials generated from conferences held by the Nanoscale Science, Engineering, and Technology (NSET) Subcommittee. In particular, it focuses on nanotech applications for measurement in the environment, sustainability in terms of materials, resources, and manufacturing, as well as implications to natural and global processes and human health and the environment.
  - *Environmental, Health, and Safety Research Needs for Engineered Nanoscale Materials*.[114] The purpose of this report was to identify the research needs

111. NANOTECHNOLOGY, A REPORT OF THE U.S. FOOD & DRUG ADMIN. NANOTECH TASKFORCE (2007), *available at* http://www.fda.gov/downloads/scienceresearch/specialtopics/nanotechnology/ucm110856.pdf.

112. The National Nanotechnology Institute has also released a series of policy documents intended to provide guidance to federal agencies related to nanotech EHS. *See* Memorandum from Exec. Office of the President on Policy Principles for the U.S. Decision-Making Concerning Regulation and Oversight of Applications of Nanotechnology and Nanomaterials to Heads of Exec. Dep'ts & Agencies (June 9, 2011), *available at* http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/nanotechnology-regulation-and-oversight-principles.pdf; Memorandum from Exec. Office of the President on Principles for Regulation and Oversight of Emerging Technologies to Heads of Exec. Dep'ts & Agencies (Mar. 11, 2011), *available at* http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Principles-for-Regulation-and-Oversight-of-Emerging-Technologies-new.pdf.

113. NAT'L NANOTECH. COORDINATION OFFICE, NANOTECHNOLOGY AND THE ENVIRONMENT: REPORT OF THE NATIONAL NANOTECHNOLOGY INITIATIVE WORKSHOP (2003), *available at* http://pdf.edocr.com/c4cc40a08c9ee229d49ce851693c198c9ded3ebc.pdf.

114. NAT'L NANOTECH. INITIATIVE, ENVIRONMENTAL HEALTH, AND SAFETY RESEARCH NEEDS FOR ENGINEERED NANOSCALE MATERIALS (2006), *available at* http://www.whitehouse.gov/files/documents/ostp/NSTC%20Reports/NNI_EHS_research_needs%202006.pdf.

necessary to gather the requisite information to create sound risk assessments and policies for nanotechnology. The report centers on the following subjects: instrumentation, metrology and analytical methods, human heath, environment, environmental surveillance, and risk management methods.

- *Environmental, Health and Safety Research Strategy*.[115] Synthesized from earlier reports this strategy reflects federal efforts to create a comprehensive "science-based risk management research framework."[116] The strategy is compartmentalized into the following distinct aspects: nanomaterial measurement structures, human exposure assessment, human health, environment, risk assessment and management models, and informatics and modeling for nanotech EHS research.
- *Strategic Plan*.[117] The Strategic Plan sets forth the goals, benchmarks, and priorities for effectuating the 2011 *Environmental, Health and Safety Research Strategy*.

- National Science Foundation
  - *Societal Impacts of Nanoscience and Nanotechnology*.[118] This extensive report was generated in the wake of the September 2000 National Science Foundation Workshop organized by the foundation's NSET Subcommittee. Specifically, Section 6.4 briefly focuses on the Medical,

115. NAT'L NANOTECH. INITIATIVE, ENVIRONMENTAL, HEALTH AND SAFETY RESEARCH STRATEGY (2011), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ ostp/nni_2011_ehs_research_strategy_final.pdf.

116. *Id.* at xi.

117. NAT'L SCI. & TECH. COUNCIL COMM. ON TECH., SUBCOMM. ON NANOSCALE SCI., ENG'G, & TECH., NATIONAL NANOTECHNOLOGY INITIATIVE STRATEGIC PLAN (2011), *available at* http://www.nano.gov/sites/default/files/pub_resource/2011_strategic_plan.pdf.

118. NAT'L SCI. FOUND., SOCIETAL IMPACTS OF NANOSCIENCE AND NANOTECHNOLOGY (Mihail C. Roco & William Sims Bainbridge eds., 2001), *available at* http://www.wtec.org/loyola/nano/NSET.Societal.Implications/nanosi.pdf.

Environmental, Space Exploration, and National Security Implications on nanotechnology.

### b. Congressional Research Service Reports

The Congressional Research Service (CRS),[119] the public policy research arm of Congress, has also weighed in on issues pertaining to nanotechnology in several of its reports. The benefits of CRS reports are numerous as they typically provide excellent overviews of topics, programs, or statues. While basic, the reports frequently include background materials, reviews, and references to key government reports and legislation. Despite their value, CRS reports are only disseminated at the discretion of Congress.[120] Thus, locating relevant reports can sometimes prove challenging. That being said, several Internet sites have begun disseminating both new and historic reports in an ad hoc fashion.[121] For the topic at hand, while most CRS reports only mention nanotechnology in passing or strictly focus on the regulatory and/or funding difficulties associated with nanotech,[122] a few select reports have concentrated on nanotech EHS issues exclusively.

119. *Congressional Research Service*, LIBR. OF CONG., http://www.loc.gov /crsinfo/ (last visited Jan. 24, 2013).

120. For more information on CRS, *see also* IDA A. BRIDNICK, CONG. RESEARCH SERV., RL33471, THE CONGRESSIONAL RESEARCH SERVICE AND THE AMERICAN LEGISLATIVE PROCESS (2011), *available at* http://www.fas.org/sgp/crs/ misc/RL33471.pdf.

121. For information on how to locate CRS reports online, see Taryn L. Rucinski, *Congressional Research Service Reports Online*, PACE L. LIBR. BLOG (Aug. 14, 2012), http://library.blogs.law.pace.edu/2012/08/14/crs_reports_onlin/.

122. *See* JOHN F. SARGENT, JR., CONG. RESEARCH SERV., R41706, FEDERAL RESEARCH AND DEVELOPMENT FUNDING: FY2012 10 (2011), *available at* http://www.fas.org/sgp/crs/misc/R41706.pdf; JOHN F. SARGENT, JR., CONG. RESEARCH SERV., R41098, FEDERAL RESEARCH AND DEVELOPMENT FUNDING: FY2011 9 (2011), *available at* http://www.fas.org/sgp/crs/misc/R41098.pdf; HEATHER B. GONZALEZ, JOHN F. SARGENT, JR. & PATRICIA MOLONEY FIGLIOLA, CONG. RESEARCH SERV., R41231, AMERICA COMPETES REAUTHORIZATION ACT OF 2010 (H.R. 5116) AND THE AMERICA COMPETES ACT (P.L. 110-69): SELECTED POLICY ISSUES 11-12 (2010), *available at* http://www.ift .org/public-policy-and-regulations/~/media/Public%20Policy/0728America CompetesAct.pdf (reviewing the legislative history of the National Nanotechnology Initiative Amendments Act of 2010); JOHN F. SARGENT, CONG. RESEARCH SERV., RL34493, NANOTECHNOLOGY AND U.S. COMPETITIVENESS: ISSUES AND OPTIONS (2008),

- *Nanotechnology: A Policy Primer* (2012).[123] This seventeen-page report provides researchers with a basic overview of nanotechnology, a brief history of the NNI, as well as a brief discussion of key issues in the field. Among the issues discussed are EHS implications on pages 11-12.
- *Nanotechnology and Environmental, Health, and Safety: Issues for Consideration* (2011).[124] This forty-page report (which functionally updates an earlier 2008 version), discusses such foundational EHS issues as, scope of federal research, regulation, and international involvement. The report also provides a historic perspective on EHS research funding, examines regulatory alternatives, and offers a review of legislation proposed during the 111th Congress.
- *Engineered Nanoscale Materials and Derivative Products: Regulatory Challenges* (2008).[125] Although a bit dated, this 26-page report "consider[s] certain challenges faced by federal EHS risk assessors, risk managers, and policy makers, and . . . discuss[es] possible legislative approaches to address those challenges."[126] Of note, the review of the existing regulatory schemes appears to deviate from conclusions made by the ABA.[127]

### c. Government Accountability Reports

Similarly to CRS, the U.S. Government Accountability Office (GAO)[128] is another nonpartisan governmental agency that works

*available at* http://www.fas.org/sgp/crs/misc/RL34493.pdf (discussing benchmarks for U.S. nanotech market competitiveness).

123. JOHN F. SARGENT, JR., CONG. RESEARCH SERV., RL34511, NANOTECHNOLOGY: A POLICY PRIMER (2012), *available at* http://www.fas.org/sgp/crs/misc/RL34511.pdf.

124. SARGENT, JR., NANOTECHNOLOGY AND ENVIRONMENTAL, HEALTH, AND SAFETY, *supra* note 5.

125. LINDA-JO SCHIEROW, CONG. RESEARCH SERV., RL34332, ENGINEERED NANOSCALE MATERIALS AND DERIVATIVE PRODUCTS: REGULATORY CHALLENGES (2008), *available at* http://www.fas.org/sgp/crs/misc/RL34332.pdf.

126. *Id.* at 1.

127. *Id.*

128. U.S. GOV'T ACCOUNTABILITY OFFICE (GAO), http://www.gao.gov/ (last visited Jan. 24, 2013).

for the benefit of Congress "to help improve the performance and ensure the accountability of the federal government for the benefit of the American people."[129] In terms of our topic, GAO has generally been called upon to evaluate the performance and relevancy of funds authorized for nanotech EHS risk research.[130] Although not tremendously helpful in terms of the topic at hand, the reports play an integral role in tracking EHS research scope and funding.

- *Improved Performance Information Needed for Environmental, Health, and Safety Research* (GAO-12-427, May 21, 2012).[131] This report examines NNI's EHS research: 1) fund issues related to nanotech EHS research from 2006 to 2010; 2) identifies nanomaterials researched in 2010; 3) evaluates collaboration with relevant stakeholders; and 4) evaluates how well research is meeting defined nanotech national strategies.[132]
- *Nanomaterials Are Widely Used in Commerce, but EPA Faces Challenges in Regulating Risk* (GAO-10-549, May 25, 2010).[133]
- *Better Guidance Is Needed to Ensure Accurate Reporting of Federal Research Focused on Environmental, Health, and Safety Risks* (GAO-08-402, Mar. 31, 2008).[134]

129. *About GAO*, GAO, http://www.gao.gov/about/index.html (last visited Jan. 24, 2013).

130. *Id.*

131. GAO, GAO-12-427, NANOTECHNOLOGY: IMPROVED PERFORMANCE INFORMATION NEEDED FOR ENVIRONMENTAL, HEALTH, AND SAFETY RESEARCH (May 21, 2012), *available at* http://www.gao.gov/assets/600/591007.pdf.

132. *Id.*

133. GAO, GAO-10-549, NANOTECHNOLOGY: NANOMATERIALS ARE WIDELY USED IN COMMERCE, BUT EPA FACES CHALLENGES IN REGULATING RISK (May 25, 2010), *available at* http://www.gao.gov/assets/310/304648.pdf.

134. GAO, GAO-08-402, NANOTECHNOLOGY: BETTER GUIDANCE IS NEEDED TO ENSURE ACCURATE REPORTING OF FEDERAL RESEARCH FOCUSED ON ENVIRONMENTAL, HEALTH, AND SAFETY RISKS (Mar. 31, 2008), *available at* http://www.gao.gov/assets/280/274219.pdf; *see also* GAO, GAO-08-709T, NANOTECHNOLOGY: ACCURACY OF DATA ON FEDERALLY FUNDED ENVIRONMENTAL, HEALTH, AND SAFETY RESEARCH COULD BE IMPROVED (Apr. 24, 2008), *available at* http://www.gao.gov/assets/120/119810.pdf (summarizing GAO-08-402 as testimony before the U.S. Senate Subcommittee on Science, Technology, and Innovation, Committee on Commerce, Science, and Transportation).

### d. National Academy Publications

Another excellent source for locating information relating to nanotech EHS issues is the National Academies Press (NAP).[135] The Press was founded by the National Academies to foster the open exchange of reports and other information issued by the "National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council, all operating under a charter granted by the Congress of the United States."[136] Of interest to researchers, NAP annually publishes over 200 titles a year totaling roughly 4,000 titles.[137] In terms of access, NAP has been making electronic versions of their material accessible since 1994, and after June 2011 all NAP books and reports are now available free as a downloadable PDF with a one-time user registration.[138]

The materials generated by the Academies as distributed by NAP are of a high quality ranging from "topics in science, engineering, and medicine, providing authoritative information on important matters in science and health policy."[139] From this unique perspective, nanotech EHS documents are generated on a fairly consistent basis. To locate relevant reports, a basic keyword search box is available on the top-left side of the homepage's navigation header.[140] Although results here can be sorted by title and year, additional filters are also available on the right-side navigation bar including by term and authoring organization. Researchers should be cautioned here to employ a broad spectrum of overlapping search terms as drastically disparate results are typical.[141] For current projects, a separate

135. NAT'L ACAD. PRESS, http://www.nap.edu/ (last visited Jan. 24, 2013).

136. *About the National Academies Press*, NAT'L ACAD. PRESS, http://www.nap.edu/content/help/about.html (last visited Jan. 24, 2013).

137. *Id.*

138. Press Release, Nat'l Acad., The National Academies Press Makes All PDF Books Free to Download; More Than 4,000 Titles Now Available Free to All Readers (June 2, 2011), *available at* http://www8.nationalacademies.org/onpinews/newsitem.aspx? RecordID=06022011.

139. *About the National Academies Press*, NAT'L ACAD. PRESS, http://www.nap.edu/content/help/about.html (last visited Feb. 22, 2013).

140. NAT'L ACAD. PRESS, http://www.nap.edu/ (last visited Jan. 24, 2013).

141. *See, e.g.*, Search of "nanotechnology," NAT'L ACAD. PRESS, http://search.nap.edu/napsearch.php?term=nanotechnology (last visited Jan. 24, 2013) (listing

search is also available by clicking the magnifier icon on the basic search and then by selecting "search" from the right-side navigation bar.[142] In particular, researchers should focus on the reports of the National Research Council[143] and the National Academy of Science[144] as both organizations focus on issues inclusive of nanotech EHS.[145] Below please find a list of the most relevant publications:

- *A Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials* (2012).[146] The EPA employed the assistance of the National Research Council to develop a research strategy for the EHS implications of engineered nanomaterials. Specifically, this report: 1) sets forth a conceptual framework for considering EHS risks; 2) poses key questions for understanding potential effects; 3) reviews new tools and methodologies for identifying risk; 4) proposes a list of research priorities and needs; and 5) suggests an implementation and evaluation scheme for the proposed strategy.[147]

559 results); Search of "nanotech," NAT'L ACAD. PRESS, http://search.nap.edu/napsearch.php?term=nanotech (last visited Jan. 24 2013) (listing fifty-two results); Search of "nanomaterials," NAT'L ACAD. PRESS, http://search.nap.edu/napsearch.php?term=nanomaterials (last visited Jan. 24, 2013) (listing 159 results); Search of "nanoparticle," NAT'L ACAD. PRESS, http://search.nap.edu/napsearch.php?term=nanoparticle (last visited Jan. 24, 2013) (listing 229 results).

142. Search for Projects, Current Projects, NAT'L ACAD., http://www8.nationalacademies.org/cp/search.aspx (last visited Jan. 24, 2013) (researchers can search by: project title, project ID number, subject, scope, major unit, board, committee membership, etc.).

143. NAT'L RESEARCH COUNCIL, http://www.nas.edu/nrc/ (last visited Jan. 24, 2013).

144. NAT'L ACAD. OF SCI., http://www.nasonline.org (last visited Jan. 24, 2013).

145. *See, e.g.*, *Board on Environmental Studies and Toxicology, Division on Earth & Life Studies*, NAT'L ACAD., http://dels.nas.edu/best/ (last visited Jan. 24, 2013).

146. NAT'L RESEARCH COUNCIL, A RESEARCH STRATEGY FOR ENVIRONMENTAL, HEALTH, AND SAFETY ASPECTS OF ENGINEERED NANOMATERIALS (2012), *available at* http://www.nap.edu/catalog.php?record_id=13347.

147. *Id.*

- *Review of the Federal Strategy for Nanotechnology-Related Environmental, Health, and Safety Research* (2009).[148] In 2007, the National Technology Coordination office requested that the National Research Council conduct a scientific and technical review of the federal government's *Strategy for Nanotechnology-Related Environmental, Health, and Safety Research*.[149] This book reflects the independent reviewing committee's criticisms and recommendations for addressing potential nanotech EHS risks.
- *Implications of Nanotechnology for Environmental Health Research* (2005).[150] This report summarizes the findings of a May 27, 2004 roundtable event sponsored by the Board on Health Sciences Policy of the Institute of Medicine of the National Academies entitled, *Technology and Environmental Health: Implication of Nanotechnology*.[151] While this report is a bit dated and lacks specificity, the discussions concerning the impact of nanoparticles on human health remains the same, today. Of interest, the report includes discussions of Canada's treatment of nanotech EHS issues.

### e. The Project on Emerging Nanotechnologies (PEN)

A truly unique nanotechnology EHS resource can be found in The Project on Emerging Nanotechnologies (PEN),[152] a partnership between the Woodrow Wilson International Center for Scholars[153] and the Pew Charitable Trusts.[154] According to

148. NAT'L RESEARCH COUNCIL, REVIEW OF THE FEDERAL STRATEGY FOR NANOTECHNOLOGY-RELATED ENVIRONMENTAL, HEALTH, AND SAFETY RESEARCH (2009), *available at* http://www.nap.edu/catalog.php?record_id=12559.

149. NAT'L RESEARCH COUNCIL, REVIEW OF THE FEDERAL STRATEGY FOR NANOTECHNOLOGY-RELATED ENVIRONMENTAL, HEALTH, AND SAFETY RESEARCH xiii (2009), *available at* http://www.nap.edu/openbook.php?record_id=12559&page=R13.

150. INST. OF MED. NAT'L ACAD., *supra* note 22.

151. *Id.*

152. PEN THE PROJECT ON EMERGING NANOTECHNOLOGIES, http://www.nanotechproject.org/ (last visited Jan. 24, 2013).

153. WILSON CTR., http://www.wilsoncenter.org (last visited Jan. 24, 2013).

its mission statement, "[t]he Project is dedicated to helping ensure that as nanotechnologies advance, possible risks are minimized, public and consumer engagement remains strong, and the potential benefits of these new technologies are realized."[155] In reviewing the site, the Project has sponsored a large number of project reports, presentations, congressional testimony, and project papers (approximately seventy documents total) that are all available as free downloadable PDFs on its Publications page.[156] All publications have been authored by notable scholars in the field and many probe discrete issues of nanotech EHS including regulation, contamination, and risk assessment.[157]

In addition, the site also maintains a series of "Inventories": collections, maps, and databases, including information on consumer products, agriculture and food, medicine, and silver nanotechnology.[158] However, of most interest to researchers is the site's Environment, Health and Safety Research Inventory, which provides information on 561 projects in seventeen

154. PEW CHARITABLE TRUSTS, http://www.pewtrusts.org (last visited Jan. 24, 2013).

155. *About Us, Mission*, PEN, http://www.nanotechproject.org/about/mission/ (last visited Jan., 24, 2013).

156. *Publications*, PEN, http://www.nanotechproject.org/publications/ (last visited Jan. 24, 2013) (see links for each type of publication listed on the right-side navigation bar).

157. *See, e.g.*, DANIEL J. FIORINO, PEN, VOLUNTARY INITIATIVES, REGULATION, AND NANOTECHNOLOGY OVERSIGHT: CHARTING A PATH (2010), *available at* http://www.nanotechproject.org/process/assets/files/8347/pen-19.pdf; J. CLARENCE DAVIES, PEN, OVERSIGHT OF NEXT GENERATION NANOTECHNOLOGIES (2009), *available at* http://www.nanotechproject.org/process/assets/files/7316/pen-18.pdf; SAMUEL N. LUOMA, SILVER NANOTECHNOLOGIES AND THE ENVIRONMENT: OLD PROBLEMS OR NEW CHALLENGES? (2008), *available at* http://www.nanotechproject.org/process/assets/files/7036/nano_pen_15_final.pdf; LINDA K. BREGGIN & JOHN PENDERGRASS, PEN, WHERE DOES THE NANO GO? END-OF-LIFE REGULATION OF NANOTECHNOLOGIES (2007), *available at* http://www.nanotechproject.org/process/assets/files/2699/208_nanoend_of_life_pen10.pdf; KAREN F. SCHMIDT, PEN, GREEN NANOTECHNOLOGY: IT'S EASIER THAN YOU THINK (2007), *available at* http://www.nanotechproject.org/process/assets/files/2701/187_greennano_pen8.pdf; J. CLARENCE DAVIES, PEN, EPA AND NANOTECHNOLOGY: OVERSIGHT FOR THE 21ST CENTURY (2007), *available at* http://www.nanotechproject.org/process/assets/files/ 2698/197_nanoepa_pen9.pdf; J. CLARENCE DAVIES, PEN, MANAGING THE EFFECTS OF NANOTECHNOLOGY (2006), *available at* http://www.nanotechproject.org/process/assets/files/ 2708/30_pen2_mngeffects.pdf.

158. *Inventories*, PEN, http://www.nanotechproject.org/inventories/ (last visited Jan. 24, 2013).

countries.[159] In evaluating the site, the only potential problem is that there are few dates listed to indicate currency of the material and there is little indication that new resources have been added in within the last two years.

### E. Continuing Legal Education (CLE) Courses & Conferences

Although CLE materials are generally considered to have a short shelf-life,[160] researchers may also find them to be valuable resources for nanotech EHS information and insights. Following in the general timeline of the SEER's Nanotechnology Project, the first CLE course offering on nanotechnology began to appear circa 2005.[161] Since that time, numerous courses have been offered by both state and national organizations on topics related to EHS. Recent courses and programs of note include the American Law Institute's ALI-CLE[162] and ELI co-sponsored: *Chemical Control Law and Policy* (2010),[163] *Hazardous Substances, Site Remediation, and Enforcement* (2008),[164] *Environmental Impact*

159. *Environment, Health and Safety Research*, PEN, http://www.nanotechproject.org/inventories/ehs/ (last visited Jan. 24, 2013).

160. WESTLEGALEDCENTER, ONLINE CONTINUING LEGAL EDUCATION: BREADTH, DEPTH, AND EFFICIENCY 4 (2001), *available at* http://westlegaledcenter.com/requirements/forms/WLEcWhite.pdf (indicating a value of "only a few weeks").

161. *See CLE Sampling*, 36 TRENDS 6, 9 (2005) (listing the relevant CLE course *Assessing and Managing Nano Risks: A Real World Case Study in Nanotechnology*). This course was offered at the 13th Annual ABA Section of Environment Energy and Resources on September 22, 2005 at 10:30 am. *13th Section Fall Meeting CLE Attendance Schedule*, ABA (Sept. 2005), *available at* http://www.americanbar.org/content/dam/aba/events/environment_energy_resources/2012/10/section_fall_meeting/planning_materials/sess_counts_2005.authcheckdam.pdf (last visited Jan. 24, 2013).

162. ALI-CLE, http://www.ali-cle.org (last visited Jan. 24, 2013) (formerly ALI-ABA).

163. *Table of Contents*, ALI-ABA COURSE OF STUDY, CHEMICAL CONTROL LAW AND POLICY (Apr. 16, 2010), *available at* http://files.ali-cle.org/files/coursebooks/pdf/CR054_chapter_17.pdf (last visited Jan. 24, 2013) (offering the relevant programs: "Office of Pollution Prevention and Toxics (OPPT) TSCA Program Update," "Office of Pesticide Programs (OPP) FIFRA Program Update," and "Chemical Legislation To Watch").

164. *Table of Contents*, ALI-ABA COURSE OF STUDY, HAZARDOUS SUBSTANCES, SITE REMEDIATION, AND ENFORCEMENT (Apr. 24-25, 2008), *available at* http://www.ali-cle.org/doc/frontmatter/CN088_fm.pdf (offering the relevant programs: "End-of-Life Regulation of Nanotechnologies," "Where Does the Nano

*Assessment: NEPA and Related Requirements* (2007),[165] and *Hazardous Substances, Site Remediation, and Enforcement* (2006).[166] Current and historic course materials are available online for purchase, through the ALI-CLE's Knowledge Portal,[167] or through such vendors as LexisNexis[168] and Westlaw.[169] Other programs are of course available, however, their materials are often difficult to obtain or require payment of a fee.[170]

Go? End-of-Life Regulation of Nanotechnologies," "Responsible Development of Nanotechnology," "National and International Developments Impacting Nanotechnology").

165. *Table of Contents*, ALI-ABA COURSE OF STUDY, ENVIRONMENTAL IMPACT ASSESSMENT: NEPA AND RELATED REQUIREMENTS (Dec. 12-14, 2007), *available at* http://www.ali-cle.org/doc/frontmatter/CN010_fm.pdf (offering the relevant program: "Surveying the National Environmental Policy Act and the Emerging Issues of Climate Change, Genetic Engineering and Nanotechnology").

166. *Table of Contents*, ALI-ABA COURSE OF STUDY, HAZARDOUS SUBSTANCES, SITE REMEDIATION, AND ENFORCEMENT (Apr. 26-27, 2006), *available at* http://www.ali-cle.org/doc/courseware/pdf/toc/CM028.pdf (offering the relevant programs: "Keeping Pace with Innovation: Nanopesticide Research & Regulation," "Regulatory Efforts Regarding Nanotechnology in the U.S.," "Regulation of Nanotechnology: A TSCA Perspective").

167. ALI-CLE KNOWLEDGE PORTAL, http://www.ali-cle.org/portal/ (last visited Jan. 31, 2013).

168. *ALI-ABA Course of Study Materials*, LEXISNEXIS, http://www.lexisnexis.com/en-us/home.page (follow "Legal" tab, follow the "Secondary Legal" header link and then conduct a title segment search using the "Combined ALI-ABA Course of Study Materials" database); *ALI-ABA Course of Study Materials*, LEXISADVANCE, http://www.lexisnexis.com/en-us/home.page (from the landing page follow Secondary Sources as a content type then input the search phrase "ali-aba nanotechnology" in the search box; results can be filtered by CLE Materials).

169. *ALI-ABA Course of Study Materials*, WESTLAW, http://web2.westlaw.com/signon/default.wl?vr=2.0&fn=_top&rs=WLW13.01&bhcp=1 (materials can be accessed by using a terms and connectors or natural language field search (title) in the "American Law Institute-American Bar Association Continuing Legal Education" database (ALI-ABA)); *ALI-ABA Course of Study Materials*, WESTLAW NEXT, https://1.next.westlaw.com/ Session/SignOn.html?bhcp=1 (follow the link for "Secondary Sources," then follow "CLE & Seminar Materials" under Type, and then follow the link for "American Law Institute-American Bar Association Continuing Legal Education").

170. *See, e.g.*, *Table of Contents*, ALI-ABA COURSE OF STUDY, MANAGING NANOTECHNOLOGY'S LIFE CYCLE RISKS RESPONSIBLY - DECISION MAKING TO PROTECT WATER RESOURCES (June 27, 2007), *available at* http://www.ali-cle.org/doc/courseware/pdf/toc/TSMX02.pdf (offering the relevant programs: "Managing Nano Risks – Practical Advice For Responsible Decision Making," "Commercialization of Nanotechnology: Enterprise Risk Management Issues," and "Managing Nanotechnology's Life Cycle Risks Responsibly – Decision

Government and industry conference materials may also prove valuable, especially for more scientific EHS concerns. Here, the National Nanotechnology Initiative (NNI) sponsors a wide variety of nanotech related workshops, meetings, and events designed to "inform and educate the public, and to assess the progress of research concerning the emerging technology's potential environmental, health, and safety (EHS) implications."[171] Moreover, NNI maintains a calendar of "both NNI-sponsored and -affiliated workshops, as well as outside nanotechnology-related workshops"[172] for past,[173] future,[174] and congressional events[175] dating back to 2008. Where available, materials from conferences can be accessed by drilling down to the individual programs. In the alternative, researchers may consult the individual websites of conference sponsors. A good example is the Safer Nanomaterials and Nanofacturing Initiative (SNNI),[176] an international collaborative between researchers, academics, government, and industry that "aim[s] to ensure that the emerging field of nanotechnology develops responsibly . . . in order to protect health, the environment, and the workforce";[177]

Making to Protect Water Resources"). These program materials are not available on Westlaw or LexisNexis. *See Coursebook, Managing Nanotechnology's Life Cycle Risks Responsibly - Decision Making to Protect Water Resources*, ALI-CLE, http://www.ali-cle.org/index.cfm?fuseaction=online.course_products&containerid=39170 (last visited Jan. 31, 2013); *see also Nanotechnology Legislation, Regulation, and Litigation: Where Is It Going?*, CLECENTER.COM, http://clecenter.com/program/programdescription.aspx?pgmid=1878 (last visited Jan. 31, 2013); *Nanotechnology - The Next Asbestos?*, STRAFFORD, http://www.straffordpub.com/products/nanotechnology-the-next-asbestos-2007-04-05 (last visited Jan. 31, 2013).

171. *Events*, NANO.GOV, http://www.nano.gov/node/10 (last visited Jan. 31, 2013).

172. *Upcoming Meetings & Events*, NANO.GOV, http://www.nano.gov/events/meetings-workshops (last visited Feb. 25, 2013).

173. *Past Meetings & Events*, NANO.GOV, http://www.nano.gov/events/past-events (last visited Jan. 31, 2013).

174. *Upcoming Meetings & Events*, *supra* note 172.

175. *Congressional Events & Information*, NANO.GOV, http://www.nano.gov/events/congress (last visited Jan. 31, 2013).

176. SNNI, http://www.greennano.org/ (last visited Jan. 31, 2013).

177. *About Us*, SNNI, http://www.greennano.org/about (last visited Jan. 31, 2013).

here, the organization holds an annual conference which has links to speaker materials on its website.[178]

### F. American Bar Association (ABA) Resources

One of the best resources available for updates in the field of nanotechnology can be found on the website of the ABA.[179] Here, ABA members from the Section of Environment, Energy, and Resources (SEER),[180] and to a lesser extent the Section of Science and Technology Law,[181] demonstrate a high involvement with issues pertaining to the intersection of nanotechnology and the environment. Of most importance to researchers is SEER's Nanotechnology Project.[182] Initiated in 2006, the two-phase project resulted in the publication of the ABA's text, *Nanotechnology: Environmental Law, Policy, and Business Considerations*.[183] In addition, the ABA has two[184] committees that specifically address issues involving nanotechnology: the first is SEER's Pesticides, Chemical Regulation, and Right-To-Know Committee (PCRRTK Committee),[185] and the second is the

178. *SNNI Conference Series*, SNNI, http://www.greennano.org/taxonomy/term/41 (last visited Jan. 31, 2013).

179. AM. BAR ASS'N (ABA), http://www.americanbar.org/aba.html (last visited Jan. 31, 2013).

180. *Section of Environment, Energy, and Resources*, ABA SEER, http://www.americanbar.org/groups/environment_energy_resources.html (last visited Jan. 31, 2013).

181. *Section of Science and Technology Law*, ABA, http://www.americanbar.org/groups/science_technology.html (last visited Jan. 31, 2013).

182. *Nanotechnology Project*, ABA SEER, http://www.americanbar.org/groups/environment_energy_resources/projects_awards/nanotech.html (last visited Jan. 31, 2013).

183. *See* ABA NANOTECHNOLOGY, *supra* note 50.

184. The SEER Environmental Disclosure Committee also peripherally deals with nanotechnology issues as they pertain to "the discussion of corporate environmental disclosure in light of the requirements recently imposed by Sarbanes-Oxley and the increasing number of environmental "transparency" initiatives." *Environmental Disclosure Committee Description*, ABA SEER, http://apps.americanbar.org/dch/committee.cfm?com=NR351700 (last visited Jan. 31, 2013); *see also* NANOTECHNOLOGY POLICY, *supra* note 52, at 6.

185. *Pesticides, Chemical Regulation, and Right-To-Know Committee (PCRRTK)*, ABA SEER, http://apps.americanbar.org/dch/committee.cfm?com=NR351500 (last visited Jan. 31, 2013) [hereinafter *Pesticide Sub-Committee Homepage*].

Science and Technology Law section's Nanotechnology Committee.[186] In reviewing these sites, it should be noted that the names are a bit of a misnomer as the more useful website for researchers belongs to the PCRRTK Committee.

For researchers, the PCRRTK Committee website contains highly valuable information, all of which is buried on the left-side navigation bar, halfway down the page.[187] The Committee keeps its members updated through the periodic publication of nanotech articles in its bi-monthly newsletter[188] and through a subscription listserv available to its members.[189] Moreover, the "Practitioner's E-Reference" and "Committee Resources" sections on the Committee homepage contain free links to various nanotech resources, the most important being the Committee's *Nanotechnology Policy*.[190] This ten-page document functions as a mini electronic research guide as it provides links and descriptions for both U.S. and international law for the following categories: federal resources (and agency links), federal statutes, proposed legislation, congressional hearings, Congressional Research Service reports, Government Accountability Office reports, state resources, nongovernmental organizations, academic institutions, blogs and media sites, as well as international resources broken out by country.[191]

## III. ONLINE RESOURCES

The field of nanotechnology is changing on a daily basis. To keep up with the new legal trends and issues, access to updates is critical. As discussed below, some resources are free however the most valuable typically require payment of a fee, or a

186. *Section of Science & Technology Law: Nanotechnology Committee*, ABA SEER, http://apps.americanbar.org/dch/committee.cfm?com=ST206014 (last visited Jan. 31, 2013).

187. *Pesticide Sub-Committee Homepage*, *supra* note 185.

188. *Pesticides, Chemical Regulation, and Right-To-Know Committee Newsletter*, ABA SEER, http://apps.americanbar.org/dch/comadd.cfm?com=NR351500&pg=3 (last visited Jan. 31, 2013) (providing free, online access to PDF versions of this newsletter from September 2008 to the present).

189. *Pesticide Sub-Committee Homepage*, *supra* note 185 (noting the listserv name ENVIRON-PESTICIDES).

190. NANOTECHNOLOGY POLICY, *supra* note 52.

191. *Id.*

subscription. The number of resources available are too numerous to list, however, below please find some of the most relevant:

### A. Federal Resources

- Center for Disease Control and Prevention (CDC).[192] The CDC's National Institute for Occupational Health & Safety (NIOSH)[193] has a dedicated nanotechnology page. The main landing page provides a good overview of the health and safety risks associated with nanotech. Researchers should mark the links for "Guidance and Publications," (documents on exposure risks, safety procedures, and potential harms from nanomaterials) "10 Critical Topic Areas," (overview of research areas that NIOSH has identified as a potential EHS risk in the workplace), and "Other Resources" (links to other relevant sites: federal and general).
- Environmental Protection Agency (EPA). The EPA website, on account of its non-linear and somewhat organic construction,[194] has numerous pages dedicated to nanotechnology that are not centrally linked from a main portal. Pages of note to researchers are available on the following topics: research,[195] pesticides (FIFRA),[196]

192. *Nanotechnology, NIOSH*, CTRS. FOR DISEASE CONTROL & PREVENTION, http://www.cdc.gov/niosh/topics/nanotech/ (last visited Mar. 3, 2013).

193. NAT'L INST. OCCUPATIONAL HEALTH & SAFETY, http://www.cdc.gov/NIOSH/ (last visited Mar. 8, 2013); *see also Safety and Health Topics, Nanotechnology*, OSHA, U.S. DEP'T OF LABOR, http://www.osha.gov/dsg/nanotechnology/ nanotechnology.html (last visited Mar. 8, 2013) (listing other relevant occupational health and safety related links and documents).

194. *See generally* Taryn L. Rucinski, *An Environmental Legal Practitioner's Guide to EPA's Website*, 42 ENVTL. L. REP. 10416 (2012) (discussing the challenges of searching for information on EPA.gov).

195. *Nanotechnology & Nanomaterials Research*, EPA, http://www.epa.gov/ nanoscience/ (last visited Mar. 3, 2013); *Nanomaterials*, EPA, http://cfpub. epa.gov/ncea/CFM/nceaQFind. cfm?keyword=Nanomaterials (last visited Mar. 3, 2013); *Nanotechnology, Extramural Research*, EPA, http://epa.gov/ncer/nano/ index.html (last visited Mar. 3, 2013); *Nanotechnology, Risk Management Sustainable Technology*, EPA, http://www.epa.gov/ nrmrl/std/nanotech.html (last visited Mar. 3, 2013).

waste,[197] and pollution (TSCA).[198] In addition, one of the more valuable resources on the EPA's site is its list of nanotechnology research publications organized by topic.[199]

- Food & Drug Administration (FDA).[200] The FDA's nanotech main page is relatively simple and direct as it provides information on FDA guidance, news ("Spotlight" section), and programs. One of the hidden gems of the site is its link on the left-hand side navigation bar marked "FDA Publications" which provides a list (not hyperlinked) of FDA articles: these articles are filtered by year and date from 2006 to 2012.
- National Nanotechnology Initiative (NNI).[201] The NNI is a cooperative group of twenty-six federal agencies dedicated to various aspects of nanotechnology research and development. Geared towards the general public, the site provides excellent basic discussions of nanotechnology's science, history, and issues. For nanotech EHS researchers the most valuable information lies in its "Publications and Resources" tab. Here, the advanced search option allows searching by date, keyword, and subject: Environmental Health and Safety.
- Center for Nanoscale & Science Technology (CNST).[202] While not focused on nanotech EHS issues per se, the

196. *Regulating Pesticides that Use Nanotechnology*, EPA, http://www.epa.gov/pesticides/regulating/nanotechnology.html (last visited Mar. 3, 2013).

197. *Nanotechnology for Waste & Cleanup*, EPA, http://www.epa.gov/oswer/nanotechnology/index.htm (last visited Mar. 3, 2013).

198. *Fact Sheet for Nanotechnology under the Toxic Substances Control Act*, EPA, http://www.epa.gov/opptintr/nano/nano-facts.htm (last visited Mar. 3, 2013).

199. *Nanotechnology Research Publications*, EPA, http://www.epa.gov/nanoscience/publications-overview.htm (last visited Mar. 3, 2013) (updated at least through 2011).

200. *Nanotechnology, Science & Research*, U.S. FOOD & DRUG ADMIN., http://www.fda.gov/ScienceResearch/SpecialTopics/Nanotechnology/default.htm (last visited Mar. 8, 2013).

201. NAT'L NANOTECH. INITIATIVE, http://www.nano.gov/nehi (last visited Mar. 7, 2013).

202. CTR. FOR NANOSCALE SCI. AND TECH. (NIST), http://www.nist.gov/cnst/ (last visited Mar. 7, 2013).

CNST, part of the National Institute of Standards and Technology (NIST),[203] provides access to high-quality scientific articles, studies, research projects, and publications related to nanotechnology.

## B. News Services

- Bloomberg BNA.[204] A paid subscription service, Bloomberg BNA "is a leading source of legal, regulatory, and business information for professionals . . . [which] delivers expert analysis, news, practice tools, and guidance"[205] on a wide variety of topics. Here, Bloomberg BNA includes EHS news and case updates and analysis (in the form of short articles) related to nanotechnology within the following reporters: Chemical Regulation Reporter, Daily Environment Report,[206] Environment Reporter, International Environment Reporter, Occupational Safety & Health Daily, Occupational Health & Safety Reporter, and the Toxics Law Reporter.[207] Analytical materials are available from the "BNA Insights" link listed on the top navigation bar[208] while the best way to access relevant news is to follow the link for "Recent Topics" from the top navigation header and then to post-filter by the letter "N." Once selected, the researcher can then expand to the term, "nanomaterials" or "nanotechnology medical research" if available to gain access to recent articles.[209] Subscribers

203. NAT'L INST. STANDARDS & TECH., http://www.nist.gov/index.html (last visited Mar. 7, 2013).

204. BLOOMBERG BNA, http://www.bna.com/ (last visited Jan. 24, 2013).

205. *About Us*, BLOOMBERG BNA, http://www.bna.com/about-bna-a4760/ (last visited Jan. 24, 2013).

206. The Daily Environment Report may also be included as part of the Environment & Safety Resource Center.

207. Other Bloomberg BNA's services, including the State Daily Report and the World Climate Change Report, do not list nanotechnology as a topic as of the date of this article, however, they may at a future date. For more information about Bloomberg BNA products, see *Products*, BLOOMBERG BNA, http://www.bna.com/products-p4177/ (last visited Jan. 24, 2013).

208. The most effective search here is to do a Ctrl+F search for the term "nano" to locate relevant articles.

209. For all Bloomberg BNA Reporters, to access older articles, use the "Advanced Search Option" located on the top right-hand navigation header.

may also choose to request daily or weekly headline or highlight updates via email from these services through their Account Profiles.[210] Select reporters, including the Chemical Regulation, Daily Environment Report, and International Environment Report also have the capability of displaying custom headlines limited only to "nanomaterials."

- Westlaw's Nanotech News (NANOTECNEWS).[211] To meet the interest for nanotech news, Westlaw has a composite database titled Nanotech News which "contains documents from newspapers, magazines, journals, newsletters, transcripts and wires about Nanotechnology."[212] The database—currently only available on Westlaw Classic—is best employed by limiting searches using the smart terms option at the bottom left of the search screen.
- Nanotechnology Weekly and Nanotechnology Business Journal.[213] Both journals are published by Vertical News. Lexis Nexis currently has coverage of both journals from January 4, 2008 through the present.[214]
- New York Times.[215] The New York Times has a Nanotechnology News Topic page which "includ[es] commentary and archival articles published"[216] on this topic.

When conducting a search here, avoid employing a Topic field search as the topic "nanomaterials" was added only recently.

210. *See Email Updates, Account Profile Feature Tour*, BLOOMBERG BNA, http://www.bna.com/email_email/ (last visited Jan. 31, 2013).

211. *Nanotechnology News*, WESTLAW DATABASE DIRECTORY, http://directory.westlaw.com/ (last visited Jan. 31, 2013) (conduct a search using the term "nanotechnology"; this entry is listed fifth).

212. *Id.*

213. *Search Results, Searchable Directory of Online Resources*, LEXISNEXIS, http://w3.nexis.com/sources/scripts/eslClient.pl?Name=nanotechnology (last visited Jan. 31, 2013).

214. *Id.*

215. *Nanotechnology*, N.Y. TIMES, http://topics.nytimes.com/topics/news/science/topics/nanotechnology/index.html (last visited Jan. 24, 2013).

216. *Id.*

### C. Blogs

- Nano & Other Emerging Chemical Technologies Blog.[217] Authored by nanotechnology expert Lynn L. Bergeson of Bergeson & Campbell, P.C.[218] Since March 2007, this blog is updated on an approximate bi-weekly basis.
- Nanotechnology Law Report.[219] This well-written blog dating back to 2006 is currently being maintained by the staff and attorneys at Porter Wright.[220] The blog is updated on an approximate monthly basis and focuses on providing up-to-date news and commentary on issues pertaining to: Antitrust and Trade Regulation, Business and Securities, Environmental Law, Finance and Commerce, Food and Drug Regulation, Government Contracts, Government Affairs, Health Care, Intellectual Property, International Business, Occupational Health and Safety Regulation, Products Liability, SEC Investigations and Enforcement, Tax, Utilities and Energy, and Voluntary Standard Setting.[221] Of note, the blog also maintained a monthly newsletter highlighting news, cases, and publications related to nanotech. However that service appears to have ceased as of October 2008.[222]
- NanoLaw Blog.[223] Authored by Widener Law Professor Jean Macchiaroli Eggen and Eric J. Laury, this blog which

217. NANO & OTHER EMERGING TECH. BLOG, http://nanotech.lawbc.com/ (last visited Jan. 31, 2013).

218. BERGESON & CAMPBELL, P.C., http://www.lawbc.com/ (last visited Jan. 31, 2013).

219. NANOTECH. L. REP., http://www.nanolawreport.com/#axzz2Ci5BU224 (last visited Jan. 24, 2013).

220. PORTER WRIGHT, http://www.porterwright.com/ (last visited Jan. 31, 2013). Porter Wright maintains a small nanotechnology practice. *Nanotechnology*, PORTER WRIGHT, http://www.porterwright.com/nanotechnology-industry/ (last visited Jan. 31, 2013).

221. *About/Contact*, NANOTECH. L. REP., http://www.nanolawreport.com/promo/about/ (last visited Jan. 24, 2013).

222. *Newsletter*, NANOTECH. L. REP., http://www.nanolawreport.com/promo/newsletter/ (last visited Jan. 24, 2013).

223. NANOLAW BLOG, http://blogs.law.widener.edu/nanolaw/ (last visited Jan. 24, 2013).

currently has archives available since September 2011, is intended to "raise legal questions about the impact of nanotechnology and comment upon the ways in which those questions are likely to be raised in the legal system."[224]

- Nanotechnology Now.[225] Provides blog-type news posts to issues relating to nanotechnology with a monthly archive dating back to 2001; however, there is no search option or topic filter.

### D. Reference Websites

- Nanoscience & Nanotechnology LibGuide.[226] This Swain Chemistry and Chemical Engineering guide is a superior resource for staying abreast of the science of nanotechnology. Created for a scientific research audience, the guide provides search tips and techniques as well as RSS feeds to journals that commonly discuss nanotechnology.
- Guide to Nanotechnology Internet Resources.[227] This guide authored by Science Library Coordinator and Engineering Librarian Jill Dixon at Binghamton University provides excellent access to free links for nanotechnology. In particular, the sections listing institutes and international organizations are most helpful.
- Center for Environmental Implications of Nanotechnology.[228] The publications listing for this Center, a collaboration between researchers from Duke, Carnegie Mellon University, Howard University, Virginia

224. *About this Blog*, NANOLAW BLOG, http://blogs.law.widener.edu/nanolaw/about/ (last visited Jan. 31, 2013).

225. *Nanotechnology News - Current Month's News*, NANOTECHNOLOGY NOW, http://www.nanotech-now.com/current-months-news.htm (last visited Jan. 24, 2013).

226. Grace Baysinger, *Nanoscience & Nanotechnology*, STANFORD U. LIBR. (Jan. 8, 2013), http://libguides.stanford.edu/nano.

227. Jill Dixon, *Science and Technology Resources on the Internet: Guide to Nanotechnology Internet Resources*, ISSUES IN SCI. & TECH. LIBRARIANSHIP (2011), http://www.istl.org/11-winter/internet1.html.

228. *Publications*, CTR. FOR THE ENVTL. IMPLICATIONS OF NANOTECH., http://ceint.duke.edu/biblio (last visited Mar. 5, 2013).

Tech, University of Kentucky, and Stanford University, is impressive, including over 200 indexed entries of relevant scientific articles dating from 2008 to the present.

## IV. CONCLUSION

As the integration of nanomaterials into our daily lives continues to grow, the unforeseen EHS consequences of nanotechnology will become more pressing and simultaneously more likely to trigger a groundswell of litigation in the near future. Despite the dichotomous nature of nanotechnology's public persona, the risk to human health and our environment is tangible. And while more research and analysis still needs to be dedicated to this topic, legislators, analysts, and litigators should stay mindful of the fact that a body of materials to assist them in evaluating these nano-harms does exist—all they have to determine is under what haystack they should look.