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INTERNATIONAL CONTROL OF THE SAFETY OF NUCLEAR-POWERED MERCHANT SHIPS†

*William H. Berman** and *Lee M. Hydeman***

Few men combine the attributes of scholarship, leadership, imagination, industry, and intellectual curiosity that have characterized the professional career of E. Blythe Stason. It was typical, for example, in 1946, when the full implications of the peaceful uses of atomic energy were merely a glimmer to most persons, that this man would have the foresight to recognize that nuclear technology would have a great impact on both public and private law. It was still more typical that Dean Stason, having recognized this inevitable amalgamation of science and law, would undertake to become an authority on the problems that loomed ahead. In the ensuing years Dean Stason has made both significant and voluminous contributions to the legal, policy, and, for the layman, technical literature on atomic energy and the law. [See p. 185 *supra*. — Ed.]

Dean Stason has brought his wisdom and experience in the field of administrative law to bear upon the many complex public law problems which the peaceful uses of atomic energy have engendered. His published works in this field have ranged from an early paper on the difficulties likely to be encountered, and the juridical dangers, in attempting to regulate complex technological activities, to a more recent collaborative monograph in which the authors proposed an imaginative and practicable role for state governments in connection with the control of radiation hazards.

Since 1956 Dean Stason's efforts have been devoted increasingly to the private law aspects of radiation injury. A series of speeches and articles pertaining to the tort liability aspects of atomic energy culminated in 1959 in the publication (with Professors Estep and Pierce) of Atoms and the Law, *a comprehensive and scholarly volume which will stand as the definitive treatise on the radiation liability problem for years to come.*

During the past two years the authors have had the privilege and pleasure of working under the general guidance of this man of remarkable qualities and achievements. This close association has increased their admiration and respect for him. It is, then, with sincere affection that the paper which follows is dedicated to a friend and mentor, Dean E. Blythe Stason. — W.H.B. *and* L.M.H.

In recent years we have witnessed the transition of nuclear-powered ships from an imaginative dream to an engineering reality. This vast step from the drawing board to successful operation on the high-seas has taken place in a remarkably short span of time. Nevertheless, in the flush of enthusiasm over the technological achievement, we must not lose sight of the fact that the promise of nuclear power for the propulsion of ships will not have been fulfilled until nuclear vessels are operating safely and economically over the maritime trade routes of the world. It would be unrealistic to assume that further progress, from military and demonstration vessels subsidized by governments, to com-

† This article is based upon a paper which the authors presented before EURATOM's International Symposium on Legal and Administrative Problems of Protection in the Peaceful Uses of Atomic Energy, Brussels, Belgium, Sept. 5-8, 1960.

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mercially competitive merchantmen, will not be more difficult, more time-consuming, and more taxing to our ingenuity than the steps taken thus far.

I. THE PROBLEMS OF NUCLEAR SHIP OPERATION

Significant technical, legal, and administrative problems remain as barriers to the widespread operation of nuclear merchant vessels. The major categories of difficulty are ship economics, ship safety, and legal liability for radiation damage. These interrelated problem areas have been highlighted by three major conferences during the past year.

A. *Ship Economics*

The primary requisite to the commercial operation of nuclear ships is to make them economically competitive with conventional ships. This was the principal subject of a merchant ship industry conference in Philadelphia in April 1960.[1] The Philadelphia Conference was neither planned nor expected to achieve specific solutions to problems of the economics of nuclear ships. In fact, to a considerable extent, the Conference constituted a restatement of earlier predictions on the achievement of economic nuclear vessels[2] and an intensification of conflicting views on the outlook.[3] The Conference, however, did serve the valuable purpose of providing new perspective. In this connection, a significant observation was made in partial response to the general mood of pessimism that pervaded the Conference; the speaker noted that most existing plans for the nuclear propulsion of ships are still on paper and pointed out that "you make much greater progress when you work with things."[4] In addition, the nature of many of the existing technological problems, and the areas of development most worthy of early attention, were identified distinctly.[5] Further, it was made

1 Conference on the Role of Nuclear Propulsion in Merchant Shipping, sponsored by the Atomic Industrial Forum, April 28-30, 1960.

2 HYDEMAN & BERMAN, INTERNATIONAL CONTROL OF NUCLEAR MARITIME ACTIVITIES 9 (1960).

3 Contrast, for example, the assertion of John H. Lancaster, Bethlehem Steel Company, that economic nuclear ships may be one hundred years in the future, N.Y. Times, April 30, 1960, p. 36M, col. 8, with the statement of David L. Gorman, George G. Sharp, Inc., to the effect that certain ship applications of nuclear propulsion would be competitive now, reported in Atomic Industrial Forum, The Forum Memo, May 1960, p. 10.

4 Luncheon remarks of Francis K. McCune, reported in Atomic Industrial Forum, The Forum Memo, May 1960, p. 10.

5 Remarks of Louis H. Roddis, Jr., Chairman, NAS-NRC Maritime Research Advisory Committee, reported in Bureau of National Affairs, Atomic Industry Reporter, News and Analysis 6:139 (1960).

abundantly clear that nuclear ship technology cannot be viewed as a mere extension of the technology for central station power plants,[6] and that the achievement of economic nuclear ships will not be easy. In this latter context, there was general recognition that effective solutions to the concomitant problems of legal liability and safety control could be instrumental in facilitating the approach to competitive nuclear propulsion and essential to ultimate success.

B. *Liability for Nuclear Damage*

Another nongovernmental conference on nuclear ships took place in Rijeka, Yugoslavia in September 1959, and was directed to the problem of potential liability for damage arising out of a release of fission products from a nuclear-powered ship. The Rijeka Conference was convened by the International Maritime Committee in recognition of the importance of an early resolution of the liability problem and of the fact that none of the nuclear liability conventions then under consideration[7] was sufficiently comprehensive to cover nuclear-powered vessels. The Conference prepared a draft convention on the liability of ship operators.[8]

The Rijeka draft provides for the sole and absolute liability of the operator for radiation injuries arising out of the fuel used in the ship,[9] except for willful damage caused by claimants or others.[10] The draft also deals with related matters, such as the establishment of a period of limitation on claims and the selection of a forum for asserting claims, and adopts a specific rule to cover instances of contributory nuclear damage.[11] Two vital matters, however, remain open. First, although the draft provides for a limitation on the liability of a duly licensed operator, no specific monetary limit was adopted.[12] Second, the draft requires only that an op-

6 In his remarks, Louis H. Roddis, Jr. directed attention to the difference in power level requirements between most ships and central station power plants. *Ibid.* For an extensive description of the major differences between ship and stationary reactor power plants, see HYDEMAN & BERMAN, *op. cit. supra* note 2, at 84-87.

7 In September, 1959, Euratom, the Organization for European Economic Cooperation, and the International Atomic Energy Agency all were preparing or considering drafts of liability conventions for land-based atomic energy activities.

8 THE MARITIME LAW ASSOCIATION OF THE UNITED STATES, FINAL ENGLISH DRAFT OF INTERNATIONAL CONVENTION RELATING TO THE LABILITY OF OPERATORS OF NUCLEAR SHIPS, Document No. 434, October 20, 1959.

9 *Id.*, Art. II (i).

10 *Id.*, Art. II (v) & (vi).

11 *Id.*, Arts. V, VII, & XII.

12 *Id.*, Art. III (i), provides that "An operator of a nuclear ship . . . shall in no circumstances be liable for more than _____ in respect of any one nuclear incident. . . ."

erator maintain the amount of insurance specified by the licensing State;[13] no agreement was reached on what would be an appropriate amount of insurance. It is precisely in these unresolved issues that the major problems of international agreement on the liability question lie.

A limit on liability, of course, must be sufficiently high to make nuclear ships acceptable in most ports. As indicated by experience with land-based nuclear facilities, such a limit probably will be beyond the capacity of the insurance underwriters. In recognition of these facts, the delegates to the Rijeka Conference acknowledged that governmental indemnification probably would be necessary to supplement available insurance.[14] However, they took the position that a monetary limit on liability, the amount and terms of insurance required, and the means for supplementing insurance with governmental indemnities, were all essentially matters for governments to resolve at a diplomatic conference.[15] Thus, while the Rijeka Conference did achieve specific agreement on a number of difficult legal questions, the issues most crucial to a resolution of the problem of legal liability were not resolved.[16]

C. *Ship Safety*

The third of the recent conferences dealing with nuclear propulsion for ships, and the one of primary concern for purposes of this paper, was the intergovernmental Safety of Life at Sea (SOLAS) Conference in London during May and June of 1960. While the Conference was concerned with the general subject of ship safety, one committee[17] devoted its efforts exclusively to possible amendments to the 1948 Safety of Life at Sea Convention[18] to provide for regulating the safety of nuclear-powered vessels. To facilitate an appreciation of the context in which these discussions were held, some background on the traditional approach to international agreement on the safety of ships at sea is necessary.

[13] *Id.*, Art. III (ii).

[14] *Id.*, Recommendations, I, Art. III.

[15] *Ibid.* Present plans contemplate the convening of such a diplomatic conference by the Government of Belgium during 1961.

[16] An excellent summary of the liability problem is contained in Könz, *On International Action in Connection with Liability and Insurance for Nuclear Powered Ships*, remarks before the Conference on the Role of Nuclear Propulsion in Merchant Shipping, *supra* note 1.

[17] The Committee on the Safety of Nuclear-Powered Ships.

[18] International Convention for the Safety of Life at Sea, 1948, June 10, 1948, T.I.A.S. No. 2495, 164 U.N.T.S. 113.

The first SOLAS Conference was convened in 1914, largely as an outgrowth of the *S. S. Titanic* disaster. Other major conferences on ship safety followed in 1929, 1930, and 1948.[19] At these later conferences, maritime safety conventions were drafted; the Load Line Convention of 1930[20] and the Safety of Life at Sea Convention of 1948[21] remain in force. The basic approach to control adopted by both conventions is identical. They contain detailed regulations pertinent to various elements of ship safety. Contracting States are obligated to impose the substance of those regulations on ships which fly their flags and are authorized to issue safety certificates to those vessels as evidence of compliance. While primary responsibility for inspection and for enforcement of the regulations is reposed in the flag State, other contracting States have the right to inspect and verify the seaworthiness of foreign vessels which have entered their ports and, under some circumstances, to detain such vessels for violation of the conventions. The conventions do not impose a clear obligation on contracting States to admit vessels certificated by other contracting States; nor do they provide contracting States with a clear right to exclude certificated vessels which they deem unsafe. The conventions require only that contracting States treat vessels certificated by other contracting States on a par with their own ships.[22]

Two important characteristics of this existing pattern for dealing with vessel safety by international agreement need to be identified and related to the problems engendered by the nuclear propulsion of ships.

First, assurance of ship safety has, in the past, been achieved through agreement on detailed design, construction, and operating standards and by the adoption of an approach to control over individual ships that is essentially unilateral in character. Precise criteria, however, are not yet possible for most elements of the safety of nuclear ships. During the present research and developmental stage of reactor technology, the large reactors which are

[19] A brief but excellent history of the SOLAS Conferences is set forth in UNITED STATES COAST GUARD, INTERNATIONAL CONVENTIONS AND CONFERENCES ON MARINE SAFETY, Department of the Treasury, CG 242 at 9-11 (1951). A conference to establish uniform principles and rules with regard to the limits to which ships on international voyages may be loaded was held in London in 1930.

[20] International Load Line Convention, July 5, 1930, 47 Stat. 2228, T.S. No. 858, 135 L.N.T.S. 301.

[21] Note 18 *supra*. The convention entered into force on November 19, 1952.

[22] SOLAS Convention, *supra* note 18, Ch. I, General Provisions, Regulation 16; Load Line Convention, *supra* note 20, Art. 15.

necessary for ship propulsion are not standardized. Even with respect to existing reactor types, only limited operating experience is available and many design changes for each new model can be expected. Reasonable assurance of the safety of a nuclear power plant, therefore, can be achieved only by means of a detailed hazards analysis of each reactor system. Such an evaluation must be made in light of all of the safety features designed into the reactor system, and must include consideration of the type of ship involved as well as the operating plans proposed for the vessel. Because of the many variables and their complete interrelationship in achieving the goal of reactor safety, about all that can be done by way of establishing an international reactor code is to set forth a general safety criterion, such as requiring "reasonable assurance that the health and safety of the public will be protected," and to specify the nature of the hazard evaluation which should be undertaken. Although somewhat more detailed standards may be possible with respect to the construction of the hulls of nuclear ships and with respect to navigational requirements, hull construction standards undoubtedly will have to vary considerably with the size, type and function of particular vessels, and operating criteria, by and large, will be meaningful only if developed in detail in a context of the navigational hazards of a specific port or coastal area. In general, then, nuclear ship construction and operation is not amenable to the detailed standards that have been incorporated in existing conventions which deal with the safety of ships.[23]

The second noteworthy characteristic of the existing pattern of international agreement on the safety of ships stems from the fact that the relatively standardized technology of conventional ships, and the hazards incident to their operation, have not required nations to consider an extensive revision of customary rules of international law pertaining to the relative rights and obligations of vessels and coastal States in the various regimes of the sea. As a result, ship safety conventions have merely specified the right of coastal States to inspect foreign vessels about to enter their ports and have required that such States treat vessels certificated by other contracting States on a par with their own ships. There are, however, areas of uncertainty in international law regarding the rights of vessels and coastal States, particularly with respect to passage

[23] For a discussion of the problems of establishing detailed safety standards for the construction and operation of nuclear ships, see HYDEMAN & BERMAN, *op. cit. supra* note 2, at 87-103.

through territorial waters and through areas of the high seas contiguous to those waters,[24] which are likely to assume greater significance in a context of potential nuclear hazards. Under existing rules of international law, the distance beyond territorial waters at which health and safety controls can be imposed is uncertain; the right of a State to require the submission of information relating to safety as a condition of passage through its territorial sea is open to question; and the right of a coastal State to exclude foreign vessels in distress for reasons of safety is equivocal.

Thus, in undertaking to deal with nuclear ships, the 1960 Safety of Life at Sea Conference was confronted with novel problems which required at least some consideration of a departure from the traditional pattern of controlling ship safety.

II. AN APPROACH TO THE HEALTH AND SAFETY CONTROL OF NUCLEAR SHIPS

A. *The 1960 Safety of Life at Sea Conference Proposals*

The proposals adopted by the 1960 SOLAS Conference with respect to nuclear ships[25] would incorporate in the 1948 Convention only a few, new, formalized regulations. These are limited to statements of general principles and procedures.[26] In addition, the Conference adopted a number of recommendations to provide guidance for governments in the application of those principles and procedures.[27] The proposed regulations provide that nuclear ships are subject to all other rules of the Convention.[28] In broad outline, the regulations require approval by each flag State of the design, construction, and standards of inspection of the reactor installation,[29] prescribe the development of a fully detailed operating manual,[30] and call for the conduct of periodic surveys by the flag State.[31] The test of radiation safety is ". . . that there are no unreasonable radiation or other nuclear hazards, at sea or in port, to the crew, passengers, or public, or to the waterways or food or water resources."[32]

24 For a detailed discussion of present legal rights and obligations of vessels and coastal States, *id.* at 123-295.

25 INTERNATIONAL CONFERENCE ON SAFETY OF LIFE AT SEA, IMCO Doc. No. IMCO/SAFCON/25/Rev. 1 (1960).

26 *Id.*, Annex B (Revised), Ch. VIII, Nuclear Ships.

27 *Id.*, Annex C (Revised), Recommendations Applicable to Nuclear Ships.

28 Note 26 *supra*, Regulations 2 & 3.

29 *Id.*, Regulations 4 & 5.

30 *Id.*, Regulation 8.

31 *Id.*, Regulation 9.

32 *Id.*, Regulation 6.

Administratively, the proposed regulations incorporate a new control device. A flag State is required to prepare a "Safety Assessment" consonant with the prescribed test of safety,[33] and to make the safety assessment ". . . available sufficiently in advance to the Contracting Governments of the countries which a nuclear ship intends to visit so that they may evaluate the safety of the ship."[34] The flag State may issue Nuclear Ship Safety Certificates.[35] Presumably, consistent with the SOLAS requirements pertaining to conventional ships, such certificates would entitle a nuclear ship to be treated by foreign States on a par with nuclear vessels to which such States have issued their own certificates. Coastal States are authorized to inspect a vessel prior to its entry into ports[36] for purposes of verifying the validity of the certificate and of determining whether operation is being conducted in conformance with the prescribed test of nuclear safety.

These proposals for the control of nuclear ships follow closely the pattern of existing conventions on ship safety and incorporate only such departures from the traditional approach as are clearly necessitated by the present state of nuclear technology or by the demands which the Conference anticipated that coastal States would make. The areas of departure from tradition are these. First, the proposals do not incorporate detailed safety standards; rather, in recognition of the unstandardized state of the reactor art and the complex task of assuring reactor safety, a broad safety criterion is adopted and an evaluation of each nuclear ship by the flag State is required. Second, the proposals contemplate the advance transmittal of an evaluation report from the flag State to other States to permit an appraisal of the safety of the vessel prior to the time it seeks entry into the ports of those States.

[33] *Id.*, Regulation 7 (a).

[34] *Id.*, Regulation 7 (b). The description in the Recommendations of the appropriate contents of the Safety Assessment is in very general terms. Note 27 *supra*, Recommendation 9. For example, the flag State is enjoined to make ". . . an evaluation of credible accidents which indicates that the hazards are minimized." Experience in the United States with reactor evaluations would indicate that this language could mean all things to all men. Consequently, precisely what constitutes an appropriate "evaluation of credible reactor accidents" may be a significant stumbling-block in achieving mutually acceptable arrangements between flag and coastal States.

[35] Note 26 *supra*, Regulation 10.

[36] *Id.*, Regulation 11. The Regulation does not specify at what distance the coastal State may assert this inspection right. Thus, it would seem that whatever exclusion rights are implicit in the provision for advance inspection, they may not include the right of the coastal State to exclude a vessel from territorial waters.

B. *Goals of International Accord on the Safety of Nuclear Ships*

Before turning to an assessment of the adequacy of the 1960 SOLAS Conference proposals, it is important to identify the goals of international agreement on the health and safety control of nuclear-powered ships. First and foremost, of course, is the necessity of assuring that nuclear vessels are safe. The use of atomic energy for the propulsion of vessels adds new scope to the problem of ship safety. Risk no longer will be confined to persons or property on board vessels or in the immediate harbor areas of ports. A major release of fission products from a ship's power plant could cause almost immediate and widespread damage on shore areas more than fifty miles away.[37] In addition, such an incident could endanger other vessels within a considerable area, could contaminate the resources of the sea within an even greater radius, and could result in increased radiation levels in any region toward which there is a current or wind drift from the site of the release. Thus, not only do nuclear ships constitute an increased risk for individual coastal States, but they also present a significant hazard to the general interests of the community of nations in the resources and use of the high seas.

A second goal of international accord is the achievement of a climate that will encourage the development and use of nuclear propulsion for ships. The capital investment required for such ships is very substantial. Absent a proper developmental climate, which presupposes a significant degree of advance assurance that nuclear vessels will be comparatively free to pursue normal commercial trade routes, even governments may not undertake the necessary investments. Customary international law and existing bilateral and multilateral treaties provide coastal States with considerable latitude to regulate and even prevent foreign vessels from traversing territorial waters for the purpose of entering ports, and may provide a basis for control well beyond territorial limits.[38] This means that unless nations agree upon the nature and limits of controls that can be exercised by coastal States, and devise a system which assures that nuclear vessels can enter most ports under some

[37] *E.g.*, see UNITED STATES ATOMIC ENERGY COMMISSION, BROOKHAVEN REPORT, THEORETICAL POSSIBILITIES OF MAJOR ACCIDENTS IN LARGE NUCLEAR POWER PLANTS, WASH-740 (1957).

[38] HYDEMAN & BERMAN, *op. cit. supra* note 2, at 236-40.

reasonable conditions, incentive for the construction of nuclear ships may be lacking.

A third goal of international agreement on nuclear ships is the avoidance of disputes between nations. As we have seen, at the present time a criterion of nuclear safety can be only very general and therefore imprecise. We also have identified some of the numerous circumstances under which international law is equivocal with respect to the unilateral acts a coastal State is entitled to take in order to protect itself from a significant risk of injury to its interests. When these facts are taken in conjunction with the prevailing widespread fear over radiation hazards, the operation of nuclear-powered ships is clearly an area of atomic energy activity ripe for international controversy.

A fourth goal of international agreement is the establishment of a health and safety control system which will provide a realistic framework for achieving a solution to the problem of liability for injury and damage due to nuclear ship accidents.

C. *An Evaluation of the SOLAS Proposals*

In light of these goals, it is possible to identify a number of deficiencies that are inherent in the approach to the control of nuclear ships taken by the 1960 SOLAS Conference.

1. *Assuring Health and Safety.* From the standpoint of assuring coastal States that their citizens and territories will be adequately protected from nuclear hazards, the SOLAS proposals leave a good deal to be desired. The great majority of coastal States do not yet have the skills or experience to undertake meaningful reactor evaluations, or even to assess evaluation reports transmitted to them by flag States. Even those few States which have achieved a considerable degree of sophistication in reactor technology may be somewhat less than fully reassured by the right to analyze an evaluation report made by a foreign State. This is particularly true because a thorough evaluation necessitates not only a review of final plans and operating procedures, but a detailed examination of components as they are fabricated or embodied in a reactor system. Thus, as a practical matter, the great majority of coastal States, and to a lesser degree all of them, will be placing primary reliance on the good faith and ability of the flag State.

The significance of this weakness in the 1960 SOLAS proposals may be magnified by the prevalence of a practice of registering privately-owned vessels with States which impose the lowest

registration charges, minimal labor standards, and the least costly safety requirements. The possible future use of flags of convenience for nuclear ships is particularly troublesome because the States most commonly used in this respect are frequently those with relatively undeveloped degrees of technological competence. Admittedly, only nations of considerable technological sophistication are likely to have the facilities for constructing nuclear ships. However, even assuming a properly built vessel, assurance of safety will depend very much upon continuing surveillance by individuals who have had a great deal of training and experience in reactor technology. It is doubtful that nations which hold themselves out as flags of convenience could, or by inclination would, obtain the services of foreign experts to undertake the task of continuing to review the safety of nuclear vessels which they register. To date, efforts to restrict the use of flags of convenience have not been particularly successful.[39] Nor was there any meaningful effort to deal with this problem, either directly or indirectly,[40] in the recent SOLAS Conference.

The right of a coastal State to exclude nuclear vessels from its ports does not rectify these deficiencies in the SOLAS proposals. Because of the distance at which a fission product release can cause injury or damage, mere exclusion from territorial seas, or even from reasonably extended contiguous areas of the high seas, will not necessarily provide coastal States with a guarantee of the protection of their interests. In addition, a coastal State's use of the right to exclude vessels as a general method of protecting itself would have an obvious adverse impact on its economic and diplomatic relationships.

From the standpoint of protecting the interests of the whole community of nations, the 1960 SOLAS proposals are even less effective and for substantially identical reasons. The safety of

[39] The recent efforts of the 1958 Conference on the Law of the Sea to require a closer connection between a vessel and a State in order to justify registry with that State were far from adequate. The Convention on the High Seas, which was developed by the Conference, provides only that "There must be a genuine link between the State and the ship. . . ." U.N. Doc. No. A/CONF.13/L.53 (1958), Art. 5. For a discussion of the inadequacy of this provision, see McDougal, *The Maintenance of Public Order at Sea and the Nationality of Ships*, 54 AM. J. INT'L L. 25, 28-30 (1960).

[40] The Conference proposals merely require that the flag State keep its safety assessment of the vessel up-to-date and specify that that State "assumes full responsibility for the certificate" of safety which it issues. Note 26 *supra*, Regulations 7 (a) and 10 (f). Even had the Conference not deemed it propitious to deal more comprehensively with the question directly, it could have adopted some method of imposing sanctions on flag States that do not live up to their international obligation to assure the safety of nuclear vessels under their jurisdiction. See discussion *infra*, p. 254.

other vessels on the high seas, and the protection of the resources of the high seas from the risks engendered by any particular nuclear ship, will depend entirely on the degree to which a flag State voluntarily complies with its international obligations. While coastal States can take some steps under international law to protect persons or property within territorial limits, no compulsory legal forum exists for enforcing the rights of nations to navigate and use the resources of the high seas.

In final analysis, then, the SOLAS proposals incorporate no effective means for an independent check on whether a flag State is meeting its international obligations, a question that cannot be resolved very satisfactorily by the cursory and varied inspections which will take place when a vessel is waiting to enter ports. In addition, the proposals fail to embody general sanctions designed to stimulate flag State compliance with those obligations.

2. *Encouraging Use and Development.* A second limitation inherent in the 1960 SOLAS Conference approach is the likelihood that it will not create a developmental climate that will encourage investment in the application of nuclear propulsion to ships. In the first place, the procedures prescribed for obtaining permission to enter foreign ports may well prove economically onerous. The probability that ship operators will be required to obtain advance approval from a considerable number of coastal States, each approval being based on a detailed review of the initial safety assessment made by the flag State, is likely to constitute a significant burden. In addition, different national interpretations of a general criterion of nuclear safety may result in inconsistent or even incompatible requirements, thus adding to the burden. Moreover, since it would be impractical to have five or ten nations evaluating the safety of a nuclear propulsion plant concurrently with its design, construction, and evaluation by the flag State, the assessment of the safety of a vessel by other States probably will take place only after construction is completed. At that time, changes or alterations which those States may require are likely to be extremely expensive if they are possible at all. None of these circumstances is conducive to investment in a technology that is economically marginal.

Second, the SOLAS proposals will not provide the prospective builder of a nuclear vessel with much assurance that his ship, even if certificated by the flag State, will be able to operate freely in international commerce. As we have seen, the 1948 SOLAS Con-

vention does not impose an affirmative obligation on coastal States to admit foreign vessels; it merely requires them to treat such vessels on a par with their flag ships. Until most coastal States have nuclear vessels flying their flags, the concept of equal treatment will not be very meaningful. And, even when most coastal States have registered nuclear vessels, a requirement of "equal treatment" will not prove very reassuring to an operator until we are able to develop detailed safety standards or other means of assuring reasonably uniform interpretations of a general criterion of reactor safety.[41]

The failure of the SOLAS proposals to provide nuclear ship operators with a reasonable degree of advance assurance that their vessels will have access to foreign ports could, of course, be alleviated by the negotiation of formal bilateral agreements between a flag State and all coastal States which each nuclear vessel is likely to visit. This remedy, however, ultimately may prove to be more harmful than the ill. Assuming that a considerable number of nuclear merchant vessels are in eventual prospect, the solution presupposes a world-wide complex of bilateral agreements that will be confusing and perhaps impossible to administer effectively. Moreover, even if we suppose conservatively only one hundred nuclear vessels,[42] the mere negotiation of bilateral agreements can be expected to tax severely governmental and industrial resources of technically qualified personnel.

3. *Avoiding International Controversy.* A third deficiency inherent in the 1960 SOLAS proposals is the absence of effective means for preventing international disputes. Without a yardstick to assure reasonably uniform interpretations of a broad safety criterion, it is inevitable that different nations, and even different

41 When most coastal States have vessels flying their flags and there has been international agreement on detailed ship safety standards, as is the situation for conventional vessels under the SOLAS and Load Line conventions, the concept of equal treatment affords a meaningful degree of assurance to ship operators. Absent either factor, the concept of equal treatment will mean very little. If a State has no comparable vessel of its own, it will remain entirely free to treat foreign vessels arbitrarily. If a State does have comparable vessels flying its flag but detailed ship safety standards are lacking, the leeway of interpretation afforded by a very general criterion of safety will leave it relatively free to act arbitrarily with respect to foreign vessels. See HYDEMAN & BERMAN, *op. cit. supra* note 2, at 366, and discussion *infra*, pp. 249-50.

42 A recent study by a working group of the United States National Academy of Sciences, for example, adopted a premise of 300 nuclear-powered vessels by about 1970. PRITCHARD, and others, CONSIDERATIONS ON THE DISPOSAL OF RADIOACTIVE WASTES FROM NUCLEAR POWERED SHIPS INTO THE MARINE ENVIRONMENT, NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL REPORT at 7 (Pub. No. 658, 1959).

authorities within a nation, will disagree as to what constitutes an "unreasonable radiation or other nuclear hazard."[43] And, even assuming that a flag State and a coastal State come to agreement on the adequacy of a safety assessment and the general reliability of a particular vessel, the possibilities for controversy over safety still are considerable, particularly in the absence of any clarification of the unilateral acts which a coastal State is permitted to take to protect itself. For example, a coastal State may find that a nuclear vessel has not been operated strictly in accordance with the conditions of its safety assessment, but not in a manner that could create a serious risk of a nuclear accident. To what extent would the coastal State be justified in excluding the vessel from territorial waters, or, more troublesome, from contiguous areas of the high seas beyond territorial waters? Not only do the SOLAS proposals fail to incorporate guides which might avoid controversy over such questions, but the proposals, and indeed the 1948 SOLAS Convention itself,[44] fail to provide or suggest means for resolving such disputes.

4. *Solving the Liability Problem.* Finally, the approach of the recently proposed amendments to the 1948 SOLAS Convention clearly is not conducive to a realistic resolution of the problem of legal liability for radiation damage resulting from nuclear ship accidents. As already noted,[45] there was recognition at the Rijeka Conference that governmental indemnities probably would be necessary to supplement the private insurance coverage available. However, it is distinctly possible that a number of small but active maritime nations may be unable to make firm commitments to assume financial responsibility for damages from a nuclear accident in amounts which States are likely to demand as a condition of permitting foreign nuclear ships to enter their ports. This possibility suggests the need for a multi-national indemnification pool and highlights the interrelationship between health and safety controls and a satisfactory resolution of the liability problem. If a pooling of national indemnification commitments is necessary, the acceptability of such an arrangement probably would depend on the existence of means for all of the pooling nations to have at least a sense of participation in approving the design and operating

[43] Note 32 *supra.*
[44] HYDEMAN & BERMAN, *op. cit. supra* note 2, at 345.
[45] Note 14 *supra.*

plans for all vessels covered by the pool.[46] The essentially unilateral approach to the health and safety control of individual nuclear ships adopted in the SOLAS proposals does not provide a framework of control through which nations can acquire this sense of participation in assuring the safety of foreign nuclear vessels.

5. *Conclusion.* It seems clear from the foregoing analysis that the 1960 SOLAS Conference proposals on nuclear ships, and indeed the basic approach which underlies those proposals, are conceptually inadequate for the time when a relatively large number of nuclear ships will be operating.[47] Moreover, the proposals will not create a climate that is likely to encourage the development and construction of nuclear ships. The best that can be said of the SOLAS proposals is that they may not prove to be an immediate impediment during the period when governments are willing to commit funds for the construction of experimental vessels. In addition, of course, by recognizing the need for evaluating the hazards of each ship, as well as the importance of detailed operating manuals and periodic surveys, the proposals do provide a sound technological base for international agreement on a system of control that could prove conceptually adequate.

III. RECOMMENDATIONS

In order to achieve the objectives already described, and at the same time to provide a control system that should prove acceptable to the great majority of nations, we would offer the following outline of a convention on nuclear ship safety.

[46] It is not at all clear that the Rijeka Conference recognized this need. Recommendation II of the Conference states: "In view of the international obligations which it will obviously be necessary for the States to assume under treaty, the Conference also suggests that some form of international machinery should be agreed upon to facilitate and ensure the carrying out of these obligations." Note 8 *supra.* Although this language could be construed to suggest some type of international health and safety control machinery that would facilitate indemnity pooling arrangements, the inference is not easy to draw.

[47] Although no major power recommended a more radical approach to control, it is fairly clear that the Conference went about as far as it could in proposing departures from the strictly traditional approach to ship safety. The Soviet delegate to the Conference, along with others, strenuously objected even to the provision for the exchange of safety assessments that was ultimately adopted. The objection was grounded on the conclusion that requiring such an exchange would seriously hinder the development of nuclear propulsion. The Soviets apparently felt that no exchange of hazards information was necessary. New York Times, June 14, 1960, p. 62, col. 7.

A. *International Evaluation of Nuclear Ships*

Because detailed and precise reactor safety criteria are not now possible, the key element of a reactor control system is the evaluation of the plant against a general criterion of safety. If such a system is to be effective, however, means must be devised which will assure that evaluations are adequate from the standpoint of safety and that they result in a reasonably uniform application and interpretation of the safety criterion. The most effective method of accomplishing these objectives would be to have a convention adopt a safety criterion and require that each commercial, or nonmilitary, nuclear-powered vessel to be registered by a contracting State be evaluated by a permanent international organization designated to undertake that function. The flag State would be free, and perhaps should even be required, to conduct its own concurrent evaluation. In practical effect, the two evaluations could complement and serve as reciprocal checks. Although somewhat unique in concept, this international evaluation mechanism appears to be the only practicable answer to the limitations inherent in a unilateral approach to the problem.

The international evaluation body would be performing a vital service for States that have not developed the skills essential to the evaluation of reactor hazards. It also would provide those States with an independent assessment of the hazards of each nuclear ship. In addition, since such a body is likely to be quite objective about particular nuclear vessels, its determinations should provide all nations with considerable assurance of the safety of other vessels and of the protection of the resources of the marine environment.

Further, evaluation by an international body ought to minimize the potential financial and administrative burdens on those operating nuclear ships. In this context, international evaluation should result in the application of reasonably consistent safety requirements and in limiting to two the number of detailed evaluations likely to be required. Also, since the international body could, and presumably would, conduct its evaluation concurrently with design and construction of a vessel, any necessary changes in the reactor system or hull could be made at a time when modifications remained feasible and least costly. Finally, because of the breadth of experience it would acquire, the evaluation body rapidly should become the repository of a vast amount of information on various techniques of reactor design and fabrication. This con-

centration of knowledge could prove to be a convenient and valuable source of technical assistance to nations interested in the manufacture or purchase of reactors.

Admittedly, evaluation by an international body will involve some risk that particular determinations may, through the individuals who serve on the body, reflect national political considerations. However, such a risk could be minimized if the international body were to employ a full-time staff to evaluate reactors instead of following a regular practice of using consultants who may have less insulation from their respective governments. In any event, since a group judgment is involved, the impact of the views of one or two members acting occasionally on the basis of national political motivations should not be too great.

B. *International Certification of Nuclear Ships*

In addition to evaluating nuclear ships, the international organization should be authorized to issue a safety certificate to a vessel which it has determined complies with the safety criterion and other requirements of the convention. To alleviate the disadvantages which stem from the right of States to exclude vessels arbitrarily from their ports, certification by the international body should create an affirmative obligation on the part of coastal States to permit a vessel to enter. Obviously, a convention provision that certification by the organization would bind contracting States to admit nuclear vessels to ports would afford ship operators the greatest measure of advance assurance. It is doubtful, however, that such a provision would be acceptable to many States. On the other hand, if an international certificate were given *prima facie* force and effect, the operator would be afforded a reasonable degree of assurance without precluding coastal States from exercising independent judgments. This result could be achieved by imposing an obligation on contracting States not to exclude a certificated vessel from ports or territorial seas without first making an affirmative determination that the construction or operation of the vessel failed to conform to the general criterion of safety adopted by the convention. In effect, member States would be agreeing to use the evaluation report prepared by the international body as a yardstick for their own determinations. Thus, while coastal States would not be bound to admit vessels approved by the international body, a determination by a State that a particular vessel did not conform to the safety criterion would, as a practical matter,

have to refute the technical validity of the evaluations made by the international body and the flag State.

The advantage of this approach is that it imposes a heavy moral burden on coastal States to accept ships which have been certificated by the international body without imposing a legal obligation which would render the convention politically unacceptable. It is worth noting also that this approach is more analogous, in effect at least, to the control of conventional vessels under the Load Line and Safety of Life at Sea conventions than is the approach to the control of nuclear ships taken by the 1960 SOLAS Conference. An international evaluation report would provide States with the kind of objective, detailed specifications for assessing the safety of a nuclear vessel that the Load Line and Safety of Life at Sea conventions provide through precise safety standards.

C. *Agreement on Rights and Obligations*

Certainly if a convention is to adopt this positive approach of imposing a *prima facie* obligation on coastal States to admit nuclear vessels holding an international certificate, it should clarify, and in some respects expand, the rights of those States to take acts necessary to protect their interests.

Requiring a coastal State to make an affirmative determination before excluding a nuclear vessel presupposes that State's right to inspect the vessel at some time prior to a proposed entry. The potential magnitude of impact of a major nuclear accident suggests the necessity of authorizing coastal States to conduct their inspections at some point more distant than just outside ports, as well as the desirability of specifying the right of coastal States to inspect nuclear vessels traversing territorial seas without the intention of entering adjacent ports. Consequently, a convention should give contracting States a right to require prior notice from nuclear vessels intending to enter territorial waters and should authorize such States to inspect at the time the vessel enters the territorial sea. While providing for inspection at greater distances from shore would afford coastal States even more assurance of safety, the inconvenience probably is not warranted in the case of vessels that have been certificated by an international evaluation body.

In addition to desiring to inspect nuclear ships at a considerable distance from their shores, it is quite conceivable that contracting States may not want to open all of their ports to foreign nuclear vessels until more operating experience has been acquired. In

recognition of this, the convention should permit contracting States to close some of their ports to all foreign nuclear ships. So long as the closed ports are specified at the time a State ratifies the convention, foreign nuclear ship operators could plan accordingly. However, if the over-all purpose and spirit of such a convention is to be achieved, this closure of individual ports to all foreign nuclear vessels would have to be consistent with a general obligation on each contracting State to open a reasonable number of its ports to certificated nuclear vessels.

It also is possible that contracting States may need temporarily to close ports or territorial seas to all nuclear ships because of special hazardous circumstances. For example, the impending arrival of a tidal wave would justify a coastal State in excluding all nuclear vessels from any ports likely to be affected. A convention would have to give contracting States a right to take reasonable acts of this nature under emergency circumstances.

As we have seen, international law is not entirely clear with respect to the rights of vessels in distress when the condition of distress could constitute a risk to the safety of the coastal State. Generally, vessels in distress have a right of free access to the ports of foreign States. Although the humanitarian rationale for this rule would seem to afford equal justification for the exercise of reasonable control by a coastal State over a vessel in distress that seeks access to one of its ports, the kinds of control that a State can exercise under these circumstances are anything but well defined.[48] When viewed in a context of the potential hazards of nuclear ships, this lack of clarity suggests the desirability of a specific provision in the convention granting States the right to deny entry to nuclear vessels in distress upon an affirmative determination by the State that the risk to its interests would outweigh the risk to the vessel and the cargo and persons abroad. Of course, the State should have an obligation to take all reasonable steps to alleviate the adverse impact on any vessel so excluded.

Finally, a convention might also clarify the rights of coastal States with respect to nuclear vessels that either have not been certificated by the international organization, or whose certificates have been suspended, revoked, or not renewed as required. Manifestly, such vessels deserve little consideration from the community of nations. Consequently, it would not be inappropriate, because

[48] See HYDEMAN & BERMAN, *op. cit. supra* note 2, at 153, and materials cited therein.

of the range at which reactor accidents can cause harmful effects, to give each State a right to exercise jurisdiction and control over, and to prohibit the operation of, any uncertificated vessel at as great a distance from its coast as the State deems necessary to protect persons and property within its territory.

D. *Agreement on the Mechanisms of Control*

1. *Regulations.* In addition to establishing a system of international evaluation and certification, and clarifying various rights and obligations of nuclear vessels and coastal States, a convention also should impose an affirmative obligation on flag States to maintain adequate controls over the nuclear vessels which they register. A general obligation of this nature should, of course, be reinforced by such detailed safety requirements as are possible with respect to the construction, operation, and navigation of nuclear ships. Although nuclear ship technology has not yet reached a stage at which the development of precise safety criteria is possible, greater standardization and more experience will facilitate the development of increasingly detailed standards. As this occurs, it will become ever more important that there be a stimulus for national adoption of internationally prescribed regulations. And, if the regulations are to be maintained reasonably current, uniform, and of a calibre that will give the greatest possible protection to all nations, means also must be devised to facilitate their amendment and to assure the greatest possible degree of national conformity to such amendments.

Experience has proved that these goals will not be achieved unless the parties to an international convention are required to take affirmative steps in order not to be bound by new or amended regulations. It is clear also that the needs of an era of rapid technological development cannot be met by convening diplomatic conferences at widely separated intervals of time in order to develop appropriate regulatory amendments. Thus, a convention on the safety of nuclear ships should authorize a permanent international organization to recommend safety regulations which would be binding on all contracting States that fail to take an affirmative exception within a specified period of time. In addition, because the hazards of nuclear-powered ships are considerable, regulations or amendments determined to be of particular significance from the standpoint of safety should be made binding on all contracting States once they become binding on a majority of those States. A

number of existing conventions incorporate these kinds of provisions for encouraging the adoption and assuring the harmonization of national regulations that have international impact.[49]

Of course, some regulatory aspects of nuclear ship control are, and will remain, inherently incapable of standardization. For example, variations in local traffic conditions and port characteristics would make it unrealistic to attempt to prescribe uniform speed limits and docking or mooring requirements. Such matters must be left to local authorities. A convention, however, could minimize the burden of special requirements by specifically delimiting the matters which are within the discretion of local authorities and by requiring that local rules be made currently available to all contracting States.

2. *Inspection and Enforcement.* Because the consequences of a serious reactor accident could be disastrous, a convention on nuclear ship safety should incorporate every practicable means for assuring that contracting States comply with their obligation to maintain continuing control over flag vessels. This suggests a need for a system of independent inspection of individual ships, as well as for penalties which can be imposed on States that have not fulfilled their commitments.

Under the foregoing recommendations, coastal States that are parties to the convention would have a right to inspect certificated nuclear vessels just prior to their entry into the State's territorial sea. This right of inspection might include monitoring radiation levels, physical inspection of the reactor plant, and examination of logs or other operating records. If coastal States are required to conduct inspections in accordance with an international inspection manual, and to report infractions of the convention's rules to an international body, there would be a frequent check, by independent experts, on the safety of individual nuclear vessels. Add to this a requirement of a periodic survey of such vessels and their operating records by the international evaluation group, and ample means probably would exist for determining whether flag States and vessel operators are complying with their obligations under the convention.

To the extent that noncompliance is disclosed, the international body, as a minimum, should be authorized to suspend or revoke its safety certificates. In addition, sanctions should be avail-

[49] *Id.* at 317-25.

able for imposition against a flag State, as contrasted with a vessel owner,[50] if the investigation of an infraction discloses that the State itself has been delinquent in controlling a ship bearing its registry. Certainly a suspension of the right of a flag State to have any of its nuclear flag ships treated as being properly certificated would neither be unreasonable nor unprecedented.[51] In addition, consideration should be given to the advisability of more stringent sanctions such as imposing embargoes on atomic energy materials, technical information, and research assistance to defaulting States. Naturally, special procedures, such as a vote of two-thirds of the contracting States, would have to be devised for purposes of determining when to impose particular sanctions.

Consideration might also be given to the need for the imposition of sanctions on noncontracting States whose flag vessels fail to meet international standards. The right to impose sanctions on noncontracting governments is warranted when failure to conform to international codes of conduct could jeopardize the interests of the whole community of nations. Such an extension of sanctions beyond contracting parties also is supported by precedent.[52]

3. *Resolution of Disputes.* Finally, a convention should provide a mechanism for the resolution of disputes in the absence of agreement by the parties to an alternative means of settlement. Even if the recommended clarifications of rights and obligations are adopted, disputes probably will arise. For example, nations may disagree as to whether particular circumstances afforded ample justification for the temporary closure of a port to nuclear vessels, or whether the exclusion of a particular vessel in distress was reasonable under the circumstances. Since such disputes are more likely to involve complex scientific and technical issues than strictly legal questions, it may be appropriate to consider the advisability of establishing a special panel of experts to render arbitration services.[53] A permanent arbitration panel could be established by

[50] It would seem reasonably clear that, aside from the revocation or suspension of a ship's certificate, States would resist direct punitive action by an international organization against the operator of a vessel.

[51] *E.g.*, Convention on International Civil Aviation, December 7, 1944, 61 Stat. 1180, T.I.A.S. No. 1591, 15 U.N.T.S. 295, Art. 88.

[52] Convention for Limiting the Manufacture and Regulating the Distribution of Narcotic Drugs (1931), July 13, 1931, 48 Stat. 1543, T.S. No. 863, 139 L.N.T.S. 301, Art. 14; International Opium Convention (1925), Feb. 19, 1925, 81 L.N.T.S. 317, Art. 24; CHARTER OF THE UNITED NATIONS, Arts. 41-42.

[53] The other alternative would be to provide for the submission of disputes to the International Court of Justice. However, difficulties caused by existing reservations to the

the convention, or provision could be made whereby the executive body of an appropriate international organization could appoint expert panels to deal with particular disputes.

E. *Organizational Responsibility for Administering the Control System*

The designation of an international organization to administer the provisions of a convention on nuclear ships is another matter that must be settled. Controlling nuclear ships clearly is a problem which calls for global agreement. Regional organizations may have appropriate roles of a supplemental character, but effective control would seem to require that an international body of world scope assume primary responsibility. Two existing organizations of global scope encompass talents and experience particularly pertinent to the controls that are necessary. One is the Intergovernmental Maritime Consultative Organization (IMCO) which came into being in 1958[54] to take consultative and advisory cognizance over matters of maritime safety.[55] The other is the International Atomic Energy Agency (IAEA). The Statute of the IAEA authorizes the Agency to adopt "standards of safety for protection of health and minimization of danger to life and property . . ."[56] in the field of atomic energy. The relationship agreement between the Agency and the United Nations recognizes the IAEA "as the agency . . . responsible for international activities concerned with the peaceful uses of atomic energy."[57] Thus, the charters of both organizations provide some justification for each to claim primary responsibility for the control of nuclear ships. However, it is the radiation hazard that supplies the justification for the special controls recommended, and the United Nations relationship agreement with the IAEA does seems to recognize the Agency's primacy in matters of nuclear safety.

In addition, there are several practical reasons for reposing primary responsibility in the IAEA. The most cogent of these

jurisdiction of the Court, and the possibility of delays resulting from the Court's having to cope with complex technical matters, do not commend this choice. For a more detailed discussion of this alternative, see HYDEMAN & BERMAN, *op. cit. supra* note 2, at 340-41.

[54] Convention of the Intergovernmental Maritime Consultative Organization, March 6, 1948, T.I.A.S. 4044.

[55] *Id.*, Art. 1 (a).

[56] STATUTE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY, Art. III, para. A, 6.

[57] U.N. Doc. No. A/3620, Art. I (1) (1957), adopted by the United Nations on Nov. 14, 1957, U.N. GEN. ASS. OFF. REC., 12th Sess., Annexes, 2 (1957).

stems from the need for an international body to establish a full-time staff to evaluate the safety of ship reactors. The IAEA has begun to gather a staff of experts in the field of reactor safety and already has developed some experience in evaluating land-based reactors. This same staff could, with a limited amount of assistance from individuals expert in general matters of ship safety, perform the identical function in connection with nuclear ships. The converse, however, is not true; the ship safety experts of IMCO would need considerable assistance from a variety of nuclear experts in order to evaluate reactor hazards effectively. Because the number of individuals who are qualified and willing to undertake this task is small, any assignment of responsibility which would require the establishment of an additional reactor safety group at the international level should be avoided.

The Agency's present activities in two other closely related areas also suggest the desirability of giving it primary responsibility for developing and administering a convention on the international control of nuclear ships. The international community already has assigned responsibility with respect to the sea disposal of radioactive wastes to the IAEA.[58] Since the disposal of atomic wastes from nuclear-powered ships is likely to constitute a significant segment of sea disposal activities, it will be desirable to harmonize the systems ultimately adopted for controlling nuclear vessels and the dumping of radioactive wastes at sea. The IAEA also has indicated its intention to consider the problem of the liability of nuclear ship operators.[59] As we have seen, a close correlation of solutions to the liability and health and safety control problems may be essential.[60] Obviously, the most effective coordination of these interrelated problems can be achieved if primary responsibility is vested in a single competent body.

In final analysis, an effective system for controlling the hazards of nuclear ships will require the talents of both IMCO and the IAEA; therefore, no matter where primary responsibility is reposed, cooperation between the two will be essential.

[58] Resolution on Pollution of the High Seas by Radioactive Materials, U.N. Doc. No. A/CONF.13/L.53 (1958).

[59] Statement by the Director General of the IAEA at the opening of the Agency's third General Conference on Sept. 22, 1959, reported in Bureau of National Affairs, Atomic Industry Reporter, News and Analysis 5:319 (1959).

[60] See discussion *supra*, p. 246.

IV. CONCLUSIONS

This outline of a convention for the multinational control of nuclear ships[61] admittedly constitutes a significant departure from the traditional pattern of maritime safety conventions. However, precedents, or very close analogies, for most of the recommended elements of control can be found in existing multinational agreements.[62] Thus, the recommended approach is not so unique, at least in a general context of international accord, as it might at first appear. To the extent that such a control system does represent a departure from tradition in the field of maritime safety or in international law, it may be sufficient to observe that there is nothing traditional about the hazards of atomic energy and that problems of new magnitude frequently demand novel solutions.

Just when such a convention on the safety of nuclear ships will become essential, rather than merely desirable, is not susceptible of precise delimitation. There are, however, factors which indicate the advisability of beginning to consider the long-range requirements promptly. First, although there exists at present a general atmosphere of pessimism about the early achievement of economically competitive nuclear ships, technological progress frequently exceeds expectations. Adequate health and safety controls should precede any significant growth in the number of nuclear ships. Second, achieving agreement between nations depends very considerably on the ease with which national interests can be reconciled. Efforts to achieve accord, therefore, should be made before national adherence to a unilateral concept of control becomes too fixed. Third, the process of achieving international accord, particularly when agreement involves a significant departure from tradition, may require a considerable period of time. Certainly a lapse of ten years for the development and ratification of a convention of the type necessary is not beyond the realm of possibility.[63] Finally, early agreement on the type of convention out-

[61] A more detailed description of such a convention is set forth in HYDEMAN & BERMAN, *op. cit. supra* note 2, at 363-73 .

[62] *Id.* at 316-45. Although the concept of evaluation by an international body is the element of control which finds the least support in precedent, even that is merely another means, necessitated by the present state and complexity of reactor technology, for achieving the well-accepted goal of protecting public health through international agreement on standards of safety. See discussion *supra,* pp. 249-50.

[63] It is interesting to note that the Convention of the Intergovernmental Maritime Consultative Organization, *supra* note 54, was signed in March 1948 and did not enter into force until March 1958. For a description of the halting steps toward ratification, see REIFF, THE UNITED STATES AND THE TREATY LAW OF THE SEA 220-22 (1959).

lined may be a prerequisite to any substantial development of commercial nuclear ships. Therefore, to encourage the development and use of nuclear-powered vessels for peaceful purposes, we should begin promptly to plan more adequately for the future.