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## Review of "The Oceans in the Nuclear Age: Legacies and Risks"

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*The Oceans in the Nuclear Age: Legacies and Risks.*

Edited by David D. Caron and Harry N. Scheiber. Leiden, Boston: Martinus Nijhoff, 2010. Pp. xx, 573. Index. \$296, €200.

The 2011 Fukushima Daiichi nuclear power plant meltdown in Japan, the worst nuclear crisis since Chernobyl, has at least temporarily brought to the forefront of public attention some of the risks associated with nuclear activities. The Japanese government ordered mandatory evacuations from a wide radius around the plant, and tests revealed dangerous levels of radioactivity in the soil, drinking water, milk, vegetables, and beef. This crisis has affected not only the land territory and citizens of Japan but also the marine environment. Contaminated seawater that was used to cool reactors either leaked or was released into the ocean, and low-altitude radioactive particles emitted from the plant have dispersed at sea.

The operation of nuclear plants and waste storage facilities in coastal zones is only one of many nuclear activities affecting the oceans. Most nuclear weapons tests have been conducted next to, over, or under the surface of the oceans; depleted and reprocessed nuclear fuel is shipped long distances; nuclear-powered warships carry nuclear weapons, and both warships and weapons have on occasion been lost at sea; terrorists may transport weapons of mass destruction by sea or attack nuclear vessels; and states have dumped radioactive waste from ships. The legacy of past nuclear activities stays with us, perhaps more dramatically than other historic events. Nuclear material in the oceans remains radioactive, decaying—depending on the element and isotope—over decades, centuries, or millennia.

*The Oceans in the Nuclear Age* highlights incidents and statistics that reveal the magnitude of nuclear activities affecting the oceans. For over half a century, France (1966–98), the Soviet Union (1955–90), and the United States (1946–58) conducted more than three hundred nuclear tests underwater, over the oceans, or underground at island locations. Between 1949 and 1982, thirteen states dumped approximately 150,000 tons of nuclear waste at forty-seven sites in the Atlantic

and Pacific. The Soviet Union disposed of significant amounts of radioactive waste in the Arctic Ocean, often in shallow water; large units, such as nuclear reactor components, were dumped without the protection of steel containers. A 1993 study commissioned by Russian President Boris Yeltsin found that the “former Soviet Union dumped more radioactive waste into the Arctic Ocean than the total amount of radioactive materials ever dumped into the rest of world’s oceans combined” (pp. 430–31). The legal and policy challenge is to manage not only ongoing and possible future nuclear uses of the oceans, but the consequences of past activities as well. We most likely cannot undo those consequences. Removing nuclear materials from dump and test sites may not be feasible and could be counterproductive, leading to consideration of “more modest actions” including “more active monitoring and mapping, fishing exclusion zones and public warnings” (p. 527).

The editors of *The Oceans in the Nuclear Age*, who are the codirectors of the Law of the Sea Institute, are David Caron, the C. William Maxeiner Distinguished Professor of Law at the University of California, Berkeley, and president of the American Society of International Law; and Harry Scheiber, the Stefan A. Riesenfeld Professor of Law and History at the University of California, Berkeley. As the editors note in the book’s introductory part 1, knowledge about the oceans and about various nuclear-related activities has not previously been consolidated in one place. This knowledge has been fragmented among pockets of specialized experts. This book brings together valuable historical, environmental, scientific, political, and legal studies about a variety of nuclear activities. *The Oceans in the Nuclear Age* admirably achieves its goal: it “frame[s] the complex multidimensional set of relationships between the oceans and the nuclear age, uncovers patterns of impact and response in the legal regime, and raises further questions for research” (p. 3).

The bulk of *The Oceans in the Nuclear Age* is organized into four subsequent parts (starting with part 2), corresponding to different activities. Part 2, entitled “Radioactive Wastes in the

Oceans: Managing the Past and Considering the Future," begins with Hjalmar Thiel examining the deep-sea impacts of contamination from both nonvisible sources, such as radiation, and visible sources, such as dumping (chapter 2). This part also analyzes the legacy of nuclear testing (chapters 3–5, by Thomas Leschine, Philip Okney, and Laurence Cordonner), the detailed regime regulating hazardous substances in the Baltic Sea (chapter 6, by Malgosia Fitzmaurice), and the possibility of sub-seabed disposal of high-level radioactive waste (chapters 7–8, by Daniel Fornari and Edward Miles). In part 3, "The Ocean Transport of Radioactive Fuel and Waste" (chapters 9–12), Jon Van Dyke, Luis Rodríguez-Rivera, Masahiro Miyoshi, and Tullio Treves explore the opposing political and legal positions of coastal states and nuclear powers related to such transport. Part 4 concerns "Nuclear Weapons and Weapon Grade Material on the Oceans." Ted McDorman provides an overview of maritime terrorism and international law concerning the boarding of vessels (chapter 13), Mark Valencia and Donald Rothwell review the Proliferation Security Initiative<sup>1</sup> (chapters 14–15), and Scott Parrish examines nuclear-weapon-free zones and the maritime transit of nuclear weapons (chapter 17). Craig Allen and Michael Matheson analyze national strategies to combat ocean transport of weapons of mass destruction, concentrating on U.S. security perspectives (chapters 16, 18). Part 5, "Nuclear Activities and Radioactive Waste in the Arctic," looks at transport, dumping, land-based pollution, and loss of nuclear materials in this particularly fragile environment. Elizabeth Elliot-Meisel analyzes the history, law, and politics applicable to the Northwest Passage (chapter 19), while Douglas Brubaker explores the dangers associated with nuclear transport through the Arctic's Northern Sea Route (chapter 22). Alexander Skaridov and Lakshman Guruswamy assess dumping in the Arctic Ocean and the risks posed by decommissioned Russian nuclear vessels and facilities (chapters 20–21). In the book's concluding discussion (part

6), Bernard Oxman and Caron reflect on the challenges of the nuclear age for the oceans and on past and possible responses (chapters 23–24).

Nuclear activities affecting the oceans have provoked intense political controversy, reflecting strongly held, conflicting values. Shipments of spent and reprocessed nuclear fuel provide an example. Miyoshi sets out the traditional legal position: the high seas freedom of navigation, which applies in the exclusive economic zone (EEZ), and the regime of innocent passage through the territorial sea allow such shipments through the waters of coastal states. Coastal states, he emphasizes, may only impose conditions recognized in the United Nations Convention on the Law of the Sea (Convention or Law of the Sea Convention),<sup>2</sup> such as restricting to sea lanes the vessels carrying nuclear materials in the territorial sea. However, shipping cargoes of nuclear waste or reprocessed fuel presents, in the words of Van Dyke, "a new challenge to the balance created in the Law of the Sea Convention between navigational freedoms and protection of coastal communities, coastal resources and the marine environment" (p. 147). Highlighting the duties of flag states to protect the marine environment and the risks of an accident or terrorist attack, Van Dyke notes that coastal states and nongovernmental organizations have argued that coastal states are entitled to be notified about, or even to authorize, shipments of nuclear cargoes through their waters. The conflicting positions, couched in legal terminology, reflect significant disagreement over which values deserve priority. One side emphasizes the importance of navigation, commerce, and energy production, and stresses the dangers to the established legal order of new unilateral coastal state assertions of jurisdiction. The other side focuses on risks to the marine environment, human health, and the economies of developing states through whose waters nuclear cargoes are shipped, and underlines the importance of establishing an adequate liability and compensation regime. Other nuclear-related ocean activities are

<sup>1</sup> DEP'T OF STATE, PROLIFERATION SECURITY INITIATIVE: STATEMENT OF INTERDICTION PRINCIPLES, Sept. 4, 2003, available at <http://www.state.gov/t/isn/c27726.htm>.

<sup>2</sup> United Nations Convention on the Law of the Sea, opened for signature Dec. 10, 1982, 1833 UNTS 397, available at [http://www.un.org/depts/los/convention\\_agreements/texts/unclos/UNCLOS-TOC.htm](http://www.un.org/depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm).

also politically sensitive, including proposals to bury nuclear waste in the deep seabed, efforts to prohibit nuclear testing, plans to exclude nuclear weapons and nuclear-powered vessels from certain waters, and security responses to terrorist threats.

Policy makers need to understand the consequences of past and ongoing nuclear activities to shape optimum legal responses. *The Oceans in the Nuclear Age* advances our understanding of the historical, environmental, scientific, and political contexts within which legal solutions must develop. However, a recurrent theme is the need to know more about the present and likely future effects of nuclear activities on the oceans. Several contributors cite studies indicating that leakage from nuclear sites has to date had minimal adverse effects on humans or the marine environment. But the authors also note that new studies and continual monitoring are needed and that many long-term consequences of nuclear activities affecting the oceans are uncertain. “[E]ven this far into the nuclear age,” Caron summarizes, “both the possible pathways for radioactive materials to move within ocean ecosystems and the long term risks of particularly small doses of radiation remain unclear” (pp. 516–17). Coastal nuclear installations and submerged radioactive waste may harm marine ecosystems and human health—for example, when people eat seafood from contaminated seas—but the extent of such harm and the period of latency are uncertain. We lack studies measuring leaks in the immediate vicinity of drums of nuclear wastes, we are not confident about the extent of environmental consequences when such containers eventually disintegrate, and we do not know with certainty when they will leak or disintegrate. “[W]hat can happen to military containers sunk about forty years ago,” concludes Skaridov, “is anyone’s guess” (p. 421). In many instances, we do not even know where to test, since the precise locations of many Soviet and U.S. dump sites are unknown even to the governments involved. Furthermore, some relevant existing government data have not been made available. To respond appropriately to the environmental and human health consequences of French nuclear testing in the Pacific, Cordonnery notes that “scientists need access to the baseline data cur-

rently held secret by the French government” (p. 78). The difficulty of reconstructing inventories of radioactive waste compiled by no-longer-existing Soviet agencies poses a “major impediment” to creating a database of generated and disposed waste, “leaving scientists no choice but to fumble on by trial and error” (p. 422). The need, in short, is for more transparency and new studies about the consequences of nuclear activities.

Perfect knowledge of risks is, of course, not a prerequisite for international legal responses, and international environmental lawyers and policy makers have experience structuring regimes to respond to new and changing information about risks. Moreover, much is in fact known about the consequences of releases of radiation. We may not know the exact mechanisms by which radioactivity migrates from one part of the ocean environment to another, but we have evidence that it does migrate. While the long-term effects of fallout at a distance from nuclear tests may be uncertain, it seems clear that the immediate locations of past tests “have in effect become waste sites” and need to be managed accordingly (p. 519). The world has witnessed devastating human, economic, and environmental costs of high-level radiation from nuclear weapons explosions or nuclear plant meltdowns. As Leschine, Okney, and Cordonnery discuss in their chapters on nuclear tests, Pacific atolls used for testing were evacuated, severely impacting traditional ways of life, injuring people, and damaging property (and in some cases leading to damage awards). Weighing the costs and benefits of nuclear uses of the oceans is difficult—and this volume appropriately “does not itself undertake to assess the degree of risk present in [nuclear] activities” (p. 523)—but several contributors forcefully argue that current legal mechanisms have not sufficiently recognized the risks associated with nuclear activities. With respect to shipment of nuclear cargoes, for example, Van Dyke stresses the need for “a focused and comprehensive legal regime designed to internalize the real costs of the shipments, and to ensure that the risks they create are *not* transferred from those that benefit from these shipments to those who gain nothing from them” (p. 150).

Many contributors to *The Oceans in the Nuclear Age* thoughtfully assess past and possible legal solutions and, more broadly, the ways that international law changes to meet new situations. A critical question is whether nuclear activities affecting the oceans should be banned or, instead, be allowed to continue (and, if so, under what conditions). Not surprisingly, given the range of issues, the answers to this question vary. Some treaty efforts have sought to prohibit certain nuclear-related activities. For example, test-ban treaties prohibit states from carrying out nuclear explosions. Dumping, once thought a permissible way to dispose of low-level radioactive wastes, has been prohibited under the 1996 Protocol to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Protocol).<sup>3</sup> These treaties respond, in Caron's words, to "the inability of historic customary approaches"—e.g., exercising high seas freedoms with reasonable regard for the interests of other states—"to address the unique position of nuclear material" (p. 526). The success of such global prohibitions is, however, incomplete: the Protocol does not cover military dumping or dumping in internal waters; the Protocol and test-ban treaties have not been universally accepted; state parties face implementation problems; and rogue states or nonstate actors may flaunt global bans. One alternative to a global prohibition is to exclude a risky activity from specified areas, for example by making it illegal for vessels to enter particularly sensitive sea areas.<sup>4</sup> This type of partial prohibition will often not be easy to achieve with

respect to many nuclear activities on the oceans—witness the debates over whether coastal states have the right to exclude nuclear weapons from nuclear-weapons-free zones (explored by Parrish in chapter 17) or to receive notice about or authorize shipments of nuclear cargoes in coastal waters. The process of trying to negotiate multilateral prohibitory or exclusionary solutions has at least contributed to increased awareness of the dangers of certain nuclear activities.

Some of the authors suggest that bilateral or case-specific measures could help resolve highly sensitive matters. Elliot-Meisel highlights the importance of finding pragmatic ways to protect the Arctic environment and to resolve U.S.-Canadian tensions over Canadian claims concerning the Northwest Passage. She finds that "precedent for bilateral and mutually satisfying cooperation and agreement does exist" (p. 391). In light of the melting of Arctic sea ice, Canada's difficulty allocating resources necessary to exercise comprehensive control over the North, and U.S. concerns over continental security, she suggests that conditions may be ripe for a bilateral accommodation. With respect to the transport of nuclear cargoes, Treves proposes a procedural mechanism to resolve particular controversies between coastal states and the nuclear industry. In his view, a viable regime "requires conciliation between conflicting but equally respectable rights" (p. 230). Such a cooperative procedural approach could, Treves suggests, lead to case-specific solutions, avoiding the "need to deal with the question of principle of which side has the last word" (*id.*).

Any bilateral initiatives will, however, be undertaken against the background of existing international law, especially the Law of the Sea Convention, and standard setting by international organizations. With respect to the Arctic Ocean, Brubaker reports that Norway has implemented International Maritime Organization (IMO) navigational safety regulations and International Atomic Energy Agency (IAEA) requirements for vessel traffic. The United States, Canada, and other states are also obligated to implement legally binding IMO standards, and the IMO has recently been developing measures specifically

<sup>3</sup> Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov. 7, 1996, 36 ILM 1 (1997), available at <http://www.ecolex.org/server2.php/libcat/docs/TRE/Multilateral/En/TRE001268.doc>. The Protocol is intended to replace both the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, 26 UST 2403, 1046 UNTS 120, which permitted dumping of low- and medium-level radioactive wastes in certain circumstances, and a voluntary moratorium introduced in 1983 on such dumping.

<sup>4</sup> See International Maritime Organization [IMO], Revised Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas, IMO Doc. A 24/Res. 982 (Dec. 1, 2005), available at <http://www.gc.noaa.gov/documents/982-1.pdf>.

geared to the Arctic.<sup>5</sup> Case-by-case agreements concerning shipments of nuclear material through coastal waters, as Treves suggests, might preserve existing rules of international law, although common features of such agreements could contribute to assertions of new customary international law.

One important challenge is finding multilateral solutions within the established framework of the law of the sea. Were coastal states unilaterally to prevent shipments of reprocessed nuclear material through their EEZs, that activity could have significant long-term implications for navigational mobility, contribute to creeping territorial jurisdiction, and undermine prospects for cooperative multilateral lawmaking. Oxman notes that “it makes no sense to prejudice the entire edifice of the modern law of the sea—and the underlying principles of freedom of navigation and communications through the EEZ and straits on which the Convention rests—in order to deal with [this] highly limited problem” (p. 512). Acknowledging both legal rights of navigation and legal duties important to environmental protection, Oxman maintains, should lead us to

elaborate international standards that must be respected by flag states both by virtue of agreement on those standards and by virtue of the [Law of the Sea] Convention’s requirement that states exercising freedom of navigation in the EEZ and transit passage of straits have the duty to comply with generally accepted international safety and environmental standards. There is no problem whatsoever in including in such international standards, addressed to the specific problem of transport of highly radioactive materials, special obligations and requirements tailored

to that problem. We have done this in other contexts, and we can easily do so here. The critical point is that the regulations are to be international, not unilateral, and they are to be promulgated within the framework of UNCLOS. (P. 513)

The Law of the Sea Convention, while providing considerable stability and predictability, also accommodates change. Many alternatives to unilateral measures exist, ranging from new agreements implementing the Convention to IMO ship safety, navigation, and environmental standards. Detailed treaty-based regimes, consistent with the Convention, may regulate pollution risks in regional seas; the work of the Helsinki Commission (the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area),<sup>6</sup> which Fitzmaurice explores in chapter 6, provides one model. The Law of the Sea Convention also would not constrain robust liability and compensation regimes covering nuclear-related activities affecting the oceans.

Finding multilateral solutions is complicated by the fact that nuclear-related activities on the oceans often implicate legal regimes other than law of the sea ones: non-proliferation, security and self-defense, human rights, and international environmental law. The puzzle is how to take account of these other perspectives while still operating consistently with the Law of the Sea Convention. This is a tall order, but it has indeed been possible to accommodate law of the sea norms in highly politicized contexts relating to nuclear activities. For example, despite the strains of unilateralism evident in the U.S. promotion of the Proliferation Security Initiative (PSI)—a framework to facilitate identifying and interdicting shipments of material that could be used in weapons of mass destruction—that initiative has been implemented through agreements that reflect traditional notions of flag state jurisdiction. PSI-specific actions authorizing interdiction operations depend on bilateral ship-boarding agreements,

<sup>5</sup> See Guidelines for Ships Operating in Polar Waters, IMO Doc. A 26/Res. 1024 Annex (Dec. 2, 2009), available at [http://www.tc.gc.ca/media/documents/marine\\_safety/IMO\\_Polar\\_Guidelines.pdf](http://www.tc.gc.ca/media/documents/marine_safety/IMO_Polar_Guidelines.pdf); *Mandatory Polar Code Further Developed*, IMO NEWS, No. 1, 2011, at 17, available at [http://www.imo.org/MediaCentre/NewsMagazine/Documents/IMO\\_News\\_No1\\_11\\_WEB.pdf](http://www.imo.org/MediaCentre/NewsMagazine/Documents/IMO_News_No1_11_WEB.pdf); see also Arctic Council’s Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, May 12, 2011, available at [http://library.arcticportal.org/1474/1/Arctic\\_SAR\\_Agreement\\_EN\\_FINAL\\_for\\_signature\\_21-Apr-2011.pdf](http://library.arcticportal.org/1474/1/Arctic_SAR_Agreement_EN_FINAL_for_signature_21-Apr-2011.pdf).

<sup>6</sup> Convention on the Protection of the Marine Environment of the Baltic Sea Area, Apr. 9, 1992, 2099 UNTS 195, available at [http://www.helcom.fi/Convention/en\\_GB/text/](http://www.helcom.fi/Convention/en_GB/text/). Information about the Helsinki Commission’s work is available online at <http://www.helcom.fi/>.

now negotiated with flag states accounting for over sixty percent of global commercial vessel tonnage. These ship-boarding agreements, along with other legal developments related to maritime terrorism, McDorman concludes, maintain "fidelity with the basic international legal principle of flag State consent combined with an enhancement of the ways in which consent of flag States can be given and is expected to be given in the face of 'suspected' maritime terrorist activity" (p. 264).

With respect to many oceans-related issues, international organizations prepare important studies, devise standards of conduct, and provide forums for resolving disputes. These international organizations and existing multilateral arrangements will be essential focal points for efforts to solve many problems involving nuclear activities. For example, Guruswamy, in his chapter on Arctic nuclear pollution, thoughtfully proposes "pragmatic and incremental short term goals" in part related to such organizations (p. 426). These goals include authorizing the IAEA to undertake information-gathering functions under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management<sup>7</sup> and allowing nongovernmental organizations to participate more actively in the work of international organizations and other treaty arrangements.

Although several authors examine aspects of the work of the IAEA and the IMO, additional detailed and critical evaluations of the capabilities and limitations of these and other international organizations would complement the findings in *The Oceans in the Nuclear Age*. Important questions concern how organizations, in their work on nuclear-related activities, affect multilateral treaty making and standard setting; help shape customary international law; create opportunities for consensus building and contribute to expectations of cooperative interstate behavior; and facilitate (or impede) access or participation by nongovernmental organizations. It is also important to con-

sider how international organizations that do not normally focus on maritime issues can best take account of the Law of the Sea Convention and other rules of international oceans law and how the work of various organizations should be coordinated.

While different contributors to the book view the status quo with varying degrees of concern, the volume as a whole conveys "a midpoint between hysteria and denial, between alarm and complacency" (p. 534). But that midpoint suggests that nuclear activities affecting the oceans—like other critical problems, such as increased acidity from greater absorption of carbon dioxide and dead zones from land-based pollution—have consequences that must be confronted. Finding multilateral solutions that build on current legal norms and that utilize existing international organizations will not be easy. This volume offers one clear prescription: the need to conduct more studies relating to the environmental and health effects of past and ongoing nuclear activities on the oceans.

This reviewer hopes that *The Oceans in the Nuclear Age* will prompt such scientific studies, additional legal and policy analyses, and sustained political efforts to improve regulatory and liability regimes applicable to nuclear-related oceans activity. As McDorman writes, however, "[d]evelopments in international law frequently follow catastrophic or highly-publicized incidents" (p. 239). Perhaps the recent Fukushima Daiichi crisis will spur action concerning land-based pollution and the safety of nuclear plants in coastal zones, and even renewed consideration of several of the other issues surveyed in this book. "Whatever the particular type of incident to occur," Caron concludes, "a significant lesson of international environmental law is that a window of opportunity for the . . . development of law and policy will open for a time after such an incident, and that opportunity is best anticipated" (p. 533). *The Oceans in the Nuclear Age* helps us anticipate any such opportunity.

<sup>7</sup> Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Sept. 5, 1997, 2153 UNTS 357, available at <http://www.iaea.org/Publications/Documents/Conventions/jointconv.html>.