Michigan Journal of International Law

Volume 9 | Issue 1

1988

Cherobyl: Its Implications for International Aromic Energy Regulation

Diana K. Brown
University of Michigan Law School

Chernobyl: Its Implications for International Atomic Energy Regulation

Diana K. Brown*

INTRODUCTION

Nuclear power currently supplies over 15% of the world's electricity.[1] The International Atomic Energy Agency (IAEA or Agency) predicts that by 1990 more than 500 nuclear power plants, operating in 35 countries, will generate 20% of all electricity.[2] Nuclear power is primarily regulated by national agencies;[3] each country sets its own safety and technical standards and each must undertake the research and development necessary to insure a safe nuclear program. The

*Member of the class of 1988, University of Michigan Law School.

1. IAEA Press Release, PR/87/4 (January 27, 1987).

2. Blix, *The Post-Chernobyl Outlook For Nuclear Power,* 28:3 IAEA BULL. 11 (Autumn, 1986). 397 nuclear power plants were operating in 26 countries and an estimated 133 were under construction by the end of 1986. 29:2 IAEA BULL. 65 (1987).

3. Individual countries are legally responsible for their nuclear power programs. U.S. GEN. ACCTG. OFF., INTERNATIONAL RESPONSE TO NUCLEAR POWER REACTOR SAFETY CONCERNS (GAO/NSIAD–85–128) at 4 (Sept. 30, 1985) [hereinafter cited as GAO, INTERNATIONAL RESPONSE]. *See generally* Rosen, *Establishment of an International Nuclear Safety Body,* 25:3 IAEA BULL. (Sept., 1983).

James K. Asselstine, Commissioner, U.S. Nuclear Regulatory Agency, explained the significance of ineffective national regulation in testimony before the House Subcommittee on Energy Conservation and Power:

> The bottom line is that, given the present level of safety being achieved by the operating nuclear powerplants in this country, we can expect to see a core meltdown accident within the next 20 years, and it is possible that such an accident could result in offsite releases of radiation which are as large as, or larger than, the releases estimated to have occured at Chernobyl.

NUCLEAR REACTOR SAFETY, HEARINGS BEFORE THE SUBCOMM. ON ENERGY CONSERVATION AND POWER OF THE HOUSE COMM. ON ENERGY AND COMMERCE, 99th Cong., 2d Sess. 38 (May 22 & July 16, 1986) [hereinafter cited as NUCLEAR REACTOR SAFETY HEARINGS]. "[T]he Commission acknowledged that the risk of a core meltdown in the next 20 years at a U.S. plant was between 12 and 45 percent, although, allowing for significant uncertainties, the true figure could be higher." *Id.* at 115 (statement of Rep. Markey, Subcomm. chairman).

lack of international regulation of nuclear energy results in a fragmented system which is duplicative and dangerous, as countries with less effective research and development produce less reliable nuclear power plants;[4] furthermore, this nationalistic approach to nuclear safety ignores the transboundary effects of radiation.[5] The magnitude of the risks of nuclear power necessitates reliable international safety regulation.

Nuclear power plant accidents, such as at Three Mile Island (TMI)[6] and its

4.

> National approaches to nuclear safety developed over the years have resulted not only in differences in regulations, but also in variations in technical requirements from one country to another. This has been a burden for the international nuclear market, and it has possibly had an effect on the level of public confidence.

Rosen, *supra* note 3, at 3.

5. In countries of the Organization for Economic Co-operation and Development, for example, every fourth reactor is within 40 kilometers of an international border. *Panel,* I CURRENT NUCLEAR POWER PLANT SAFETY ISSUES 474 (1981).

6. Prior to Chernobyl, the most serious nuclear accident occurred at Unit 2 of the Three Mile Island Nuclear Power Station on March 28, 1979.

The accident at Three Mile Island began with a combination of malfunctions that led to the stoppage of the flow of feedwater to the reactor's steam generators. As the primary system's pressure rose, a relief valve, which had opened to reduce the pressure, stuck open undetected for approximately 150 minutes. The resulting loss of coolant and decrease in pressure caused a buildup of steam in the reactor vessel allowing the core temperature to rise and the fuel cladding to fail. Ireland, Scott & Stratton, *Three Mile Island and Multiple Failure Accidents,* 2:2 LOS ALAMOS SCIENCE 74, 75 (Summer/Fall, 1981).

Several other incidents have mirrored the beginning stages of the accident at TMI. On June 9, 1986 a pressurized-water reactor at Davis-Besse in Ohio had an accident which "mimicked closely the first few minutes of the disaster at its sister plant [TMI] in 1979." The reactor was without feedwater to remove heat for 12 minutes. When deprived of coolant, a reactor's core can melt as at TMI. The incident was a repeat performance for Davis-Besse; between 1977 and 1979, 20 incidents at the plant involved the partial or complete loss of feedwater. The loss of feedwater, one of the principal characteristics of the TMI accident, was not the only parallel between the June 9 accident and TMI. A relief valve stuck at Davis-Besse for about a minute before operators noticed the resultant drop in pressure and took emergency measures. *Nuclear Accident Mimics Three Mile Island,* NEW SCIENTIST 21 (July 11, 1985).

An incident at England's Heysham 1 nuclear power station resembled TMI in other ways. Although fuel had not yet been loaded into the reactor, the incident revealed serious safety problems at the plant. "The post mortem on that accident [TMI] . . . laid most of the blame for the ensuing chaos on bad layout in the control room, confusing alarm systems and poorly trained operators. Embarassingly for the board [Central Electricity Generating Board], most of these elements were present in the Heysham incident." Milne, *Mistakes That Mirrored Three Mile Island,* NEW SCIENTIST, Nov. 1985.

"The equipment operated better than the people. If they'd left the plant [TMI] alone, it appears that the accident probably never would have happened. . . ." R. Bacher, *quoted in Comments on Reactor Safety From Leaders of the Manhattan Project,* LOS ALAMOS SCIENCE at 2.

The accident at Chernobyl, too, was caused largely by inept and poorly trained operators, *see infra* note 9. Overworked operators may also pose a serious safety risk. Recently, one United States power plant operator was found to have worked 97 hours in a seven day period. Wald, *Weaknesses in Nuclear Regulatory Program Cited,* N.Y. Times, July 17, 1986, at B5, col. 1.

many precursors,[7] were relatively ineffective at bringing attention to the true dangers of nuclear energy and at spurring world-wide demand for improved power plant safety. Although TMI was analyzed by special sessions of the IAEA[8] and some safety improvements were made, the international nuclear community soon regained its confidence.

The April 26, 1986 accident at Chernobyl[9] resurrected the demand for im-

7. For example, in 1957, radioactive fission products were released in a major accident at the Windscale plant in Liverpool, England; in 1961 an explosion occurred in a reactor at Idaho Falls in the United States, and in 1966 a partial core meltdown occurred at the Enrico Fermi reactor in Detroit, Michigan. Petrosyants, *The Soviet Union and the Development of Nuclear Power*, 28:3 IAEA BULL. 7 (Autumn, 1986). A. Petrosyants, Chairman of the Soviet State Committee on the Utilization of Atomic Energy, reports that between 1971 and 1985, 151 incidents occurred in the nuclear power plants of 14 countries, other than the U.S. and the U.S.S.R. *Id.* A recently declassified GAO study, INTERNATIONAL RESPONSE TO NUCLEAR POWER REACTOR SAFETY CONCERNS, mentions the 151 incident figure, although the publicized version does not contain details. *See* GAO, INTERNATIONAL RESPONSE, *supra* note 3, at 10. *See also* NUCLEAR REACTOR SAFETY HEARINGS, *supra* note 3, at 3; Franklin, *Report Finds Potential Problems With Atom Plants in 14 Nations*, N.Y.Times, May 1, 1986, at A14, col. 5.

8. TMI spawned a series of IAEA emergency meetings. The areas of occupational safety and human fallibility received intensive study. Post-accident study of TMI revealed the need for a man-machine interface and for emergency preparedness. Rosen, *Recent Nuclear Safety Activities at the IAEA*, 24:1 IAEA BULL. 8 (March, 1982).

9. Since the April 26, 1986 accident, the sequence of events leading to the accident at Chernobyl 4 has been largely reconstructed. The basic cause of the accident was that, in their determination to conduct an unauthorized experiment, operators violated operating rules and overrode protection systems. For a technical breakdown of the events culminating in the accident see *Accident Event Sequence*, NUCLEAR ENGINEERING INT'L, Oct. 1986, at 4.

Soviet engineers have, since the accident, admitted to reactor design defects and to problems with systems analysis and operator training. Wilkie, *Soviet Engineers Admit Failings in Reactor Designs*, NEW SCIENTIST, Aug. 28, 1986, at 14. The Soviet Union, however, still plans to expand its reliance on nuclear power from 11% to 50% of all electricity needs. Broad, *Rise in Retarded Children Predicted from Chernobyl*, N.Y.Times, Feb. 16, 1987, at A9, col 1.

Chernobyl caused the evacuation of 135,000 people from a 30 kilometer exclusion zone around the plant and, based on figures from a Soviet report, may cause up to 24,000 deaths in the European part of the Soviet Union. This figure does not estimate deaths beyond Soviet borders. *Counting the Human Costs*, NUCLEAR ENGINEERING INT'L, Oct. 1986, at 8. Hans Blix, Director General of the IAEA, reported on January 19, 1987 that people may now resettle up to within 10 kilometers of the plant. *USSR–IAEA Co-operation Reinforced*, 29:1 IAEA BULL. 51 (1987).

Total estimated damages from Chernobyl are impossible to compute, however, US Secretary of Energy John Herrington has stated that the accident has cost countries hundreds of millions of dollars. *IAEA Adopts Safety Conventions*, NUCLEAR ENGINEERING INT'L, Nov. 1986, at 4. Another estimate claims that Chernobyl cost the Soviet Union more than $3 billion. Hudson and Roth, *Lingering Fallout, A Year Later, Mishap at Chernobyl Damps Atom-Power Industry*, Wall St. J., April 23, 1987, at 1, col. 1.

The accident at Chernobyl has raised several key safety isues. Operator training and reactor design are among the most critical. American power plant operators contend that a Chernobyl-type accident is not possible in the United States because U.S. commercial reactors have outer containment and are not moderated by graphite. *See, e.g.*, May, *Disaster in Soviet Affects Shoreham*, N.Y.Times, May 1, 1986, at A14, col. 1; Boffey, *Soviet, Reporting Atom Plant "Disaster," Seeks Help Abroad to Fight Reactor Fire: Assessment of U.S.*, N.Y.Times, April 30, 1986, at A1, col. 3.

proved safety at nuclear power plants. Chernobyl focused debate on internationally mandated safety standards, the proper role of the IAEA, emergency response systems, and liability standards for nuclear accidents. Most important, Chernobyl changed the political climate of the nuclear states. Countries, sufficiently alarmed by the realities of nuclear disasters that Chernobyl so dramatically illustrated, are now less resistant to cooperating in nuclear matters and are more receptive to reworking and improving international nuclear law.

The process of reform began after Chernobyl. Following an overture by Mikhail Gorbachev, the International Atomic Energy Agency approved two conventions on nuclear safety. These beginnings, however, are insufficient. More widespread change is required, and, given the post-Chernobyl political climate, possible. Nuclear safety demands the obligatory reporting of all commercial nuclear incidents and the establishment of mandatory base-level safety standards.

The first section of this note focuses on the IAEA's role in the existing network of international organizations designed to improve nuclear power plant safety. The second section examines the implications of the Chernobyl accident for international cooperation in the nuclear field. The final section proposes several improvements for nuclear safety management, and is subdivided accordingly. The first subsection analyzes the incident reporting systems of the IAEA and the Nuclear Energy Agency and recommends amending the IAEA Convention on Early Notification of a Nuclear Accident to ensure that all nuclear incidents, as well as accidents, are covered by its terms. The second subsection proposes the standardization of safety requirements for nuclear power plants.

I. Current International Regulation

The long-recognized need for international cooperation in the nuclear field has led to various bilateral[10] and multilateral agreements and to the creation of several international agencies.[11] The United Nation's International Atomic Energy

---

Documents obtained by the subcommittee show that the Administration had a knee-jerk reaction to the Soviet meltdown. Internal briefing memoranda reveal their primary concern was not to investigate the possibility of such an accident occurring in a U.S. nuclear plant, but rather to make blanket statements as to why they believed a serious accident could not happen in this country.

Nuclear Reactor Safety Hearings, *supra* note 3, at 3. *But see infra* note 26.

10. The United States had established, as of June 1984, 21 bilateral safety arrangements. *See* GAO, International Response, *supra* note 3, at 19.

11. Many countries now conduct joint research on nuclear power and share individual developments with other nations. The first joint nuclear project was the Dutch–Norwegian reactor, completed in 1951, at Kjeller Center. Other international agreements include the Nuclear Energy Agency, EURATOM, and the International Atomic Energy Agency. B. Goldschmidt, *International Cooperation in the Nuclear Field*, in Nuclear Energy : A Sensible Alternative 181 (K. Ott and B. Spinrad ed. 1985).

Agency is, with 113 member states,[12] the largest and most influential such agency.

The IAEA came into legal existence on July 29, 1957, with the main purposes of furthering peaceful uses of nuclear energy[13] and limiting the proliferation of nuclear weapons.[14] The Agency facilitates the international exchange of information on nuclear matters, develops internationally recommended safety standards, and fosters training of nuclear personnel. The Agency summarizes its objectives in improving safety as: "(a) The establishment of a coherent and comprehensive set of Safety Codes and Guides based on international consensus; (b) Missions and expert assignments; (c) The dissemination of technical information; (d) Training in the field of nuclear safety and regulation; and (e) Nuclear emergency assistance."[15]

Although the IAEA has issued a myriad of safety standards and guides, it lacks the power to insure their adoption. Only when a member state requests technical assistance can the Agency insist that some, but not all, of its recommended standards be implemented.[16]

Perhaps the most important safety information compiled by the IAEA is con-

12. IAEA Information Circular, INFCIRC/2/Rev. 36, Sept. 1986.

13. D. Caulfield, THE INTERNATIONAL ATOMIC ENERGY AGENCY AND ITS RELATIONSHIP TO THE UNITED NATIONS 2 (1959), inaug. diss. Cologne.

14. The safeguard system of the IAEA is one of the Agency's principal functions, one without which the Agency might not have been formed.

> As used in the Statute and as restricted by established practice to the external controls implemented by the Agency, the term "safeguards" means the measures taken by the Agency to prevent: (A) Additional States from achieving a military nuclear capability ("proliferation") by the misuse of assistance rendered to them by the Agency for peaceful purposes; (B) Proliferation by the misuse of certain other international transfers; (C) The increase in the nuclear military resources of any State (i.e., whether or not a nuclear power) through the use of nuclear materials produced under Agency safeguards; (D) The use for military purposes of nuclear items submitted to Agency control, which might otherwise either lead to proliferation or to the increase in the nuclear military resources of any State.

P. SZASZ, THE LAW AND PRACTICES OF THE INTERNATIONAL ATOMIC ENERGY AGENCY 533, (Int'l Atomic Energy Agency Legal Series No. 7, 1970). For a more detailed analysis of the safeguard functions of the IAEA *see generally Id.* at chapter 21.

15. IAEA SERVICES AND ASSISTANCE IN NUCLEAR POWER PLANT SAFETY, 1983, at 2.

16. Article III, section 6 of the IAEA Statute provides that the Agency shall set standards for its own practices and "provide for the application of these standards to . . . operations making use of materials, services, equipment, facilities, and information made available by the Agency. . . ."

> Aside from safeguards, the only regulations explicilty mentioned in the Statute are the "standards for protection of health and minimization of danger to life and property . . ." referred to in Article III.A.6. However, these can be made binding on Member States only through Project Agreements (Article XI.F.4(b) and XII.A.2), or on the basis of requests, by the States concerned. . . .

SZASZ, *supra* note 14, at 330.

tained in the Nuclear Safety Standards (NUSS) documents.[17] Instituted in 1974, the Agency's NUSS program establishes codes of practice for the regulation, siting, design, safety, and quality assurance of nuclear power plants. NUSS documents represent the "technical consensus among the developers, experts, and users of nuclear power —— a common understanding for safety."[18] However, many experts are unaware of the NUSS documents.[19] The NUSS standards are, therefore, insufficient.[20]

Although no plans were initially made to formalize the NUSS documents through a convention mandating their use, suggestions for mandatory safety standards have been made in recent years.[21] Currently NUSS documents are mere suggestions to states already involved with or contemplating the construction or operation of nuclear power plants. Although the Agency attempts to increase NUSS acceptance through missions of experts,[22] its teams are somewhat misdirected, for a state must request Agency assistance before a team will be sent, and members seeking Agency help are those most likely to follow IAEA recommendations without Agency experts.[23] Thus, states with established nuclear pro-

17. In addition to the IAEA's NUSS program, the International Organization for Standardization (ISO), through its Technical Committee 85 "Nuclear Energy" program, strives for world-wide standardization in the nuclear field. Becker, *ISO: International Standards Development for Nuclear Technology,* II CURRENT NUCLEAR POWER PLANT SAFETY ISSUES 266 (1981). The ISO, formed in 1946, is comprised of the partly governmental, partly non-governmental national standards agencies of 86 countries. *Id.* at 261. Unlike the IAEA's NUSS standards, which primarily address regulatory bodies, ISO concentrates on technical standards for industrial and contractual purposes, as well as standardized procedures, designs, materials, test methods, and terminology. *Id.* at 272. The ISO and the IAEA cooperate to avoid duplicative and inconsistent results. *Id.* at 273.

18. Rosen, *supra* note 8, at 8.

19. Andreas, staff member, Nuclear Safety Section of the IAEA's Division of Nuclear Safety, *Practical Experience in Nuclear Safety,* IAEA BULL. SUPPLEMENT, 1982, at 17.

20. While the IAEA strives to disseminate NUSS standards and other technological information widely, there is an overwhelming amount of data available. A more thorough discussion and publication of such recommendations might result in more receptive attitudes toward them. Public opinion within states could be useful in achieving the adoption of NUSS standards.

21. The Soviet Union has encouraged the use of international standards. *Soviets Propose New Regime,* NUCLEAR ENGINEERING INT'L, Nov. 1986, at 5. H. Blix briefly discusses the possibility of internationally binding minimum safety regulations in Blix, *supra* note 2, at 11. An IAEA working group was organized to meet in November, 1986 to discuss the implications of mandatory safety regulations. Rosen, *New Directions in Nuclear Safety,* 28:3 IAEA BULL. 14 (Autumn, 1986).

22. The IAEA sends out such teams, called Operational Safety Review Teams, or OSART, at the request of Member States. Governments may wish to have such international verification of the safety of nuclear power plants on their territories, in order to satisfy both internal opinion and neighboring countries." Blix, *supra* note 2, at 11–12.

OSART teams, composed of 10–15 experts, travel to a plant site for a two to three week review of the plant. The goal of an OSART mission is to compare the plant's safety practices with internationally successful practices and to exchange ideas. Rosen, *supra* note 21, at 13.

23. Most states requesting IAEA assistance are lesser developed countries. Milne, *The Show Goes On,* NEW SCIENTIST, Sept. 4, 1986, at 19. The IAEA has sent review teams to only nine countries,

grams are likely to continue without input from Agency teams, even though they may not be operating safe reactors,[24] while countries developing nuclear power will be inundated with Agency information.

The IAEA is not limited to developing safety standards; the Agency provides numerous other valuable services for the international nuclear community. The Agency conducts research on safety and waste disposal techniques, pools information, eases the transfer of technology, and provides a forum for international communication on nuclear issues.

The IAEA has recently expanded its role in maintaining and improving the safety of nuclear power plants world-wide.[25] However, the current network of international regulation is inadequate as only a limited number of countries comply with IAEA standards.

II. Chernobyl and its Effects

The Chernobyl accident demonstrated the immediate need for safety improvements at nuclear power plants, and corrective efforts have been made at both national[26] and international levels. Internationally, the political climate remains

mostly in the Third World. Such countries, in the process of establishing nuclear power programs, seem more likely to adopt IAEA safety standards in an attempt to legitimize their programs.

Developing countries, according to IAEA officials, lack the trained personnel to draft individual nuclear safety regulations and to implement such standards. *See* GAO, International Response, *supra* note 3, at 4.

In 1984, 10 of the 25 countries operating nuclear power plants were developing countries. Mexico, Cuba, Rumania, Poland, and the Phillipines are now constructing nuclear reactors for the first time. According to IAEA projections, by the year 2000, just over one half of the countries with nuclear power plants will be developing countries. *Id.* at 2.

24.

> Western experts on nuclear technology asserted . . . that the Soviet Union had the worst safety planning of any nation, even worse than that in developing countries and the rest of the Soviet bloc. . . . "In order of safety, one would put the Germans first, the Americans in the middle and the Russians at the bottom."

Diamond, *Western Experts Say Soviet Has Worst Nuclear Safety,* N.Y.Times, May 1, 1986, at A 12, col. 1.

25. The IAEA provides technical information to member states through meetings and publications, advisory services, the Technical Co-operation Programme for lesser developed countries, and the development of internationally recommended safety standards. Rosen, *supra* note 8, at 8–9.

26. In the United States, for example, the closing of the Hanford Nuclear Facility in Washington state was a response to the Chernobyl accident. The accident at Chernobyl cast doubt on the reliability and safety of graphite-moderated reactors. Two reactors in the United States, the Fort St. Vrain reactor and the Hanford N reactor are graphite-moderated. *Chernobyl Casts a Shadow,* Nuclear Engineering Int'l., June 1986, at 2. The Hanford N reactor has been shut down, and $50 million of repair work was begun in January, 1987. *Plutonium Plant is Restarted,* N.Y.Times, Feb. 24, 1987, at A20, col. 1. For a comparison between the Hanford N Reactor and the Chernobyl reactor *see* Nuclear Safety: Comparison of DOE's Hanford N-Reactor With the Chernobyl Reactor, GAO/RCED–86–213BR (Aug. 1986). Chernobyl also demonstrated the dangers of plants

good for revising nuclear law. A now disconcerted public has increased its pressure on officials,[27] and governments themselves seem much more willing to cooperate with each other.

The IAEA held a series of emergency meetings after Chernobyl and drafted the two conventions that it presented to the Agency's Board of Governors on September 24, 1986.[28] The Agency adopted both the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and, as of November, 1986, 57 countries had signed both documents. Both Conventions enter into force 30 days after three states have consented to be bound by them.[29] Norway, Czechoslovakia, and Denmark signed the early notification convention with binding effect on October 27, 1986.[30] The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency entered into force on February 26, 1987.[31]

---

without containment structures. Five United States plutonium producing facilities operate without outer containment: four at the Savannah River Plant near Aiken, South Carolina, and one at the Hanford Reservation in Washington. NUCLEAR ENERGY, A COMPENDIUM OF RELEVANT GAO PRODUCTS ON REGULATION, HEALTH, AND SAFETY, 1 GAO/RCED–86–132 (June, 1986). Similarly, early British Magnox reactors do not have containment structures. NUCLEAR ENGINEERING INT'L, *Id.* at 2.

Chernobyl brought out the inadequacies of the present system of measuring radiation releases worldwide. "From the outset of the Chernobyl accident, this became a major problem — initially because of the failure of the Soviet Union to provide notification of the location, time, or magnitude of the accident, and later because of the extensive data retrieval effort required to acquire all the essential data, for a four-to seven-day prior period, encompassing the western Soviet Union, Europe, and eventually the entire northern hemisphere." M. Dickerson, *ARAC Response to the Chernobyl Reactor Accident,* Lawrence Livermore National Laboratory, UCID–20834, at 3 (July, 1986).

The IAEA has initiated a new program to provide comparison data for use in the event of radiological releases and to help member states set up monitoring laboratories. *New IAEA Programme for Radioactivity Measurements,* 29:1 IAEA BULL. 52 (1987).

27. A 1987 study by Worldwatch Institute, *Reassessing Nuclear Power: The Fallout From Chernobyl,* found that "the political consequences of the accident last April at the Soviet Union's Chernobyl reactor was [sic] the 'collapse in country after country' of a 'pro-nuclear consensus' and the growth of anxiety about nuclear safety to levels that government leaders could not ignore. 'Chernobyl was an event of major historical proportions that later generations will undoubtedly mark as a milestone of the 20th century. Its real importance lies not in the actual accident but in the fact that it has triggered international political recognition of the economic and human tragedy that nuclear power threatens to become.'" Franklin, *Report Calls Mistrust a Threat to Atom Power,* in N.Y.Times, March 8, 1987, at A27, col. 1. *See also* Molotsky, *Phase-Out of A-Plants in U.S. is Urged,* N.Y.Times, April 30, 1986, at A12, col 4.

28. Conventions on Early Notification of a Nuclear Accident and on Assistance in the Case of a Nuclear Accident or Radiological Emergency, March 23, 1987, Item 996–A, 996–B, Treaty Doc. 100–4. 41.¼:100–4.

29. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Art. 14, par. 4; Convention on Early Notification of a Nuclear Accident, Art. 12, par. 3. 30. *IAEA Adopts Safety Conventions, supra* note 9, at 3.

30. *IAEA Adopts Safety Conventions, supra* note 9, at 3.

31. IAEA Press Release, PR/87/5, January 27, 1987.

Although both Conventions are now in effect, many states who have consented to be bound by the

The speed with which the IAEA's conventions were ratified is indicative of the post-Chernobyl political atmosphere. The USSR, although initially slow to release information concerning Chernobyl, has made significant contributions to reducing international tension over nuclear matters. The USSR has allowed IAEA inspection of the disabled plant,[32] produced a report on the accident for discussion at Agency meetings,[33] released information on cleanup measures,[34] and planned a study of the long-term effects of radiation on those within the 30-kilometer evacuation zone around the Chernobyl plant.[35]

After the Chernobyl accident, Soviet leader Mikhail Gorbachev wrote Hans Blix, Director General of the IAEA, stressing the need for international cooperation and action on nuclear safety matters. "Ensuring reliable and safe nuclear power development must become a universal international obligation of all States severally and collectively."[36] Many of Mr. Gorbachev's suggestions are found in the two conventions;[37] others, however, deserve further attention. "It will be necessary . . . to go further — to elaborate within the IAEA recommendations on nuclear power plant safety questions and to strengthen national and, where appropriate, international verification of compliance with them in all States."[38]

Mr. Gorbachev's letter is indicative of the shift in the Soviet stance since Chernobyl. The Chernobyl accident has focused international attention on nuclear power safety issues, and many countries, including the USSR, are demon-

Conventions have made reservations as to the dispute settlement procedures and thus are not bound by these provisions. *See* Convention on Early Notification of a Nuclear Accident, Art. 11, par. 2, and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Art. 13, par. 2. IAEA Information Circular, INFCIRC/335/Add.1; INFCIRC/336/Add.2 (May, 1987).

32. D. MARPLES, CHERNOBYL & NUCLEAR POWER IN THE USSR, 26 (1986); *Chernobyl—The IAEA Visit,* NUCLEAR ENGINEERING INT'L, June 1986, at 3.

33. *Good Work by the IAEA,* NUCLEAR ENGINEERING INT'L, Oct. 1986, at 9.

34. *The Show Goes On,* NEW SCIENTIST, Sept. 4, 1986, at 19.

35. N. HAWKES, G. LEAN, D. LEIGH, R. MCKIE, D. PRINGLE & A. WILSON, CHERNOBYL: THE END OF A NUCLEAR DREAM 211 (1986); Hoffer, *Moscow Plans Huge Chernobyl Study,* Wash. Post, May 23, 1987, at A28, col. 1.

The Soviet Union's failure to notify the IAEA of the Chernobyl accident was arguably not contrary to then existing international law. *See Chernobyl — The U.S. Reaction,* NUCLEAR ENGINEERING INT'L, June 1986, at 4. *But consider* Principle 21 of the Stockholm Declaration on the Human Environment, which provides: "States are responsible for ensuring that activities within their jurisdiction or control cause no damage to the environment of another state." Hoess, Schmidt & Binner, *Transfrontier Aspects of the Use of Nuclear Power,* CURRENT NUCLEAR POWER PLANT SAFETY ISSUES, *supra* note 17, at 197.

The Soviets' quick notification of the accident aboard its nuclear submarine on October 3, 1986 was clearly within the spirit of the IAEA Convention on Early Notification. *IAEA Adopts Safety Conventions, supra* note 9, at 4. Gwertzman, *Moscow Reports Fire on Atomic Sub in North Atlantic,* N.Y.Times, Oct. 5, 1986, at A1, col. 6.

36. IAEA INFORMATION CIRCULAR, June 20, 1986, at 1, INFCIRC/334, attachment.

37. Mr. Gorbachev, for example, suggests an international mechanism for the provision of mutual assistance and notification in the case of nuclear emergencies.

38. IAEA INFORMATION CIRCULAR, *supra* note 36, at 2.

strating their willingness to pursue more comprehensive solutions to these problems.

III. Recommendations

The IAEA conventions and Mr. Gorbachev's letter signal the beginning of a reform movement for nuclear power plant safety. Alone, however, these improvements are insufficient. More comprehensive change is necessary to ensure the safe use of nuclear power.

A. Incident Reporting

Improved nuclear safety requires a reporting system for all nuclear incidents.[39] The accident at Three Mile Island made this need apparent. Although two similar accidents preceded TMI, one in Switzerland in 1974[40] and another in Ohio in 1977,[41] their analyses were unavailable to assist the operators of TMI.[42] One commentator explains the importance of this omission:

> As the investigation into the accident at Three Mile Island made clear, there is a wealth of safety-related information buried in the operating history of the world's nuclear power plants. Unusual events, when analysed within the context of the environment of a specific plant, can highlight general weaknesses in design, construction, and operation.[43]

By the end of 1986, nuclear power plant operators had accumulated over 4,200 years of reactor experience.[44] The information available through analyses of incidents at nuclear plants, many of which are over 15 years old and some of which have been in operation for 25 years, is crucial to accident prevention and effective reactor design.[45]

Two agencies now operate incident reporting systems. The IAEA's Incident Reporting System (IAEA–IRS) aims at "harmoniz[ing] with national systems, to collect, review, store, and disseminate information on a world-wide basis."[46] The IAEA–IRS was developed in 1982 and began operating on a trial basis in 1983.[47]

39. Tolstykh, *IAEA–IRS: New Directions in a Cooperative Network for Nuclear Safety,* in 28:4 IAEA Bull. 8 (Winter, 1986).

40. GAO, International Response, *supra* note 3, at 22.

41. *See supra* note 6.

42. *See* GAO, International Response, *supra* note 3, at 22. *See Supra* note 6.

43. Epel, Franzen & Osmachkin, *IAEA Efforts to Improve Nuclear Power Plant Operational Safety,* in 25:3 IAEA Bull 9 (Sept., 1983).

44. 29:2 IAEA Bull. 65 (1987).

45. IAEA Press Release, PR/85/8, June 18, 1985. GAO, International Response, *supra* note 3, at 22. *See supra* note 6.

46. Epel, Franzel & Osmachkin, *supra* note 42, at 9.

47. GAO, International Response, *supra* note 3, at 17.

The Nuclear Energy Agency (NEA)[48] conducts its own incident reporting system. The IAEA and NEA systems are based on the following eight reporting categories:

1. Exposure to radiation or release of radioactive material.
2. Degradation of items important to safety (structures, systems, components).
3. Deficiencies in design, construction, operation, and quality assurance.
4. Generic problems (recurring events which, taken together, have implications for similar plants.
5. Significant consequential actions (actions taken by the regulatory body as a result of reported events).
6. Events of potential significance to safety (those during which a protection system operates unnecessarily, or fails to actuate when required).
7. Unusual events, of either man-made or natural origin, that directly or indirectly threaten the ability of the plant to cooperate safely.
8. Events which, although they have no safety significance, attract significant public interest.[49]

The two reporting systems address similar incidents, but differ substantially in their membership and international acceptability.

Several countries, including the United States,[50] had been reluctant to join the IAEA–IRS, contending that the NEA's system provided an adequate information base and that the two systems are duplicative.[51] The NEA membership, however, does not include Eastern Bloc or developing countries, and the program is coordinated with the IAEA–IRS to decrease duplication.[52] The United States' reluctance to join the IAEA–IRS was, in part, due to a fear that the Soviet Union would receive technical information about United States reactors without providing similar data on its own power plants.[53] The Soviet Union, however, already receives such information.[54] Furthermore, post-Chernobyl politics have eased the transfer of information, making it likely that Soviet bloc countries will contribute more to the reporting system. Testimony before the Senate Subcommittee on Energy, Nuclear Proliferation and Government Processes explains the need for full participation in incident reporting systems:

> The United States has . . . agreed to join and participate in the IAEA system. . . . [I]n view of the serious accident at Chernobyl, full participation by all nations that

48. The NEA, a specialized agency of the Organization for Economic Co-operation and Development, with 24 members, functions to improve the safety of nuclear power programs through increased cooperation on safety and regulatory matters. *Id.* at 4.

49. Epel, Franzen & Osmachkin, *supra* note 42, at 9.

50. The United States, through the NEA and its own bilateral agreements, shares information on operating experience with the operators of about 80% of the nuclear power plants world-wide. The remaining 20% are located mainly in Eastern Bloc countries. GAO, INTERNATIONAL RESPONSE, *supra*, note 3, at 25.

51. *Id.* at 26.

52. IAEA Press Release, *supra* note 44. The IAEA alone expects 150 reports annually.

53. GAO, INTERNATIONAL RESPONSE, *supra* note 3, at 26.

54. *Id.* at 40.

> have nuclear power programs would maximize the benefits of the incident reporting arrangements. Sharing such information, if the United States can acquire more information on Soviet reactors, is of special importance in view of the Soviet construction of two large nuclear power reactors in Cuba.[55]

In addition to the reporting systems of the IAEA and the NEA, many countries have promulgated bilateral agreements to require the exchange of general safety information on nuclear power plants near international borders, and the immediate transmission of information on reactor abnormalities at these plants. The Soviet Union has agreed, for instance, to provide the United States with technical information regarding the safety of its two Cuban nuclear reactors.[56] A more formal example of these bilateral agreements is the 1984 agreement between Austria and the Czechoslovak Socialist Republic, which provides for the exchange of specific information on nuclear power plants near the border, and which requires the immediate exchange of information regarding significant changes in reactor conditions.[57]

These bilateral agreements and the multilateral reporting systems of the IAEA and the NEA provide stepping stones to the necessary level of international cooperation; alone, however, they do not generate sufficient information. All countries operating nuclear power plants are not involved in a reporting system,[58] and reporting gaps exist even for those countries which actively participate in the IAEA or NEA program.[59]

The IAEA Convention on Early Notification of a Nuclear Accident, although an important recognition of the problem, does not supplant the need to improve incident reporting. The Convention covers "any accident . . . from which a release of radioactive material occurs or is likely to occur and which has resulted in or may result in an international transboundary release that could be of radiological safety significance for another State." The Convention, by concerning itself only with accidents that threaten or result in the release of radioactivity, ignores many of the "incidents"[60] reported by the NEA and IAEA systems, and therefore misses many opportunities to provide states with the safety related

55. *International Response to Nuclear Power Reactor Safety Concerns: Hearings Before the Subcomm. on Energy, Nuclear Proliferation and Gov't Processes of the Senate Comm. on Governmental Affairs*, 99 Cong., 2nd Sess. (1986) at 5 (statement of Allan Mendelowitz, Assoc. Dir. Nat'l Security and Int'l Affairs Div. of GAO) (discussing GAO, INTERNATIONAL RESPONSE, *supra* note 3).

56. *IAEA Adopts Safety Conventions*, *supra*, note 9, at 4.

57. 36 NUCLEAR LAW BULL. 39 (Dec., 1985).

58. V. Tolstykh reports that 15 of 26 IAEA Member States with operating nuclear power plants participate directly in the IAEA–IRS, while seven others participate in the NEA system. Two other Member States participate in IAEA–IRS meetings, although they have not yet officially joined the program. Tolstykh, *supra* note 39, at 8.

59. "[IAEA–IRS] co-operation with the NEA–IRS is based on reciprocity, which takes into account the ratio of reactors operating in OECD countries to those in the rest of the world (about 3:1)." *Id.* at 9.

60. *See supra* text accompanying note 45.

information necessary to improve accident response and reactor design.[61] Especially important is the reporting of events which may precede serious accidents, but which may not, alone, threaten the imminent release of radiation, and thus would not be subject to the Convention. This type of reporting might have prevented the accident at TMI in 1979.[62]

The Convention also lacks objective criteria by which to determine when its provisions become effective. Rather than specifying when countries must provide information on power plant conditions, the Convention leaves such determinations to governmental discretion. Because there is no international standard defining radiological significance and there is no guide as to what constitutes the "imminent release" of radioactivity, the Convention is ineffective; it will allow many significant events to go unreported and will maintain the present system of inconsistent incident reporting.

An amendment to the Convention providing for the prompt notification of all abnormal reactor incidents would enhance nuclear safety.[63] The mechanism for such reporting already exists through programs of the IAEA and the NEA, and the definitional work has already been done by these agencies.[64] Rather than relying on differing state interpretations of Convention terms such as "release that could be of radiological safety significance," the working terms of IAEA and NEA programs should be used.

Because of the obvious association with national defense and the technological sophistication necessary for nuclear power capability, states are very protective of their nuclear industries and may well be skeptical of approving such an amendment. However, states, in the post-Chernobyl reform movement, appear willing to forego some of their sovereignty in order to attain meaningful advances in international nuclear safety. Cooperative efforts must be undertaken before the political climate returns to its pre-Chernobyl status to achieve significant safety improvements and to prevent another accident.

Full incident reporting is essential to progress in nuclear safety. Alone, however, even improved reporting systems are insufficient. Information gained

61. It is essential that information as to all nuclear incidents is processed. "Every accident or abnormal event and nuclear situation must be screened. Where appropriate, it must be rigorously investigated to assess its implications for existing system design, equipment design and quality, operator training and simulators, computer models of the system, plant procedures, safety systems, emergency measures, management, and regulatory requirements. Implementation of lessons learned from operational experience improves not only plant safety, but equipment reliability and plant availability as well." Tolstykh, *supra* note 39, at 8.

62. *See supra* text accompanying notes 39–44.

63. Article 14 sets forth the amendment procedure for the Convention. Any State Party may propose an amendment. If a majority of the States Parties request a conference to consider the amendment, one will be convened and, if adopted by a two-thirds majority of all States Parties, the amendment will be laid down in a protocol open for signature. Thirty days after three States have consented to be bound by the protocol, it shall enter into force.

64. *See supra* note 49.

through incident analyses must be applied through mandatory, state-of-the-art safety regulations.

B. Standardization

The standardization of safety regulations would significantly improve the safety and efficiency of nuclear power plants world-wide. Standardization would increase public acceptance of nuclear power programs; decrease the overall costs of nuclear power; eliminate duplicative research and development while concentrating research on advanced safety and waste disposal techniques; facilitate international trade in reactors and nuclear materials, and clarify potential liability claims as to transboundary releases of radiation.[65]

Chernobyl generated an increased interest in the standardization of regulation.[66] K. Becker of the International Organization for Standardization's Technical Committee 85 "Nuclear Energy," enunciated six technical, economic, and political reasons for the standardization of nuclear safety regulations:

> 1. To simplify, accelerate and standardize the complex licensing process for nuclear facilities . . .
> 2. To guarantee the siting, construction, operation and decommissioning of nuclear facilities on a uniformly high safety level according to the latest state of science and technology.
> 3. To take into account excessive public concern about the risks of nuclear power in some of the highly industrialized countries, and improve public acceptance by establishing world-wide consensus of all relevant parties involved. . . .
> 4. The need for facilitating nuclear technology transfer to developing countries, . . .

65. *See e.g.*, Stadie, *Sharing Safety Experience*, CURRENT NUCLEAR POWER SAFETY ISSUES, *supra* note 5, at 433; *see also Panel*, *Id.* at 473.

It has been argued that the advantages of standardized safety regulations would be enhanced by the standardization of power plants themselves, and several countries already have commenced such programs. France's nuclear power program has a high degree of national standardization, and Italy is beginning its own program of standardization. Carle, *When France Departs From Standardization*, NUCLEAR ENGINEERING INT'L, Oct. 1984, at 31. Fornaciari, *Italy to Break Ground for First Standardized Nuclear Plant*, POWER, June 1985, at 55. The United States is studying the ramifications of standardizing the nuclear power industry. Atomic Industrial Forum, STANDARDIZATION OF NUCLEAR POWER PLANTS IN THE U.S., 1986.

However, the international standardization of nuclear power plants is a politically unrealistic, and, perhaps, technologically undesirable goal. Countries will be unwilling to concede all control over power plant design to an international organization. Furthermore, assuming a minimum level of safety, it is preferable to maintain several plant designs to minimize the dangers of committing to an inferior design and to increase the likelihood of technological improvements.

66. A group of 173 experts from 48 countries and five international organizations met in November, 1986 in Vienna and concluded that the IAEA's NUSS documents could form the basis for internationally accepted safety requirements. The group, however, only considered the documents in the context of voluntary standards. *Voluntary Safety Standards Preferred*, NUCLEAR ENGINEERING INT'L, Dec. 1986, at 3. *See also* NUCLEAR ENGINEERING INT'L, July 1986, at 5.

5. The increasing demand for international standards in new areas involving substantial across-the-border activities, such as waste management, reprocessing, non-proliferation and safeguards.

6. The large number of nuclear facilities sited close to international borders. . . .[67]

The formalization of standards and their incorporation into international law is achievable through the adoption of a convention accepting particular regulations, empowering the IAEA to require the adoption of its NUSS recommendations, or through the creation of an entirely new agency to operate on its own or in conjunction with the IAEA.

Morris Rosen, Assistant Deputy Director General of the IAEA and Director of the IAEA's Division of Nuclear Safety, considered the creation of an international nuclear safety body, and compared it to the International Commission on Radiological Protection (ICRP).[68] The ICRP, however, performs for radiation exposure limits what the IAEA's extant NUSS standards do for power plant safety: they provide recommendations with no enforcement. Rosen writes of the proposed agency: "The objective would be to eventually translate the developed philosophy into a licensing approach, but, as is true of the ICRP, the new body would not encroach upon the responsibility of the various national regulatory bodies by attempting to formulate specific advice concerning regulations."[69] Rosen continues, discussing "specific, universally applicable, technical *recommendations*" (emphasis added). This hypothetical international safety body does not help; recommended safety and technical standards exist now in the form of NUSS and other safety recommendations published by the IAEA. Furthermore, it is precisely this fragmented approach to safety that international standardization seeks to eliminate. Nuclear safety requires firm, enforceable standards.

Rosen suggests that an international safety body could be affiliated with the IAEA and states that the Agency is willing to cooperate with such a venture.[70] However, much duplication could be saved by mandating, through a convention, the IAEA's NUSS standards. NUSS standards are based on international consensus as to the best safety standards now used in member states. If NUSS documents are redrafted to represent the highest achievable level of safety and are updated periodically, they would provide a good source for international safety

67. Becker, *supra* note 17, at 264–65.

68. Rosen, *supra* note 3, at 4.

The ICRP could provide an alternative basis for internationally mandated standards, but enforcement would be necessary. The ICRP's present standards are a possible starting point for mandatory standards. *See* Lindh, Grill & Palmgren, *Co-ordination of International Safety Co-operation: The Nordic Example*, CURRENT NUCLEAR POWER PLANT SAFETY ISSUES, *supra* note 5, at 429 for a description of the Nordic Liaison Committee for Atomic Energy, an organization which provides common safety standards for Denmark, Finland, Norway, Sweden, and Iceland.

69. Rosen, *supra* note 3, at 4.

70. *Id.* at 5.

regulations. The IAEA itself is beginning to consider this possibility.[71] NUSS standards could be set as the minimum required level of safety measures, thus allowing for continued research and development by individual countries and by the IAEA. Natural incentives for research and development, such as improved safety and reduced implementation and liability costs, would not be affected by base-level mandates. A combined international effort to improve nuclear safety,[72] organized through the IAEA, would use resources efficiently by eliminating duplicative research and development and by disseminating information through pre-existing channels.

CONCLUSION

The spirit of increased cooperation of countries regarding nuclear safety reduces the political difficulties of amending the Convention on Early Notification of a Nuclear Accident and of adopting mandatory safety standards.[73] Several countries already have suggested a policy of mandatory standards, and many others appear willing to consider a proposal for enforceable international safety requirements. Countries concerned with reducing anti-nuclear resistance from their citizenry[74] and with implementing significant improvements in safety now seem ready to combine efforts to establish and follow stringent regulations.

Improving nuclear safety is an international priority. Chernobyl forced countries to reevaluate both internal safety programs and cooperative efforts with neighboring countries and international organizations. International regulation of the nuclear power industry should include a full reporting and information exchange system for incidents occuring at all nuclear power plants; such a system can be created by amending the Convention on Early Notification of a Nuclear Accident to incorporate the terms of the IAEA and NEA incident reporting systems. The adoption of a convention setting internationally mandated base-level safety requirements patterned after the presently unenforceable NUSS standards will also enhance nuclear safety.

71. Rosen, *supra* note 21, at 14. *IAEA Steps up Safety Measures*, NUCLEAR ENGINEERING INT'L, July 1986, at 5. *International Response to Chernobyl*, 28:4 IAEA BULL. 42 (Winter, 1986).

72. For a brief discussion of the superiority of increasing international cooperation through international organizations rather than through bilateral agreements *see* Stadie, *supra* note 65, at 433.

73. "Chernobyl has created both the right atmosphere and the political momentum for increased international co-operation, and the member States have begun to grasp the opportunity." Cruickshank, *Safety—Less Politics More Co-operation*, NUCLEAR ENGINEERING INT'L, Nov. 1986, at 15. *See, e.g.*, IAEA Press Release, PR/86/41, Nov. 3, 1986.

74. In the United States, for instance, although the public considers nuclear power necessary for long-term energy supplies, support for the nuclear industry is decreasing. A February, 1984 Office of Technology Assessment report, NUCLEAR POWER IN AN AGE OF UNCERTAINTY, shows that the public attitude is increasingly anti-nuclear. *See* GAO, INTERNATIONAL RESPONSE, *supra* note 3, at 1. Furthermore, even before the April 1986 accident at Chernobyl, polls found 40-55% of the public in many countries outside of the Eastern Bloc opposed to nuclear power programs. Cave, *The Need for a New Approach to Reactor Safety*, in CURRENT NUCLEAR POWER PLANT SAFETY ISSUES, *supra* note 17, at 433.