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TABLE OF CONTENTS

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I. INTRODUCTION

Legal regimes regulating the exploitation of atomic energy follow three patterns. The pattern adopted in a particular country depends upon its social and governmental structure. In socialist states, like the Soviet Union, the state owns and uses nuclear materials and installations and is a monopolistic insurer against atomic hazards. In such states nuclear energy law is simplicity itself. It consists of instructions and regulations on the handling, transport and storage of nuclear materials, and the management of nuclear installations by administrative agencies. An important part of the regulations deals with the safety and health of the workers.

Countries in which government monopolies (including a monopoly over nuclear materials) coexist with private enterprise present a more complicated situation. In those countries private law still constitutes the foundation for legal order and economic activity. Publicly owned enterprises are under the same tort and contract regime as private business. Transport, storage, and safety laws, and special medical and sanitary supervision of nuclear materials work sites are quite similar to the socialist regime.

Finally, when the government does not have a nuclear material monopoly, controls are designed solely to prevent public or employee exposure to the dangers of radiation or atomic disaster. Property, contract, and tort concepts retain their full force and importance and are properly adjusted to meet the special dangers posed by nuclear materials.

The differences between these three regimes are clearest under private law. Presently, the nuclear laws of the United States and West Germany are in a process of final liberalization. French law, however, represents an intermediate position because of the virtual government monopoly on the exploitation of nuclear fuels.

II. THE SOVIET NUCLEAR REGIME

One notable feature of Soviet nuclear law is the absence of insurance against tort liability for citizens or industrial installations. Also lacking is any special legislation regulating tort liability in connection with the use of nuclear materials. Under the general rules of civil law, Soviet enterprises using nuclear fuel or producing nuclear materials are liable for damage done to others. According to the tort provisions of the new Civil Code of the Soviet Union, absence of fault on the part of the tortfeasor is a good defense. Harm caused to the person or property of a citizen or an organization (*e.g.*, collective farm) must be compensated in full by the

tortfeasor. Liability for harm caused by a lawful act is imposed only in statutorily enumerated situations. According to section 454 of the Civil Code:

> Organizations and citizens whose activities involve increased danger for their neighbours (transport organizations, industrial enterprises, builders, motorists, etc.) are bound to make good any harm caused by such source of increased danger, unless, they can prove that the harm was due to irresistible force or was caused intentionally by the victim.

Special provisions deal with health and sanitation in nuclear installations and the transport of nuclear materials. The first legislative act dealing with work conditions in the handling of nuclear materials was issued in 1953.[1] It was followed by a similar set of rules issued by the Chief State Sanitation Inspector of the USSR on January 14, 1957.[2] These regulations dealt with work safety, medical examination of personnel employed in nuclear installations, and diagnosis of professional diseases related to this type of employment.[3] "Regulations concerning the transporting of nuclear materials" were promulgated in 1960.[4]

III. Western Approaches to Atomic Energy Law

While Soviet legislation suggests that dangers connected with the use of the atom are adequately dealt with by the general property and tort concepts, in nonsocialist countries the growing importance of peaceful uses of atomic energy has produced the greatest challenges in property and tort law since the Industrial Revolution. Initially, each nation had to decide whether public or private institutions would develop nonmilitary atomic energy. The resolution of this question determined the outcome of the two principal

1. USSR Academy of Sciences, Sanitary Regulations and Norms in Regard to Work with Radioactive Isotopes (1954).

2. Atomizdat, Sanitary Regulations Regarding the Transportation, Storage, Accounting for, and Work with Radioactive Substances (1958).

3. *Cf.* Profizdat, Text of Professional Ailments, Supplement 3 k.p. 63 Decree with Regard to the Order of Assignment and Payment of Compensation from the State Insurance Organization (1962). *See also,* Barry, *The Motor-car in Soviet Criminal and Civil Law,* 16 Int'l & Comp. L.Q. 56, 73 (1969); Gray, *Soviet Tort Law: The New Principles Annotated,* in Law in Soviet Society 80, 97 (W. Lafave ed. 1965); Hazard, Communists and Their Law 381-416 (1963); Grzybowski, *Soviet Socialism and the Function of Equity,* in Equity in the World Legal Systems 385-437 (R. Newman ed. 1973).

4. Atomizdat, Regulations Regarding Transfer of Radioactive Substances, No. 349-60 (1961).

issues of atomic energy law—ownership and liability. Permissible limits to private ownership of nuclear materials, facilities, and technology had to be defined. Property law was affected because any individual rights in nuclear property were now subject to modification by special nuclear legislation. Additionally, atomic energy development involved new risks unlike those normally covered by tort law. For example, if a nuclear accident were to occur, the damages sustained could considerably exceed any previous tort recovery arising out of a single accident.[5] Nuclear liability was thus considered unique and was given special legislative treatment.[6]

France, Germany, and the United States all have special nuclear legislation modifying their property and tort laws. Both the United States and Germany significantly amended their nuclear legislation in 1975. France, which has not recently made any major changes in its nuclear legislation, is a member of the European Atomic Energy Community (EURATOM) and has faithfully implemented the principles of the Paris and Brussels Supplementary Conventions. These conventions have significantly added to the nuclear law in free societies. Following the end of World War II,

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5. In 1957, the "Brookhaven Report" estimated that a major nuclear reactor accident might cause as much as $7 billion in damages, kill up to 3,400 persons and injure 43,000 others. *See* H.R. REP. No. 435, 85th Cong., 1st Sess. 31 (1957) (letter of Harold S. Vance, Acting Chairman of the AEC).

The 1974 Rasmussen Report estimated that:

> The most likely core melt accident, having a likelihood of one in 17,000 per plant per year, would cause property damage of about $100,000. . . . The chance of an accident causing $100 million damage would be about one in 50,000 per year. . . . The probability would be about one in one million per plant per year of causing damage of about $2-3 billion. The maximum value would be predicted to be about $4-6 billion with a probability of about one in 1,000,000,000 per plant per year.

U.S. Atomic Energy Commission, *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commerical Nuclear Power Plants,* 16 ATOM. ENERGY L.J. 177, 198-99 (1974).

Besides the possibility of an astronomical amount of damages, nuclear accidents may pose novel legal problems in the proof of actual causation and even personal injury itself. For a discussion of how these problems of proof might affect the plaintiff in a nuclear accident case, see Note, *Nuclear Liability Legislation in the United States and Europe,* 13 STAN. L. REV. 865 (1961).

6. Nuclear liability is defined as the legal consequence of personal injury or property damage resulting from a nuclear accident. Nuclear accident, termed "nuclear incident" in the United States Atomic Energy Act, means "any occurrence . . . causing . . . bodily injury, sickness, disease, or death, or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of source, special nuclear material, or by-product material." 42 U.S.C. § 2014(q) (1970).

both the United States and France created administrative bodies to study and research possible peaceful uses of atomic energy and the social and legal ramifications of such use.[7] Germany's development of a legal regime for the peaceful use of nuclear energy was delayed by post-war occupation until the creation of the Federal German Republic (1949) within the organizational framework of the European Communities.[8]

The remarkable feature of the evolution of nuclear laws in the three countries under discussion is that each country was able to develop a regime corresponding to its general social philosophy using a different approach and legal technique. The United States, after an early initiative to adopt a global solution (the Baruch Plan), resorted to national legislation. France and Germany combined international (EURATOM) with national legislation, each arriving at different technical solutions in accordance with their ideas on the role of free enterprise in the management of nuclear installations and the exploitaton of nuclear materials.

IV. History of American, French, German, and EURATOM Nuclear Legislation

A. *France (1945-1946)*

The *Commissariat a l'Energie Atomique (CEA)* was established in France by the Ordinance of October 18, 1945,[9] as a government organization, to engage in "pure" research and find practical applications for atomic energy. By creating *Electricité de France (EDF)*, a public utility corporation, the nationalization law of April 8, 1946, provided for a government monopoly over *the use of nuclear energy* for the production of electricity.[10] These laws establishing the administrative framework for civilian atomic energy were the only nuclear legislation in France at that time.

B. *United States (1946-1957)*

The Atomic Energy Act of 1946 (McMahon Act) created a government monopoly over nuclear materials, facilities, and technol-

7. England and the USSR also began an atomic energy program at that time. Labbé, *Rapports entre le secteur public et le secteur privé dans le domaine du droit de l'énergie atomique*, in 2 Aspects du Droit de l'Énergie Atomique 75, 78 (C.H. Puget ed. 1967).

8. Amtsblatt der Hohen Kommission 122, 882, 1361 (1950).

9. Ordonnance 45-2563 of 18 Oct. 1945, [1945] J.O. 7065, 7206.

10. Loi No. 46,628 of 8 avr. 1946, [1946] J.O. 2951.

ogy by transferring control over American nuclear power from the military to the newly created Atomic Energy Commission (AEC).[11] This government monopoly over atomic energy was later partially abandoned by the Atomic Energy Act of 1954, which revised and superseded the 1946 Act.[12] Statutory prohibitions against private manufacture, ownership, and operation of nuclear facilities were removed, but absolute restrictions against the private ownership of special nuclear material were still maintained, necessitating leasing of nuclear fuel from the Government.

Despite the 1954 authorization of private participation, business was reluctant to invest in the fledgling private nuclear industry because of certain cost disincentives, particularly unlimited liability for accidents.[13] After unsuccessfully trying various types of federal economic incentives and subsidies to spur the development of the private atomic energy industry,[14] the Price-Anderson Act of 1957[15] was enacted. The United States thereby became the first nation in the world to introduce nuclear liability legislation.

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11. Atomic Energy Act of 1946, ch. 724, 60 Stat. 755 (1946).

12. Atomic Energy Act of 1954, ch. 1073, 68 Stat. 919 (1954) (codified at 42 U.S.C. §§ 2011-2281 (1970)). Both international and domestic pressure accounted for the partial dissolution of the American government monopoly in atomic energy. By 1954, it was apparent that the secrets of atomic energy were no longer known only to the U.S. Fear of competition from other nations created a public demand that private industry be allowed to assist the United States Government in the international race for atomic energy development. There were cries to remove the "island of socialism" from the free enterprise system. Perhaps most significantly, however, Atomic Energy Commission research and development had finally expanded atomic energy technology to the stage at which civilian nuclear power seemed to have a real, and ultimately profitable, future. *See* Green, *Nuclear Power: Risk, Liability and Indemnity,* 71 MICH. L. REV. 479, 480 (1973).

13. The unlimited liability problem was aggravated by the inadequacy of the private third-party liability insurance available for nuclear accidents. *Governmental Indemnity for Private Licensees and AEC Contractors Against Reactor Hazards: Hearings on H.R. 9701, S. 3929 Before the Joint Comm. on Atomic Energy,* 84th Cong., 2d Sess. 5 (1956).

14. Morrison, *Federal Support of Domestic Atomic Power Development—The Policy Issues,* 12 VAND. L. REV. 195, 196-218 (1958).

15. Price-Anderson Act, 42 U.S.C. § 2210 (1970). Under United States legislation, nuclear liability was limited to a ceiling amount of damages that could be recovered in one nuclear incident. *Id.* § 2210(e). Operators of nuclear installations were required to maintain compulsory financial security covering all persons who might be liable for a nuclear accident. *Id.* § 2210(b). Finally, the legislation required the United States Government to indemnify any person held liable in a nuclear accident for any amount of his limited liability that private insurance would not cover. *Id.* § 2210(c).

C. *EURATOM (1958)*

While the United States sought a national solution to nuclear energy problems, on January 1, 1958, the EURATOM Treaty was enacted. The six member nations, including France and Germany, thereby created a supranational institution to deal with European civilian atomic energy development.[16] The EURATOM Treaty made the Community the "legal owner" of all special nuclear material produced in the six member nations.[17] Ownership by EURATOM, however, left the possessor of the special nuclear material with full rights to use and consume the material—a type of "economic ownership" right.[18] The EURATOM Community was also given an enforceable option to contract for all source material in the member nations.[19]

D. *Germany (1959)*

In 1959, two years after the enactment of the Price-Anderson Act in the United States, Germany passed its first Atomic Energy Law *(Atomgesetz),*[20] which limited the government's role to necessary health, safety, and security protection.[21] Unlike France and the United States, Germany did not establish a central governmental body responsible for atomic energy research or regulation. The bulk of the administrative tasks were given to the state (*Länder*) authorities who had administered previously existing atomic energy regulations.[22] An advisory committee named the *Deutsche Atom Kommission (DAK)* was to be the only federal

16. Treaty Establishing the European Atomic Energy Community, 298 U.N.T.S. 169 (1958) [hereinafter cited as EURATOM Treaty]. The other four member nations were Belgium, Italy, Luxembourg, and the Netherlands. EURATOM was to deal with foreign policy, research, public health and safety, industrial development, and supplies of materials for the EURATOM Community. Gaudet, *EURATOM* in 1 LAW AND ADMINISTRATION 140, 163 (H. Marks ed. 1959).

17. EURATOM Treaty, *supra* note 16, art. 86.

18. *Id.* art. 87. Of course, the "economic ownership" right was subject to all treaty obligations in regard to safety control, the right of option for possession, and health protection.

19. *Id.* art. 52. EURATOM had ultimate legal control over all nuclear substances—both special nuclear materials and source material. There could no longer be any "legal ownership" of special nuclear material by private parties, or indeed by individual member nations, within the EURATOM Community.

20. Act of Dec. 12, 1959, [1959] BGB1 I 813.

21. H. KRUSE, LEGAL ASPECTS OF THE PEACEFUL UTILIZATION OF ATOMIC ENERGY 15 (1962).

22. Act of Dec. 12, 1959, § 24, [1959] BGB1 I 813.

body concerned with atomic energy.[23] Although the 1959 *Atomgesetz* created a more orderly system of atomic energy administration, it did not significantly affect the property law of Germany. The *Atomgesetz* did, however, make important contributions to German liability laws.[24]

E. *The Paris and Brussels Supplementary Conventions (1960 and 1963)*

Sixteen European nations, including France and Germany, signed the Convention on Third Party Liability in the Field of Nuclear Energy (The Paris Convention)[25] on July 29, 1960. For the first time, an international agreement defined major principles of nuclear liability governing an entire group of countries.[26] The protection accorded by the Paris Convention was amplified in January 1963, when the Brussels Supplementary Convention[27] was signed by thirteen of the signatories to the Paris Convention. Under the Supplementary Convention, additional compensation, up to a total of $120 million, was made available through individual and collective state intervention. Implementation of these unique international principles of the Paris and Brussels Supplementary

23. Resolution of Cabinet of Dec. 21, 1955, [1955] BGBl II 242.

24. A ceiling was imposed on potential liability arising from a nuclear accident. Act of Dec. 12, 1959, § 38, [1959] BGBl I 813. Strict liability, without any provision for a *force majeure* exception, was established for operators of nuclear installatons. *Id.* § 25. Other persons who might be found liable for a nuclear accident, such as suppliers, were subjected to a negligence standard. *Id.* § 26. The operator was also required to maintain a financial reserve to protect himself and all other persons who could be found liable for a nuclear accident involving his nuclear facilities or material. *Id.* § 15. Finally, the German federal government agreed to indemnify private industry for any limited liability that could not be covered by private insurance. *Id.* § 36.

25. Convention on Third Party Liability in the Field of Nuclear Energy, July 29, 1960, 55 AM. J. INT'L L. 1082 (1961) [hereinafter cited as Paris Convention].

26. These principles were: (1) absolute and exclusive liability of the operator of a nuclear installation (*id.* art. 3); (2) limitation of liability in time (*id.* art. 8); (3) limitation of liability in amount (*id.* art. 7); (4) compulsory financial security to cover the liability of the operator (*id.* art. 10); and (5) one court—that of the place where the incident occurs—competent for all claims arising out of the same accident, with obligatory enforcement of its judgment by all contracting parties (*id.* art. 13).

27. Convention of 31 January 1963 to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy, art. 3, 2 INT'L LEGAL MATERIALS 685 (1963) [hereinafter cited as Brussels Supplementary Convention].

Conventions awaited only the ratification of the signatory nations.[28]

F. *United States (1964-1966)*

Popularly known as the Private Ownership Law, the 1964 amendment to the Atomic Energy Act of 1954 further weakened the remnants of the original government monopoly over atomic energy.[29] For the first time in the United States, private persons were permitted to own special nuclear material.[30] The AEC was authorized to sell its special nuclear material and private ownership was made mandatory by the forced discontinuance of AEC material leasing after December 31, 1970.[31] A government monopoly was maintained, however, in the area of uranium enrichment, since only government-owned gaseous diffusion facilities were allowed to enrich uranium.[32]

Further changes in the Atomic Energy Act were introduced in 1966 by the "waiver of defense" amendments,[33] enacted as a partial cure for the lack of uniformity among state nuclear liability laws.[34] Through a system of mandatory contractual waivers in the indemnity and underlying financial protection agreements, all members of the private nuclear industry gave the AEC the power to compel them to forego any defense based upon fault, governmental

28. France ratified the Paris Convention on March 9, 1966, and the Brussels Supplementary Convention on March 30, 1966. Germany ratified the Paris Convention on September 30, 1975, and the Brussels Supplementary Convention on October 1, 1975. 16 NUCLEAR L. BULL. 38-40 (1975).

29. Private Ownership Law Amendment of 1964, Pub. L. No. 88-489, 78 Stat. 603 (1964).

30. *Id.* § 4 *repealing* 42 U.S.C. § 2072 (1970).

31. 42 U.S.C. § 2073(c) (1970).

32. 42 U.S.C. §§ 2061, 2133, 2134 (1970); Charnoff, *Private Ownership of Special Nuclear Materials in the United States,* in 4 LAW AND ADMINISTRATION 97, 114 (J. Weinstein ed. 1966). Thus, while private persons could own uranium in both its natural and enriched state, they had to temporarily surrender their natural uranium to the Government who, for a fee, would transform the uranium into the needed special nuclear fuel. 42 U.S.C. § 2201(v) (1970). This last remnant of government monopoly was justified on national defense and security grounds.

33. Act of Oct. 13, 1966, Pub. L. No. 89-645, 80 Stat. 891 (1966) (codified at 42 U.S.C. §§ 2014, 2139, 2210 (1970)).

34. Since the original Price-Anderson Act had not changed state tort laws except to impose a limited ceiling on liability, it was possible that one state could apply a strict liability standard to nuclear accidents, while another state could apply a negligence theory thus rendering recovery in the latter state much more difficult. Unequal treatment could also result from different time requirements under applicable state statutes of limitation.

or charitable immunity, or a statute of limitations in the event of an "extraordinary nuclear occurrence."[35] Important procedural provisions to allow consolidation of nuclear liability actions in one suit were also added.[36]

G. *France (1966-1969)*

At the international level, France ratified the Paris and Brussels Supplementary Conventions in March 1966, thus incorporating them into its own domestic law. The French Atomic Energy Act (1968)[37] merely completed French nuclear legislation by filling in those areas of nuclear liability law that the two conventions had left open to the initiative of the contracting parties.

H. *Germany (1975)*

Although Germany had signed the Paris and Brussels Supplementary Conventions in the early 1960's, it did not ratify the conventions until 1975, and even then, it made important reservations to their provisions.[38] Concurrent with ratification, legislation that significantly changed the German Atomic Energy Act was enacted.[39]

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35. 42 U.S.C. § 2210(n) (1970). 42 U.S.C. § 2014(j) (1970) states in part:

> The term "extraordinary nuclear occurrence" means any event causing a discharge or dispersal of source, special nuclear, or by-product material from its intended place of confinement in amounts offsite, or causing radiation levels offsite, which the Commission determined to be substantial, and which the Commission determines has resulted or will probably result in substantial damages to persons offsite or property offsite. . . . The Commission shall establish criteria in writing setting forth the basis upon which such determination shall be made.

The AEC Regulations are contained in 10 C.F.R. §§ 140.81-.85 (1977).

For a criticism questioning the necessity of a "threshold" requirement to trigger the waiver of defenses, see Note, *The "Extraordinary Nuclear Occurrence" Threshold and Uncompensated Injury Under the Price-Anderson Act,* 6 RUT.-CAM. L.J. 360 (1974).

36. 42 U.S.C. § 2210(n)(2) (1970).

37. Loi No. 68-943 of 30 Oct. 1968, [1969] J.O. 31 Oct. 1968. *See* P. Strohl, *The Concept of Nuclear Third Party Liability and Its Implementation by Legislation in OECD Member Countries,* in EXPERIENCE AND TRENDS IN NUCLEAR LAW 69-83 (Int'l Atom. Energy Agency 1972).

38. Laws of January 31, 1975, February 21, 1975, and July 15, 1975, [1975] BGB1 I 957, 992, 1021, 1885.

39. The 1975 German Act made the operator of a nuclear installation exclusively liable. *Id.* § 25. Also, the previous ceiling on liability was doubled and the amount of financial security required from nuclear installation operators was more than quadrupled. *Id.* § 13. Finally, the system of federal indemnification

I. *United States (1975)*

Due to expire in 1977, the Price-Anderson Act was revised and extended on December 31, 1975.[40] The new legislation marks a truly unique withdrawal by the government from subsidization of private nuclear liability. The Act replaces government indemnity with a deferred premium system of private insurance.[41] By 1985, at the latest, private insurance is expected to completely cover the current liability ceiling. After that date, the ceiling on liability will gradually increase to $1 billion.[42] Discussions are being held on whether the last trace of the American government monopoly in atomic energy—the enrichment of uranium—should be abolished as well and transferred to private industry.[43] Also, the constitutionality of the limitation on potential nuclear liability is now being attacked in court.[44]

J. *Results of Legislative Evolution*

Atomic energy law has reached sufficient completeness to permit systematic review and analysis. The two main areas, property and tort law, regulate mutual relations between persons and institutions bound either by contract or nuclear incident. While there is a dominant drift towards private solutions, broader societal interests and government controls establishing standards for the use and handling of nuclear materials are still closely bound.

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was altered by the establishment of a new arrangement whereby both the federal and state governments share the indemnification of nuclear liability. *Id.* § 36. *See* International Atomic Energy Agency, 14 NUCLEAR L. BULL. 12 (1975).

40. Government Phase-out Amendment of 1975, Pub. L. No. 94-197, 89 Stat. 1111 (1975), *amending* 42 U.S.C. § 2210 (1970).

41. *Id.* § 3.

42. 121 CONG. REC. S22331 (Daily ed. Dec. 16, 1975) (remarks of Sen. Pastore).

43. *Legislation Proposed for Expansion of U.S. Enrichment Capacity Through the Involvement of Private Enterprise in the Ownership and Operation of Future Enrichment Facilities: Joint Hearings on S. 2035, H.R. 8401 Before the Joint Comm. on Atomic Energy,* 94th Cong., 1st & 2d Sess. (1975-76).

44. Carolina Environmental Study v. United States, No. C-C-73-159 (W.D.N.C., filed 1973). On December 15, 1975, a bill was also proposed in the House and Senate to compel a five-year moratorium on the issuance of new licenses by the AEC. The moratorium period would be used to thoroughly investigate the potential dangers posed by large-scale production of electricity by nuclear reactors. H.R. 11159, 19th Cong., 1st Sess., 121 CONG. REC. H12597 (Daily ed. Dec. 15, 1975) (26 sponsors).

V. NUCLEAR PROPERTY LAW

The three major types of nuclear property are nuclear substances, nuclear facilities, and nuclear patents. Either by complete prohibition or strict regulation, the governments of the United States, Germany, and France have paid particular attention to the private ownership of these three nuclear property elements.

A. *Nuclear Substances*

Source material and special nuclear material are the two basic nuclear substances. In the United States, there is no longer any prohibition against private ownership of either. Indeed, private ownership of special nuclear material is mandatory since the Nuclear Regulatory Commission (NRC) will no longer lease such material. Private ownership, however, is subject to strict administrative regulation,[45] and the actual enrichment of natural uranium can only be done in government facilities.[46]

Under the EURATOM Treaty, to which both France and Germany belong, all special nuclear materials in the member nations belong to EURATOM. EURATOM also has an option to acquire ownership of any source material. A cautious interpretation of the meaning of "EURATOM ownership" is warranted since authority is granted only to (1) exercise security control over the use of source materials, (2) demand that such materials be stored in places indicated by and in accordance with the instructions of the Commission, and (3) forbid the export of source materials when the Commission finds it contrary to Community interest. *In all other respects,* a possessor may use and consume such material provided it does not violate EURATOM's regulations or other obligations.[47] EURATOM ownership is also modified by a so-called escape clause.[48]

Subject to its EURATOM obligations, France has its own national legislation on nuclear substances. Any authorized individual can undertake exploratory work for nuclear source material.[49] Private ownership of source materials is allowed, but if the *CEA* demands the privately owned materials, such material must be

45. 42 U.S.C. § 2073 (1970).
46. 42 U.S.C. § 2061 (1970).
47. J. POLACH, EURATOM: ITS BACKGROUND, ISSUES AND ECONOMIC IMPLICATIONS 77 (1964) (emphasis added).
48. EURATOM Treaty, *supra* note 16, art. 62.
49. Décret No. 56-838, 16 août 1956, § 19, [1956] J.O. 8004.

transferred to the government.[50] As a practical matter, the *CEA* itself prospects and exploits ore deposits. Until recently, the *CEA* and the *EDF* were the only important purchasers of source materials since they owned all the large nuclear installations.[51] Although special nuclear material is legally owned by the EURATOM Community, there is no express French prohibition against private economic ownership of special nuclear material by private persons who have been licensed by the *CEA*. Again, the *EDF* and *CEA* produce and have economic ownership of virtually all special nuclear material within France due to their nearly monopolistic domination of French energy production.

Germany allows private economic ownership of both source and special nuclear material. The individual states are primarily responsible for legislation on the mining and possession of source material. Their legislation is usually modeled after Prussia's General Mining Act of June 24, 1865. Special nuclear material, however, is primarily dealt with in federal legislation, which itself is subject to the EURATOM Treaty obligations.[52] Under German federal legislation, possession of special nuclear material without specific authorization is strictly forbidden, and all special nuclear material not held by specific private license must be transferred into governmental custody. While the economic ownership and title of special nuclear material can be transferred between private persons, the special nuclear material itself must remain in government stores until a new owner can obtain a license to use the material.[53]

B. *Installations*

After special nuclear material, nuclear reactors are the most important requisite for the atomic energy industry. Since nuclear reactor installations pose a potential public hazard of gradual radiation or a sudden accident, the construction, operation, and transfer of nuclear installations are subject to strict regulation in all nations.

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50. *Id.* § 81.

51. O.E.C.D. AND ENEA, NUCLEAR LEGISLATION, ANALYTICAL STUDY, REGULATIONS GOVERNING NUCLEAR INSTALLATIONS AND RADIATION PROTECTION: FRANCE 123, 124 (1972).

52. Laws of January 31, 1975, February 21, 1975, and July 15, 1975, § 5, [1975] BGBl I 957, 992, 1021, 1885.

53. O.E.C.D. AND ENEA, NUCLEAR LEGISLATION, ANALYTICAL STUDY, REGULATIONS GOVERNING NUCLEAR INSTALLATIONS AND RADIATION PROTECTION: GERMANY 179-81 (1972).

The United States Atomic Energy Act of 1954 made possible the construction and ownership of nuclear installations by private industry, but a strict system of permits and regulations was imposed.[54] Currently, only uranium enrichment facilities may not be owned by private industry.[55] In the near future, this last vestige of the original government monopoly over atomic energy may well be abolished.

While there is no French prohibition against the private ownership of any type of "basic nuclear installation," the creation of all such installations is subject to governmental authorization.[56] Since the French government has a monopoly over electricity production, the major commercial use of nuclear reactors is foreclosed to private industry. The only exception is that a company may operate a nuclear installation to produce electricity for its own consumption. Therefore, the possibility of private ownership of nuclear reactors is illusory for the large part of French private industry that cannot economically afford to maintain a nuclear installation solely for its own consumption.

Both the German federal *(Bund)* and state *(Länder)* governments are empowered to regulate the private ownership and operation of nuclear installations.[57] There are no absolute prohibitions on the ownership of nuclear installations by private industry for either the production or the use of special nuclear material. Unlike France, which offers aid to private industry despite the predominant government monopoly over atomic energy, Germany provides an open field for the private atomic energy industry, free from the competition of government nuclear installations.

C. *Patents*

American nuclear inventions with no military applications may be patented in the normal way,[58] although the NRC can declare the patent to be "affected with the public interest" and then control by license the use of the patent by others, or compulsorily acquire it for governmental use.[59] If the NRC chooses to limit or acquire the patent, a Patent Compensation Board determines the amount

54. 42 U.S.C. § 2133 (1970).
55. 42 U.S.C. § 2061 (1970).
56. Décret No. 63.1228, 11 dec. 1963, § 1, [1963] J.O. 11092.
57. Laws of January 31, 1975, February 21, 1975, and July 15, 1975, § 7(3), [1175] BGBl I 957, 992, 1021, 1885.
58. 42 U.S.C. § 2181 (1970).
59. 42 U.S.C. § 2183 (1970).

of royalties payable to the holder of the original patent.[60]

EURATOM's role in the patent area is essentially informational.[61] Member nations may have individual patent policies, but they are bound to notify EURATOM of all nuclear patents filed in their countries.[62] If it is interested, the EURATOM Commission can then work out a patent licensing agreement with the applicant.[63]

There is no special French legislation applicable to nuclear patents, but the *CEA* Administrator-General can acquire or transfer any nuclear patent or license.[64] If patents are filed as a result of *CEA* efforts, they appear under the agency's name and the inventor sometimes receives a national award.[65] A single private body, BREVATOME, coordinates and works the nuclear patents of its members, who comprise a majority of the French public and private nuclear industry. BREVATOME is a joint stock company with variable capital; the *CEA* contributes 25 percent, the *EDF* 5 percent, and about 60 private French companies provide the remainder of the capital. Its major concerns are fair valuation of inventions and avoidance of any abuse by the government monopoly. BREVATOME members' nuclear inventions are bought by the organization, patented in the latter's name, and then distributed to the members for further development.[66] This complete and voluntary coordination of research efforts by both public and private institutions represents a novel response to nuclear invention problems.

German national legislation contains no specific provisions on nuclear patents. The general law is codified in the Patents Act of 1936 as amended in 1953 and 1967.[67] This basic law empowers the federal government to exclude from patentability inventions with military application. The federal government can also require that an invention be used in the public interest.[68]

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60. 42 U.S.C. §§ 2182, 2187 (1970).

61. EURATOM Treaty, *supra* note 16, arts. 12-23; Note, *Patent Policies of the European Atomic Energy Community,* 30 U. PITT. L. REV. 331, 362 (1968).

62. EURATOM Treaty, *supra* note 16, art. 16.

63. EURATOM Treaty, *supra* note 16, arts.14 & 17.

64. Décret No. 45.3563 of 18 Oct. 1945, § 6, [1945] J.O. 7065.

65. *Id.* § 9.

66. *See* LePêtre, *La pratique française en matière de propriété industrielle nucléaire,* in 2 ASPECTS DU DROIT DE L'ENGERGIE ATOMIQUE 197 (H. Puget ed. 1967).

67. [1953] BGB1 I 615.

68. [1967] BGB1 I 625; KRUSE, *supra* note 21, at 70-71.

VI. NUCLEAR TORT LAW

Nuclear liability legislation changes ordinary tort law in five basic areas: (1) *who* may be liable for nuclear damage; (2) the *principles* under which they may be liable; (3) the *extent* of liability—both in *amount* and *duration;* (4) the maintenance of *financial security* to guarantee payment of any liability; and (5) the *role of the government* in satisfying any liability claims.

A. *Parties Liable*

The United States, France, and Germany focus liability for nuclear accidents on operators of nuclear installations. The legal techniques they have employed to accomplish this vary significantly. Under American law, the determination of who is liable for a nuclear incident is left to state legislation and case law.[69] There is no federal provision for the exclusive liability of the operator nor, indeed, of any other person. The operator, however, must acquire private insurance[70] and enter an agreement with the United States Government to indemnify *all persons* who could be held liable for damage caused by the nuclear property of the operator.[71] Although anyone may be found liable for nuclear damage, the liability will ultimately be paid under the insurance and indemnity agreements of the operator. This concentration of liability on one final source of relief is referred to as "economic channeling."[72]

In contrast to the United States, both France and Germany, under the Paris Convention, provide for the exclusive liability of the operator by "legal channeling."[73] With one exception,[74] their laws do not permit anyone other than the operator of the nuclear installation to be sued for nuclear damage.

B. *Principles of Liability*

Determination of the basis of liability for nuclear incidents is reserved to state law by the Atomic Energy Act of the United States. Consequently, it is possible for one state to apply a strict

69. *Cf.* Note, *supra* note 5.
70. 42 U.S.C. § 2210(a) (1970).
71. *Id.* § 2210(c).
72. Strohl, *supra* note 36, at 78.
73. Paris Convention, *supra* note 25, art. 3.
74. With government approval, a French or German insurance carrier may substitute its own liability for that of the operator. Paris Convention, *supra* note 25, art. 4(d).

liability standard for nuclear incidents, while another applies a negligence standard. An attempt to unify the law was made in the 1966 waiver of defense amendments by requiring all licensees to agree in advance that the NRC may compel them, in the event of an "extraordinary nuclear occurrence," to waive any defense based upon fault or any right of recourse they might otherwise have.[75] The waiver system eliminates the necessity of proving the defendant's negligence and, thus, imposes on all states a uniform absolute liability system under which the defendant can only contest issues of causation and damages.[76]

Absolute liability of the operator is one of the basic principles of the Paris Convention[77] and has been incorporated into both the French and German atomic energy legislation.[78] Upon proof that th damage was caused by the operator's nuclear property, he automatically becomes liable for the damage regardless of how exemplary or blameless his conduct might have been. In France, the operator is exonerated from all liability if the damage arises directly out of civil conflict, civil war, or exceptional national disasters that are catastrophic and completely unforeseeable.[79] The classic exoneration of *force majeure,* a somewhat lower standard, is not applicable.[80] Germany made a reservation to the Paris Convention in the area of exoneration, and as a result, the operator is never exonerated from liability.[81] In another reservation to the Paris Convention, Germany has made an exception to the absolute liability of the operator if the fault of the injured person or the person in actual control of damaged property has contributed to the damage sustained. In such a case, section 254 of the German Civil Code governs.[82]

C. *Duration of Liability*

The United States Atomic Energy Act leaves it to state law to determine the time within which actions to recover for nuclear

75. 42 U.S.C. § 2210(n)(1).

76. Of course, no waiver system is applicable if the "extraordinary nuclear occurrence" requirement is not met.

77. Paris Convention, *supra* note 25, art. 3.

78. *See* notes 37 & 38 *supra.*

79. Paris Convention, *supra* note 25, art. 9.

80. *See* Strohl, *supra* note 37, at 73.

81. Laws of January 31, 1975, February 21, 1975, and July 15, 1975, § 25(3), [1975] BGB1 I 957, 992, 1021, 1885.

82. *Id.* § 27.

damages may be brought. In the event of "an extraordinary nuclear occurrence," however, the NRC may compel the person indemnified to waive any issue or defense based upon a statute of limitations if the suit is instituted within three years from the date on which the claimant first knew or reasonably could have known of his injury or damage and the cause thereof, but in no event more than twenty years after the date of the nuclear incident.[83] Thus, the Act establishes time limits for individuals both aware and unaware of their damage.

The Paris Convention's statute of limitation provides that the right of compensation for nuclear damage shall be extinguished if an action is not brought within ten years from the date of the nuclear accident.[84] This absolute limit is further reduced by French legislation, which provides that claims shall be brought within three years from the date at which the person suffering damage knew, or could reasonably be expected to know, of the damage and the identity of the operator responsible.[85] German nuclear legislation also fixes a three year time limit for those with knowledge, but by a reservation to the Paris Convention, it increased the absolute time limit on the statute of limitation to 30 years.[86]

D. *Liability Limitations, Required Financial Security, and the Role of the Government*

Although United States federal law did not directly purport to change state tort law, since 1957 it has placed a ceiling on the total amount of damages that may be recovered by all parties because of one nuclear incident. Before 1975 the total amount of liability was limited to $560 million.[87] The 1975 amendment to the Price-Anderson Act provides for a "floating" limitation of liability geared to the availability of private insurance.[88] It is envisioned that the limitation of liability will eventually increase to $1 billion.[89] All operators of American nuclear installations are required

83. Government Phase-out Amendment of 1975, Pub. L. No. 94-197, § 12, 89 Stat. 1111 (1975), *amending* 42 U.S.C. § 2210(n)(1)(iii) (1970). The original Act allowed only ten years as an absolute time limit.

84. Paris Convention, *supra* note 25, art. 8.

85. Loi No. 68-943 of 30 oct. 1968, § 15, [1968] J.O. 31 oct. 1968.

86. Laws of January 31, 1975, February 21, 1975, and July 15, 1975, § 32(1), [1975] BGBl I 957, 992, 1021, 1885.

87. 42 U.S.C. § 2210(e) (1970).

88. Government Phase-out Amendment of 1975, Pub. L. No. 94-197, § 6, 89 Stat. 1111 (1975), *amending* 42 U.S.C. § 2210(e) (1970).

89. 121 CONG. REC. S22331 (Daily ed. Dec. 16, 1975) (remarks of Sen. Pastore

to maintain financial security to cover their own nuclear liability and the liability of all other persons that might stem from an accident involving the operator's nuclear property.[90] Currently, the maximum amount of private insurance available is $125 million, so the limitation of liability is still $560 million. The $435 million not covered by direct private insurance is protected by both a deferred premium plan and governmental indemnity.[91] Under the new 1975 system, the financial protection will be established in two private layers and one public layer, with the public layer being eventually phased out. The base layer will consist of the traditional third party liability insurance up to $125 million. The second layer, to be fixed by the NRC no later than December 31, 1976, will be made available under an "industry retrospective rating plan" providing for total or partial deferment of premium charges until the actual liability from a nuclear accident appears likely to exceed the base layer.[92] The maximum amount of the deferred premium shall not be less than $2 million nor more than $5 million for each nuclear facility protected,[93] and the NRC will continue to provide indemnity up to the $560 million limit for any damage exceeding the two private layers of protection. As the secondary layer increases because of a yearly increase in the number of licensed reactors, however, the governmental indemnity will correspondingly be phased out. When private insurance can cover up to $560 million of liability, governmental indemnity will be completely phased out, and the limitation of liability will gradually be increased.[94]

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on the major objectives of the Government Phase-out Amendment).

90. 42 U.S.C. § 2210(a) (1970).

91. *Id.* § 2210(b)-(c).

92. *Id.* § 2210(b).

93. The NRC has not yet set the premium figure, but it must do so by December 31, 1976.

94. An example of how this phase-out system will work is provided below:

#1. — estimated 1978 (assume 90 reactors and $2 million deferred premium)

Third Party Liability Insurance	$125 million
Retrospective premiums (90 reactors x $2 million prem.)	$180 million
PRIVATE COVERAGE	$305 million
Government indemnity	$255 million
TOTAL LIMIT OF LIABILITY	$560 million

The Paris Convention established a maximum liability of $15 million for the operator. This ceiling may be raised or lowered by national legislation, but in no event can it be less than $5 million.[95] Any damage in excess of the liability ceiling set by the Paris Convention or the individual nations in accordance with the Paris Convention shall be paid by the nation in which the nuclear installation is located up to a maximum amount of $70 million.[96] Finally, damage in excess of $70 million and up to $120 million shall be paid by the contracting parties *jointly*.[97] The Paris and Brussels Supplementary Conventions, therefore, divide liability payments into three *tranches*: (1) maximum liability of the operator; (2) home nation's liability; and (3) collective liability of the contracting parties. Such a system of international payments is quite unique, for

> as far as is known, there is no precedent for a State being obliged to make available sums of money for the compensation for damage with which it has no connection. The Supplementary Convention may, in fact, result in a Contracting Party being obliged to make available funds under the third "tranche" where the incident occurs in a foreign country and where the operator liable and all victims are foreigners.[98]

In France, the maximum liability of the operator is fixed at $10 million for any one incident, regardless of the number of installa-

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#2. — estimated 1985 (assume 220 reactors and $2 million deferred premium)	
Third Party Liability Insurance	$125 million
Retrospective premiums (220 reactors x $2 million prem.)	$440 million
PRIVATE COVERAGE	$565 million
Government indemnity	$000
TOTAL LIMIT OF LIABILITY	$565 million

(After this point, the limit of liability will continue to grow as the number of reactors increases and causes a larger pool of retrospective premium coverage.)

For further discussion of the Government Phase-out Act, see *Legislative and Regulatory Activities: United States,* 14 NUCLEAR L. BULL. 30-32 (1974); Sharpar, *Nuclear Indemnity Legislation in the United States,* 15 NUCLEAR L. BULL. 50 (1975); Gehr, *The Current Status of Price-Anderson,* 10 THE FORUM 1168 (1974).

95. Paris Convention, *supra* note 25, art. 7(b).

96. Brussels Supplementary Convention, *supra* note 27, art. 3(b) (ii).

97. Brussels Supplementary Convention, *supra* note 27, art. 3(b) (iii).

98. Fornasier, *The Paris Supplementary Convention,* in 4 LAW AND ADMINISTRATION 23, 29 (J. Weinstein ed. 1966).

tions he is running on the same site.[99] The French Government is liable for any amount in excess of $10 million up to a maximum of $70 million.[100] Damage in excess of $70 million is covered by contributions from the contracting parties to the Brussels Supplementary Convention.[101] Therefore, the maximum amount recoverable from any one nuclear incident is $120 million.

The limit on an operator's liability in Germany was recently increased from $200 million to $400 million.[102] The operator is only required to furnish financial security of $200 million,[103] however; the German Government indemnifies the operator for the remaining $200 million.[104] Interestingly, the government indemnification is shared by the federal and state governments in a 3:1 ratio.[105]

Innovative legal principles of nuclear liability benefit all the parties. For the victim, absolute and exclusive liability of the operator avoids the problem of having to prove fault in the causation of the accident and also eliminates the necessity of identifying the specific person responsible for the accident. Additionally, compulsory financial security ensures that some funds for the payment of nuclear liability will be available, and government indemnity adds to the potential recovery on nuclear liability claims. If liability were not focused on the operator, maintenance of nuclear liability insurance by all potentially liable parties would be too great an economic burden for the private atomic energy industry to shoulder, perhaps leading to no system of financial security at all. The private atomic energy industry has likewise benefitted from nuclear liability legislation. The limitations on the amount and time

99. Loi No. 68-943, 30 oct. 1968, § 4, [1968] J.O. 31 oct. 1968.

100. *Id.* § 5.

101. *Id.* § 1.

102. Laws of January 31, 1975, February 21, 1975, and July 15, 1975, § 31, [1975] BGB1 I 957, 992, 1021, 1885.

103. *Id.* § 13. The new German legislation fails to clarify whether the insurance coverage of the operator extending to $200 million would first be used to satisfy claims totalling from $70 to $120 million or whether the third *tranche* of the Brussels Supplementary Convention would provide the initial payment of nuclear liability above $70 million. In contrast to the French legislation, the German legislation did not treat the Brussels Supplementary Convention as part of its internal law. Rather, it viewed the Convention as only establishing rights and obligations on the international level so that it did not affect the obligations of the German government to the nuclear operator or the victim. *See Legislative and Regulatory Activities: Germany,* 14 NUCLEAR L. BULL. 14 (1974).

104. Laws of January 31, 1975, February 21, 1975 and July 15, 1975, § 34, [1975] BGB1 I 957, 992, 1021, 1885.

105. *Id.* § 36.

of liability are the counterparts of absolute liability. Exclusive liability allows the industry to allocate the risk to fewer parties with a consequent savings in cost. The government, as indemnitor, acts as another insurer for the nuclear liability of private industry.[106]

VII. Conclusions

Thirty years ago, the first nuclear legislation in the world was enacted in the United States. Today, the United States, France, Germany, and many other nations have extensive atomic energy laws, dealing primarily with property and tort problems. Through individual experiment and the lessons learned from the experience of other countries, national nuclear legislation has innovatively adapted to the Atomic Age. Ownership of the property elements of nuclear power—nuclear substances, nuclear installations, and nuclear patents—was of primary importance during the birth of nuclear legislation. France established a de facto government monopoly in atomic energy, which has continued to the present day. BREVATOME, however, represents an interesting practical approach to public and private industry cooperation in the area of nuclear patents. The United States originally established a governmental monopoly over atomic energy, forbidding any private industry involvement. This government monopoly has been gradually eroded and now exists only in the area of uranium enrichment. This last trace of government monopoly may also soon disappear. Germany, a relative latecomer to nuclear legislation, never created a legal or de facto government monopoly in atomic energy. The only legislative interference with private ownership of nuclear property provided that even though one could have economic ownership of special nuclear material, one could not possess the material without a license from the government.

Legal prohibitions against the private ownership of nuclear property have generally ceased to exist in the United States, France, and Germany. Government monopoly has been replaced by government supervision and regulation, and nuclear legislation dealing with ownership has gradually disappeared. The increased private ownership has, however, apparently heightened the need for special nuclear liability legislation. Thus, nuclear liability is now the dominant concern of nuclear legislation. The United States, France, and Germany have all forged detailed nuclear lia-

106. *See* Strohl, *supra* note 37.

bility laws. Carefully shaped to the circumstances surrounding private ownership of the nuclear power industry, legislation has produced novel changes in traditional tort law.

Either by "economic channeling" or by "legal channeling," one person—the operator of a nuclear installation—has been made liable in the event of a nuclear accident. Absolute liability has been imposed on the operator by law or by a required "waiver of defenses." Two statutes of limitation have been created—one, an absolute limit; the other, a lesser period for plaintiffs having knowledge of their damages. Although the amounts vary between nations, the ceiling on nuclear liability imposed is largely keyed to the availability of private liability insurance coverage. Financial security has been made compulsory, and the government has become the indemnitor for amounts in excess of private financial security coverage. In all these areas, the common law solution is substantially equivalent to that of the civil law systems.

Presently, the United States is attempting an eventual governmental indemnity phase out by the use of a unique private insurance system of deferred premiums. This will gradually lead to an increased liability ceiling. In the international sphere, the Paris Convention *tranches* system of individual, national, and international contributions to nuclear liability represents an experimental attempt at international sharing of nuclear liability risks.

After a period of incubation and maturation, the world's private nuclear power industry now appears increasingly able to stand on its own feet. With the newly found independence of the private nuclear power industry, the emphasis of nuclear legislation has shifted from prohibition or sponsorship of private nuclear power development to public protection. Liability, not government ownership, is the primary focus of today's nuclear legislation.