Octavio García Pérez*

Original Scientific Paper
DOI: 10.47152/ns2025.17

THE PROTECTION OF LIFE AND HEALTH AGAINST NUCLEAR ENERGY AND IONIZING RADIATION UNDER SPANISH CRIMINAL LAW[1]

This paper examines the evolution of Spanish criminal law regarding the protection of life and health against risks arising from nuclear energy and ionizing radiation. Initially regulated by the Nuclear Energy Act of 1964, these offences were later incorporated into the 1995 Criminal Code under the category of catastrophic risk offences. Subsequent reforms – particularly those introduced by Organic Laws 15/2003, 5/2010, 1/2015, and 2/2015 – expanded and redefined the criminal framework in response to international obligations, including Directive 2008/99/EC. The analysis highlights inconsistencies in penalty structures, interpretative challenges, and the increasing importance of international law in shaping national criminal provisions concerning nuclear safety and radiological protection.

Keywords: *spanish criminal law, nuclear energy, ionizing radiation*.

* Full Professor of Criminal Law at the University of Málaga, e-mail: ogarcia@uma.es,
ORCID: 0000-0001-6881-6522

[1] This work has been carried out within the framework of project SUBV-25/2022, *Law and Radiological Protection of the Environment* (DEPRAMA), funded by the Nuclear Safety Council of Spain.

1. Introduction

Prior to the enactment of the 1995 Criminal Code, offences related to nuclear energy were regulated under Act 25/1964 of April 29, on Nuclear Energy. The preamble to Act 25/1964 justified the inclusion of these offences by stating: *"It is necessary to define and penalize specific criminal offences, given the significance that a violation in the field of nuclear energy may entail. The penalties established in the general Criminal Code have been taken into account, and it has been considered more appropriate to typify such offences within the scope of the Nuclear Act rather than include them in the aforementioned Code, due to their exceptional nature"*.

Accordingly, Articles 84 et seq. of Title XIII included both intentional and negligent conduct involving the release of nuclear energy, disruption of nuclear facilities, exposure to ionizing radiation, operation of nuclear installations or devices generating radioactive substances, and unauthorized trafficking of such substances. In most cases, the endangerment of life, health, or property was required. The regulation was supplemented by a rule on concurrence of offences, and the Criminal Code was designated as a subsidiary legal text.

Subsequently, the 1995 Criminal Code incorporated offences related to nuclear energy and ionizing radiation into Section 1 of Chapter I, titled "Offences Involving Catastrophic Risk," within Title XVI "Offences Against Public Safety" of Book II. This section includes the release of nuclear energy or radioactive substances, disruption of nuclear or radioactive facilities, and exposure to ionizing radiation. In all cases, endangerment of life, health, or property is required. Negligent conduct is also punishable, and the unlawful appropriation of nuclear materials or radioactive elements is criminalized.

One of the most striking aspects of the new regulation is that it went largely unnoticed – even by the legislator. In the reform introduced by Organic Law 15/2003 of November 25, a second paragraph was added to Article 325, stating: *"Anyone who intentionally releases, emits, or introduces ionizing radiation or other substances into the air, soil, or maritime, inland, surface, or underground waters, in quantities that cause death or illness in a person requiring, beyond initial medical assistance, further medical or surgical treatment or resulting in irreversible damage, shall be punished, in addition to the penalty corresponding to the harm caused to persons, with imprisonment of two to four years"*.

This provision was introduced to comply with Directive 2008/99/EC of the European Parliament and of the Council of November 19, 2008, on the protection of the environment through criminal law. Article 3 of the Directive mandates the criminalization of intentional or negligent conduct involving *"the discharge, emission, or introduction* *into air, soil, or water of a quantity of materials or ionizing radiation that causes or may cause death or serious injury to persons or substantial damage to the quality of air, soil, or water, or to animals or plants".*

Thus, with the addition of the second paragraph to Article 325, if nuclear energy is released and results in a person's death, the penalty is two to four years plus the penalty corresponding to the fatal outcome. In contrast, the mere endangerment of life, health, or property through the release of nuclear energy is already punishable under Article 341 with a sentence of fifteen to twenty years. In effect, the offender faces a more favorable penalty when causing death than when merely endangering it.

The issue was resolved by Organic Law 5/2010 of June 22, which transferred the content of Article 325.2 to Article 343, penalizing the endangerment of life, health, property, or the quality of air, soil, or water, as well as harm to animals or plants, through the discharge, emission, or introduction into the air, soil, or water of a quantity of materials or ionizing radiation, or exposure to such radiation by any other means. As will be seen, this new provision raises numerous interpretative challenges regarding offences related to nuclear energy.

This was not the final reform concerning nuclear energy offences. Organic Law 1/2015 of March 30, which amended Organic Law 10/1995 of November 23, the Criminal Code, introduced a new version of Article 345, which had already been modified by Organic Law 5/2010.

However, this analysis would be incomplete without reference to the reform introduced by Organic Law 2/2015 of March 30, which also amended Organic Law 10/1995 of November 23, the Criminal Code, and introduced two modifications relevant to the subject at hand. First, Article 566 was amended to criminalize the manufacture, commercialization, trafficking, and establishment of deposits of nuclear or radiological weapons not authorized by law or by the competent authority. The law imposes a prison sentence of five to ten years for organizers or promoters, and three to five years for those who have cooperated in their formation. The final paragraph imposes the same penalties for the development, use, preparation for use, or failure to destroy nuclear or radiological weapons in violation of international treaties or conventions to which Spain is a party.

Additionally, in the same reform, within the framework of terrorism-related offences, Article 574 of the Criminal Code was amended to read as follows:

"1. The deposit of weapons or ammunition, the possession or deposit of explosive, flammable, incendiary, or asphyxiating substances or devices, or their components, as well as their manufacture, trafficking, transport, or supply in any form, and the mere placement or use of such substances or appropriate means or devices, shall be punished with imprisonment of eight to fifteen years when the acts are committed with any of the purposes set forth in Article 573.1.

2. A prison sentence of ten to twenty years shall be imposed when the weapons, substances, or devices involved are nuclear, radiological, chemical, or biological, or any others of similar destructive power.
3. The same penalty of ten to twenty years of imprisonment shall apply to those who, with the same purposes indicated in paragraph 1, develop chemical or biological weapons, or unlawfully acquire, possess, transport, supply to others, or manipulate nuclear materials, radioactive elements, or materials or equipment capable of producing ionizing radiation".

The preamble to Organic Law 2/2015 merely notes that "the aggravation of penalties is specifically addressed when dealing with nuclear, radiological, chemical, or biological weapons, substances, or devices, or any others of similar destructive power". In any case, a detailed analysis of these two offences introduced by the 2015 reform exceeds the scope of this study.

2. Nuclear Energy, Ionizing Radiation, and Their Effects

Before analyzing the relevant criminal offences, it is essential to clarify the nature of nuclear energy, ionizing radiation, and their effects on individuals and the environment. Nuclear energy is the energy contained within the nucleus of an atom, which, as is well known, is the smallest particle into which a chemical element can be divided without losing its properties. The atom consists of two parts: the nucleus and the electron shell. The nucleus contains two types of particles: protons, which carry a positive charge, and neutrons, which are electrically neutral. These particles are held together by nuclear energy. Surrounding the nucleus are electrons, which carry a negative charge and are attracted to the positively charged nucleus.

Nuclear energy can be harnessed to generate electricity, but first it must be released. This can be achieved through two methods: nuclear fusion and nuclear fission. In fusion, energy is released by combining or fusing the nuclei of atoms to form a larger nucleus – this is how the sun produces energy. In fission, the nucleus of an atom is split into two or more smaller nuclei, releasing energy in the process. To induce nuclear fission, the nucleus is bombarded with neutrons. Each reaction results in a small loss of mass, which is converted into heat and radiation. This heat is used in nuclear power plants to heat a coolant – typically water – which then produces steam that drives turbines to generate electricity. Nuclear technology is not limited to energy production; it is also widely used in fields such as medicine, industry, and agriculture[2].

With regard to radioactive material, Article 2.2 defines it as "any substance containing elements that emit ionizing radiation". Paragraph 1 of the same article states that ionizing radiation refers to "radiation capable of producing ions, either directly or indirectly, as it passes through matter".

Ionizing radiation is a form of energy released by atoms during their disintegration, either in the form of electromagnetic waves (such as gamma rays or X-rays) or particles (such as alpha and beta particles or neutrons). Unlike non-ionizing radiation, ionizing radiation possesses sufficient energy to displace electrons from the atoms with which it interacts. The effects of ionizing radiation vary depending on its nature, as electromagnetic waves behave differently from alpha and beta particles.

Alpha radiation consists of helium-4 nuclei produced during certain nuclear disintegrations, composed of two neutrons and two protons. These particles have considerable mass but low penetration capacity, meaning that human skin is generally sufficient to shield against their effects.

Beta radiation consists of particles that may be electrons (negative beta) or positrons (positive beta), generated during specific nuclear disintegrations. These particles originate not from the atom's electron shell but from its nucleus, as a result of transformation through division. Beta particles are less massive than alpha particles but possess greater penetration capacity, capable of penetrating up to two centimeters into living tissue. However, they cannot pass through a sheet of aluminum.

X-rays and gamma rays are electromagnetic waves that lack both mass and electric charge. Gamma rays originate from the disintegration of atomic nuclei in certain radioactive elements, while X-rays are emitted from the atom's electron shell. Both types of radiation are highly penetrating and require lead shielding of a certain thickness to be effectively blocked.

Finally, neutrons released during nuclear fission exhibit a high degree of penetration[3].

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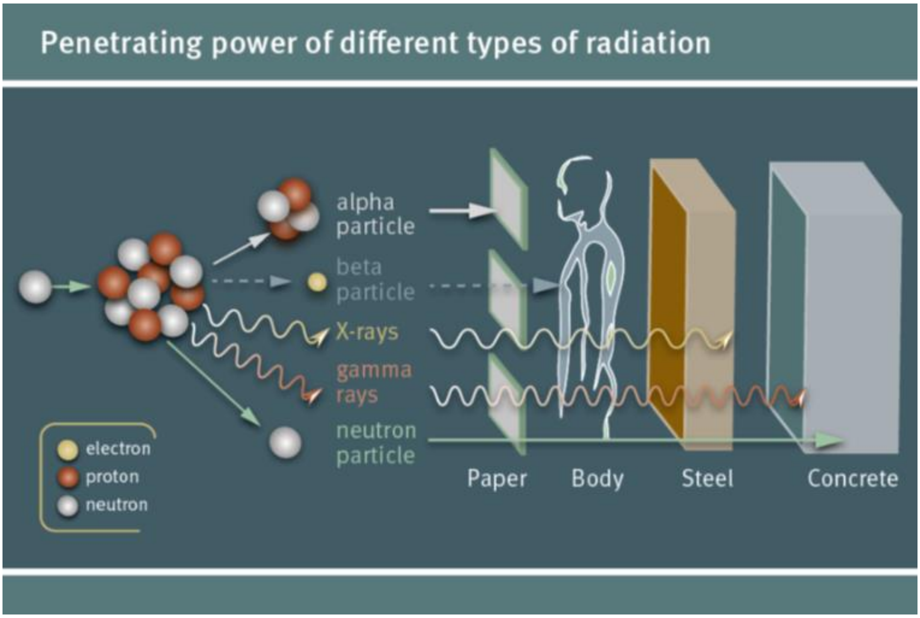
[2] On this matter, see: CONSEJO DE SEGURIDAD NUCLEAR: La energía nuclear. 2015 (last accessed on April 21, 2024 https://www.csn.es/documents/10182/26f1078a-76da-44a1-b106-8be0159d9f41); ANDREA GALINDO, A.: ¿Qué es la energía nuclear? La ciencia de la energía nucleoeléctrica. 2024 (last accessed on April 21, 2024 https://www.iaea.org/es/newscenter/news/que-es-la-energia-nuclear-la-ciencia-de-la-energia-nucleoelectrica); ALCARAZ BAÑOS, M.: "El átomo" (last accessed on April 21, 2024 https://webs.um.es/mab/miwiki/lib/exe/fetch.php?media=t1.pdf).

[3] Regarding the different types of ionising radiation, see also:. https://www.csn.es/radiaciones-ionizantes, https://espanol.epa.gov/espanol/informacion-basica-sobre-la-radiacion,



Ionizing radiation produces various effects on humans, animals, and plants. To measure radiation exposure, different units are employed. The amount of radiation absorbed per kilogram of living tissue is referred to as the absorbed dose, measured in grays (Gy). Given that the biological effects vary depending on the type of particle or wave, a weighted dose – known as the equivalent dose – is used for comparative purposes and is measured in sieverts (Sv). Since different organs and tissues exhibit varying levels of vulnerability to radiation exposure, the equivalent dose is further adjusted to reflect the specific organs affected, resulting in the effective dose, also measured in sieverts (Sv)[4].

4 UNITED NATIONS ENVIRONMENT PROGRAMME: Radiation. Effects and sources. 2016, pp. 7 y s. (last accessed on september 6, 2025 https://www.unscear.org/unscear/en/publications/radiation-effects-and-sources.html)

Dose bands used by UNSCEAR

High dose	More than ~1 Gy	Severe radiation accidents (e.g. firemen at the Chernobyl accident)
Moderate dose	~100 mGy to ~1 Gy	Recovery operation workers after the Chernobyl accident
Low dose	~10 mGy to ~100 mGy	Multiple computer tomography (CT) scans
Very low dose	Less than ~10 mGy	Conventional radiography (i.e. without CT)

Source: table extracted from the publication by the United Nations Environment Programme, *Radiation: Effects and Sources*. 2016, p. 12.

In the case of human beings, exposure to ionizing radiation may result in both early and late-onset effects. The former can be diagnosed by medical specialists, who are often able to attribute the resulting conditions directly to radiation exposure. These include skin burns, hair loss, and infertility. At doses exceeding 50 Gy, damage to the central nervous system is so severe that it typically leads to death within a matter of days.

At doses below 8 Gy, individuals may suffer from acute radiation syndrome, which manifests through symptoms such as nausea and vomiting, diarrhea, headaches, fever, dizziness and disorientation, fatigue, hair loss, infections, hypotension, and bloody stools. These symptoms appear immediately and may ultimately result in death due to gastrointestinal complications.

At lower doses, the onset of illness is delayed and symptoms tend to be less severe. Approximately half of those exposed to doses under 2 Gy experience vomiting, whereas this symptom is generally absent when the dose does not exceed 1 Gy[5].

Late-onset effects are identified through epidemiological studies, which reveal an increased incidence of specific pathologies within exposed populations. These effects include the development of solid tumors, leukemia, and genetic disorders in offspring. Cancer, in particular, is a complex phenomenon that progresses through various stages,

[5] *Ibidem*, p. 14.

and the actual contribution of radiation exposure to its development remains uncertain[6]. As noted by Gómez Gómez and Udías Moinelo, "the effects of lower doses are unknown. The most serious illnesses typically develop over the course of years, and it is nearly impossible to determine with statistical certainty what proportion of tumors originate from the radiation received. Due to these uncertainties, long-term estimates of the consequences of an accident vary significantly depending on the model used to perform such estimations" [7].

3. The legal Asset

According to numerous scholars, the criminal offences under consideration aim to safeguard a supra-individual legal Asset – namely, collective security[8]. Muñoz Conde, for instance, asserts that collective security may be interpreted in two distinct ways. First, it may be understood as "the guarantee of the prevention of harm of a supra-individual nature" [9]. Under this interpretation, the relevant criminal provisions penalize conduct that endangers predominantly collective assets, either due to their qualitative nature or the indeterminate number of individuals affected[10]. Alternatively, collective security may be construed as synonymous with "public tranquility". From this perspective, emphasis is placed on "the creation of a climate of social assurance that conduct related to atomic processes will not result in a situation of danger to legal assets – whether individual or collective". In the view of this author, only this second interpretation is capable of encompassing all the criminal offences in question[11].

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[6] *Ibidem*. pp. 15 y ss.

[7] GÓMEZ GÓMEZ/UDÍAS MOINELO: "Chernóbil, treinta años después", (last accessed on april 25, 2004, https://www.ucm.es/otri/chernobil-treinta-anos-despues).

[8] ACALE SÁNCHEZ, M.: "Los delitos contra la seguridad colectiva", en ACALE SÁNCHEZ, M. (coord.): *Lecciones y materiales para el estudio del Derecho penal. T. III. Derecho penal. Parte Especial*. Vol. II, 3ª ed., Iustel, Madrid, 2023, p. 30; GORDILLO ÁLVAREZ-VALDÉS, I. (2005), "Estudio de los delitos relativos a la energía nuclear", en *Revista CSN: Seguridad nuclear*, nº 34, p. 10; RODRÍGUEZ MONSERRAT, M.: La "seguridad nuclear" a juicio: análisis del sistema punitivo español aplicable a los peligros y daños generados por el uso de la energía nuclear, en *Actualidad Jurídica Ambiental*, nº. 107 (Diciembre), 2020, pp. 43 y s.; CARDENAL MONTRAVETA, S. (2015), "De los delitos de relativos a la energía nuclear y a las radiaciones ionizantes", en CORCOY BIDASOLO/MIR PUIG: *Comentarios al Código penal*. Tirant lo blanch, Valencia, p. 1209. También la jurisprudencia se ha inclinado por esta postura. Cfr. Audiencia Provincial de Tarragona, Sección 4ª, Auto 226/2020, de 13 Mar. 2020 (ECLI: *ES:APT:2020:1411A*); Audiencia Provincial de Cádiz, Sección 1ª, Auto de 31 May. 2004.

[9] MUÑOZ CONDE, F.: Derecho Penal. Parte especial. 25ª Edición, revisada y puesta al día con la colaboración de Carmen López Peregrín. Tirant lo Blanch, Valencia, 2023, p. 635.

[10] Ibidem.

[11] *Ibidem*. p. 636.

Thus, Morales Prats and García Solé argue that Articles 341 and 342 do not seek to protect individual legal assets such as life, health, or property, but rather "the conditions that ensure their inviolability as a distinct and anticipatory object of legal protection". In the face of conduct with high destructive potential, collective security acquires sufficient relevance to be configured as an autonomous legal asset, which could be "defined as the right of all individuals to conduct their lives in peace, serenity, well-being, and tranquility". From this perspective, these authors consider that the references made in the criminal provisions to individual assets such as life, health, or property serve as "the (accurate) benchmark for the danger assessments typically expressed". In their view, at most, the individual assets mentioned in the provisions would constitute the mediate object of protection[12].

Cardenal Montraveta also suggests that collective security may be understood "as an expression of the abstract capacity of the described conduct to endanger the life and/or physical integrity of an indeterminate plurality of persons"[13], in line with Supreme Court Judgment 538/2000 of 25 April. That ruling endorsed the inclusion of offences such as arson and public disaster within the category of crimes against collective security, distinguishing them from property damage offences, which primarily protect individual legal assets such as ownership. The Court further emphasized that "the doctrinal interpretation of Article 346, which requires that the risk to life or physical integrity resulting from public disasters be concrete, cannot be accepted. Considering that this criminal provision is included in a Title referring to crimes against collective security, and therefore does not require identification of specific individuals for its application, it is sufficient that the danger threatens indeterminate persons, namely, all citizens as members of the social collective"[14]

As can be seen, collective security is largely linked to the prevention of risks to both individual and supra-individual assets. This is reflected in a definition frequently cited in legal doctrine, offered by González Rus: "a set of conditions whose fulfillment ensures and generates the social expectation that the risk to personal or collective assets involved in certain hazardous activities will not increase beyond what is inherent to the

[12] MORALES PRATS/GARCÍA SOLÉ: "De los delitos relativos a la energía nuclear y a las radiaciones ionizantes", en QUINTERO OLIVARES (Dir.): *Comentarios a la Parte Especial del Derecho penal.* Aranzadi, 10ª ed., Cizur Menor, 2016, p. 1325.

[13] CARDENAL MONTRAVETA, S.: "De los delitos de relativos a la energía nuclear y a las radiaciones ionizantes", en CORCOY BIDASOLO/MIR PUIG (Dir.): *Comentarios al Código penal*. Tirant lo blanch, Valencia, 2024, p. 1563.

[14] ROJ: STS 3476/2000.

permitted development of each activity"[15]. This author further asserts that collective security constitutes "a mediate form of protecting legal assets whose importance justifies the anticipatory intervention of criminal law at the moment an activity deviates from the established safety parameters designed to control its inherent risks, well before any actual harm to those assets occurs". He concludes by noting that catastrophic risk offences may result in "consequences of extraordinary magnitude," which does not preclude the criminal provisions from "limiting the typical danger to that which affects specific and identifiable individuals"[16].

Indeed, legal doctrine offers various nuances when identifying the protected legal asset under Articles 341 et seq. For instance, Morales Prats and García Solé maintain that although the immediate object of protection in Article 343 remains collective security[17], the inclusion in the 2010 reform of references to risks affecting "the quality of air, soil, or water, or to animals or plants" implies the mediate protection of the environment alongside individual assets such as life, health, and property[18].

Conversely, a sector of the doctrine contends that collective security cannot constitute the protected legal asset. In this regard, Villacampa Estiarte, discussing the criminal provisions in Articles 348 to 350 of the Criminal Code, argues that "although the conduct typified affects an indeterminate group of individuals, this circumstance should not lead us to conclude that something as ethereal and indeterminate as the security of all members of the social body must be elevated to the status of a protected asset"[19]. In his view, the object of protection in the aforementioned provisions should be identified as "the life, physical integrity, and health of individuals, as well as the environment"[20].

In my opinion, security as such cannot constitute the protected legal asset, since in this context, security is synonymous with the absence of danger or risk. This is precisely what criminal punishment seeks to achieve: the prevention of endangerment or harm to the protected asset. The criminal provision, whether by prohibiting certain conduct or mandating specific behavior, aims to guarantee the security of the legal asset. In

[15] GONZÁLEZ RUS, J. J.: "Delitos contra la seguridad colectiva. Delitos de riesgo catastrófico. Incendios", en Morillas Cueva, L.: *Sistema de Derecho penal español. Parte Especial*. Dykinson, Madrid, 2011, p. 779.

[16] *Ibidem*. pp. 779 y s.

[17] Para DE LA CUESTA AGUADO, M. P.: "Delitos relativos a la energía nuclear y radiaciones ionizantes", en ÁLVAREZ GARCÍA, F. J.: *Derecho penal español. Parte Especial*.Tirant lo blanch, Valencia, Vol. 2, 2011, p.1122, Article 342 protects collective security, conceiving it as the "immutability of the essential safety conditions in the performance of highly dangerous activities".

[18] MORALES PRATS/GARCÍA SOLÉ: De los delitos relativos a la energía nuclear. *Op. Cit.*, p. 1325.

[19] VILLACAMPA ESTIARTE, C.: "De otros delitos de riesgo provocados por explosivos y otros agentes", en QUINTERO OLIVARES, G.: *Comentarios a la Parte Especial del Derecho Penal*. Aranzadi, Cizur Menor, 2015, p. 1346.

[20] *Ibidem.*

other words, these are normative commands directed at citizens, instructing them to refrain from actions that may endanger or harm a legal asset, or to engage in conduct that preserves it. Consequently, security is a predicate applicable to any legal asset – whether individual (e.g., the security of life, health, etc.) or collective (e.g., the security of the environment, public administration, etc.). Ultimately, the legal asset cannot be security itself, but rather that which is intended to be secured.

We are dealing with criminal provisions that require conduct resulting in a specific effect on individual legal assets – namely, a danger to life, health, or property[21]. If these provisions demand the existence of a threat to individual legal assets such as life, health, or property, there is no justification for elevating the level of abstraction in the determination of the protected asset by identifying a supra-individual asset whose harmfulness is, in turn, assessed based on the impact on individual assets.

Legal doctrine interprets these provisions as encompassing both independent and dependent life, thereby including cases in which the danger affects fetal life[22]. Regarding health, De la Cuesta Aguado notes that both physical and psychological health are covered, although he acknowledges that endangerment of the latter presents particular challenges, as it seems difficult for the conduct typified in these offences to directly affect psychological health[23]. The psychological effects of the Chernobyl nuclear accident have been thoroughly studied. Significant psychological sequelae have been observed, including headaches, depression, sleep disorders, impaired concentration, and emotional instability. Among emergency workers with no prior experience in the nuclear industry, cases of neurosis were documented, as well as symptoms consistent with post-traumatic stress

[21] DE LA CUESTA AGUADO, M. P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1122,; ANDRÉS DOMINGO, A. C.: "De los delitos relativos a la energía nuclear y a las radiaciones ionizantes, en GÓMEZ TOMILLO, M. (Dir.): *Comentarios prácticos al Código penal*. T. IV. Thomson Reuters/Aranzadi, Cizur Menor, 2015, pp. 220 y ss.; CARBONELL MATEU, J. C.: "Delitos contra la seguridad colectiva (I): riesgos catastróficos. Estragos e incendios", en GONZÁLEZ CUSSAC, J. L.: *Derecho penal. Parte Especial*. 8ª ed., Tirant lo blanch, Valencia, 2023, p. 636; WOLFF, H.: Comentario al parágrafo 307, en *Strafgesetzbuch. Leipziger Kommentar*. 12ª ed. Tomo 11. De Gruyter, Berlin, 2008, marginal 1. WOLTERS, G.: Comentario al parágrafo 307, en *Strafgesetzbuch. Kommentar*. 4ª ed., Carl Heymanns Verlag, Colonia, 2019, marginal 1.

[22] ANDRÉS DOMÍNGUEZ, A. C.: De los delitos relativos a la energía nuclear. *Op. Cit*., p. 221.

[23] DE LA CUESTA AGUADO, M. P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1123.

disorder (PTSD)[24]. Similarly, in the case of the Fukushima accident, psychological conditions such as depression and PTSD have been reported[25].

This conceptual framework must be qualified in relation to certain offences. Indeed, Article 343, by contemplating a threat to the quality of air, soil, or water in addition to individual assets, seeks to protect a collective legal asset – namely, the environment[26]. The same observation applies to Article 345.

In my view, the current legal framework is deficient with respect to the identification of the protected legal asset. Initially, the provisions referred solely to the endangerment of life, health, or property. However, subsequent reforms have introduced references to the environment. It is worth noting that the original configuration was based on an anthropocentric conception, which presumed that adequate protection of human life would inherently safeguard the lives of animals and plants. This assumption is largely valid, given that mammals are among the most sensitive organisms to radiation exposure. Nevertheless, it cannot be ruled out that certain environmental elements may be even more vulnerable.

Therefore, de lege ferenda, it would be advisable for all relevant criminal provisions to explicitly include the environment alongside human life and health as protected legal assets.

4. General Analysis of Criminal Offences

The criminal offences related to nuclear energy and ionizing radiation are structured as endangerment offences, which is a logical approach. As previously discussed, except in cases involving immediate effects, it is virtually impossible to determine

[24]UNSCEAR: Sources and effects of ionizing radiation. Vol. II: Effects. Naciones Unidas, Nueva York, 2000, p. 513 (last accessed june 28, 2024, https://www.unscear.org/docs/publications/2000/UNSCEAR_2000_Report_Vol.II.pdf). METTLER, F. A.: “non-cancer health effects of the chernobyl accident and special health care programmes”, en INTERNATIONAL ATOMIC ENERGY AGENCY: *CHERNOBYL: Looking Back to Go Forward. Proceedings of an international conference*. Viena, 2008 (last accessed june 28, 2024, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1312_web.pdf), p. 109.

[25] UNSCEAR: *Sources, Effects and Risks of Ionizing Radiation (Report to the General Assembly), 2013 Report, Vol. I, Scientific Annex A: Levels and Effects of Radiation Exposure Due to the Nuclear Accident after the 2011 Great East-Japan Earthquake and Tsunami*, UNSCEAR, Naciones Unidas, Nueva York, 2014, p. 10 (consultado por última vez el 30 de junio de 2024 en https://www.unscear.org/unscear/uploads/documents/unscear-reports/UNSCEAR_2013_Report_Vol.I.pdf.

[26] In this regard also, for example, DE LA CUESTA AGUADO, M. P.: Delitos relativos a la energía nuclear. *Op. Cit.*, p. 1122 y s.

whether health conditions such as cancer are the result of radiation exposure or attributable to other factors.

Under the original version of Act 25/1964, only certain criminal provisions required the existence of danger, and this was always linked to life, health, or property – that is, to individual legal assets. Additionally, a rule on concurrence was established for cases in which, beyond the risk, the conduct resulted in death, injury, or damage to property.

When these offences were incorporated into the 1995 Criminal Code, the reference to danger to life, health, or property was retained. However, in some provisions, the risk was limited to life or health alone. In offences concerning the trafficking of nuclear or radioactive material, any reference to risk to personal property continues to be omitted.

The situation has become more complex following subsequent reforms to the Criminal Code in this area. Currently, the offence of releasing nuclear energy or radioactive materials requires a danger to life, health, or property. The offence of disrupting nuclear or radioactive installations or their operations requires a serious danger to life or health, without mentioning property. By contrast, the offence of exposure to radiation is now complemented by provisions concerning the discharge, emission, or introduction of substances into the air, soil, or water, encompassing not only danger to life, health, or property, but also to the quality of air, soil, and water, as well as to animals and plants.

Finally, the offence related to the trafficking of nuclear materials or other hazardous radioactive substances – which until 2010 was punishable without reference to any impact on individual or collective legal assets – now includes the requirement that such conduct "causes or may cause death or serious injury to persons, or substantial damage to the quality of air, soil, or water, or to animals or plants". Thus, the current legal framework consistently requires that the conduct pose a risk to some individual or collective legal asset, except in the case of the production of radioactive materials, where no such requirement is specified.

In my view, this situation is deeply unsatisfactory. It is unclear why, depending on the specific conduct, the law requires a danger to life or health, or to those assets and property, or to those and the environment. In fact, since the introduction of the second paragraph of Article 325 – which, as noted, was later transferred to the offences related to nuclear energy – it appears that a shift has occurred in the configuration of these offences, aimed at granting greater relevance to environmental protection in their definition. Nevertheless, much remains to be done. While some provisions consider only risks to life, health, or property, others include danger to the environment.

If progress is to be made in this direction, at least two alternatives are available. The first would involve classifying these offences under environmental crimes and punishing them based on their impact on this collective legal asset, with aggravated forms introduced when the risk extends to individuals. The second would entail removing the reference to radiation from Article 325 and reformulating Articles 341 to 345 to explicitly include the environment as one of the protected legal assets.

There also appears to be a lack of consistency in the penalties imposed. Under no circumstances should the penalties be the same when the danger is to life or health as when it is to property. As De la Cuesta Aguado has pointed out, it is difficult to understand why the 2010 reform failed to provide for the punishment of legal persons under Articles 341 and 342, which address the most serious conduct and typically occur in facilities owned by legal entities[27]. Another issue worth noting is the structural inconsistency in the treatment of intent and negligence. After typifying three intentional offences, the law provides for their punishment when committed negligently, only to then introduce another intentional offence that also includes negligent conduct. A more coherent approach would have been to dedicate the first four articles to the typification of intentional conduct and reserve the final article, Article 345, for the punishment of negligent acts.

5. The Offence of Releasing Nuclear Energy or Radioactive Elements

Article 341 of the Spanish Criminal Code penalizes "anyone who releases nuclear energy or radioactive elements that endanger the life, health, or property of individuals, even if no explosion occurs". The prescribed penalty for such conduct is imprisonment for a term of fifteen to twenty years, along with special disqualification from public office, profession, or trade for a period of ten to twenty years.

The typical conduct – "to release" – refers specifically to nuclear energy or radioactive elements. The active subject may be any individual, as no specific technical qualification is required to commit at least some of the typified behaviors[28].

The offence does not consist merely in carrying out any nuclear process to generate energy, as this would render typical the activity of, for example, a thermal power plant. Rather, the conduct consists in "producing or allowing the emanation of developed energy in such a way that it escapes the control established by the regulations governing

[27] DE LA CUESTA AGUADO, M. P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1119.

[28] En este sentido, GONZÁLEZ RUS, J. J.: Los delitos contra la seguridad colectiva. *Op. Cit*., p. 783.

the proper operation of the nuclear plant and the entire nuclear combustion cycle"[29]. Thus, the offence concerns the uncontrolled emission of energy outside authorized circuits, whether in the form of particles or waves[30]. The release of radioactive elements is equivalent to the emission of ionizing radiation. This effect may be caused by what Article 2 of Act 25/1964 of 29 April on Nuclear Energy defines as radioactive material, which includes radioactive minerals, concentrates – defined as products derived from the treatment of radioactive minerals with uranium or thorium content higher than that found in nature – nuclear fuels, and radioactive products or waste[31].

In any case, as legal doctrine emphasizes, the determination of the criminal typicity of the conduct must be assessed in accordance with the applicable regulations on nuclear facility safety and the use of ionizing radiation. A broad regulatory framework exists, beginning with Act 25/1964. Among the relevant regulations are: Royal Decree 1029/2022, approving the Regulation on Health Protection Against Risks from Exposure to Ionizing Radiation; Royal Decree 601/2019, on the justification and optimization of ionizing radiation use for medical exposure; Royal Decree 1400/2018, approving the Regulation on Nuclear Safety in Nuclear Facilities; Order ETU/1185/2017, regulating the declassification of residual materials generated in nuclear facilities; Royal Decree 1308/2011, on the physical protection of nuclear facilities and materials, and radioactive sources; Royal Decree 229/2006, on the control of high-activity sealed radioactive sources and orphan sources; and Royal Decree 1836/1999, approving the Regulation on Nuclear and Radioactive Facilities[32].

This offence raises delimitation issues with Article 343, since the release of nuclear energy or radioactive material entails the emission into air, soil, or water of a quantity of materials or ionizing radiation. It also overlaps with environmental crimes under Article 325, which likewise addresses the emission of radiation. However, the penalties differ significantly, with Article 341 prescribing the most severe sanctions. Delimitation with Article 342 is also problematic.

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[29] DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit.*, p. 1126; MORALES PRATS/GARCÍA SOLÉ: De los delitos relativos a la energía nuclear. *Op. Cit.*, p. 1327.

[30] DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit.*, p. 1126; MORALES PRATS/GARCÍA SOLÉ: De los delitos relativos a la energía nuclear. *Op. Cit.*, p. 1328.

[31] En este sentido, por ejemplo, GONZÁLEZ RUS, J. J.: Los delitos contra la seguridad colectiva. *Op. Cit.*, p. 782.

[32]A more thorough list: https://www.csn.es/centro-de-documentacion?_20_folderId=896582&_20_viewEntries=1&_20_viewFolders=1&_20_struts_action=%2Fdocument_library%2Fview&p_p_id=20&p_p_lifecycle=0&_20_entryStart=0&_20_entryEnd=30&_20_folderStart=0&_20_folderEnd=100&_20_action=browseFolder

According to Acale Sánchez, the relationship between Articles 325 and 341 should be resolved through the application of ideal concurrence of offences[33]. In my view, this solution is unconvincing. The release of nuclear energy or radioactive material necessarily entails contamination of at least air and soil. Notably, Article 325, in cases of serious risk to the balance of natural systems and human health, provides for a maximum prison sentence of seven years and six months, whereas Article 341, which implicitly presupposes environmental risk and explicitly requires danger to life or health, imposes significantly harsher penalties.

Regarding delimitation with Article 342, Cardenal Montraveta argues that Article 341 applies to cases where the danger affects "a large number of people"[34]. This criterion seems insufficient, as nuclear facilities themselves may affect many individuals. Nonetheless, the author points in the right direction by suggesting that the conduct under Article 342 is less dangerous than that under Article 341 and concludes that the provision anticipates protective barriers, punishing conduct where control over hazardous materials has not yet been lost. This interpretation is sound: the provision targets pre-release conduct, including actions that could contribute to a radiation leak but have not resulted in such due to compliance with emergency protocols. For example, diverting part of a river's flow used as a coolant may disrupt facility operations, yet if resolved through proper protocols without endangering life or health, the conduct would fall under an abstract endangerment offence, justifying a lesser penalty and rendering Article 342 subsidiary to Article 341.

Following the 2010 reform, further delimitation issues arise with Article 343.1, which overlaps with Article 325.1. Originally, Article 343 typified the exposure of one or more individuals to ionizing radiation, with the result being endangerment of life, integrity, or property. From this perspective, Morales Prats distinguished Articles 341 and 342 as involving "an indeterminate or incalculable number of affected individuals," whereas Article 343 "requires exposure of one or more specific individuals to ionizing radiation"[35]

Since 2010, Article 343 penalizes "anyone who, through discharge, emission, or introduction into air, soil, or water of a quantity of materials or ionizing radiation, or through exposure by any other means to such radiation, endangers the life, integrity,

[33] ACALE SÁNCHEZ, M.: "Los delitos contra la seguridad colectiva", en ACALE SÁNCHEZ, M. (coord.): *Lecciones y materiales para el estudio del Derecho penal. T. III. Derecho penal. Parte Especial*. Vol. II, 3ª ed., Iustel, Madrid, 2023, pp. 30 y ss.

[34] CARDENAL MONTRAVETA, S.: "De los delitos de relativos a la energía nuclear. *Op. Cit.*, p. 1565.

[35] MORALES PRATS, F.: "De los delitos relativos a la energía nuclear y a las radiaciones ionizantes", en QUIINTERO OLIVARES, G.: *Comentarios a la Parte Especial Del Derecho Penal*. Aranzadi, 1996, p. 919; REQUEJO CONDE, C.: *El delito relativo a la energía nuclear*. Thomson/Aranzadi, 2005, p. 49.

health, or property of one or more individuals". The penalty is imprisonment for six to twelve years and special disqualification from public office, profession, or trade for six to ten years. These penalties also apply "when such conduct endangers the quality of air, soil, or water, or animals or plants". De la Cuesta Aguado rightly notes that the amendment did not eliminate the original content – namely, limited exposure of one or more individuals or their property[36]. However, she adds that "the first clause of the first paragraph introduces a new mode of conduct more characteristic of a catastrophic risk offence (typical of a risk society)". Thus, Article 343 now contains two modes of conduct: the original and a new one, "which alone creates a general risk of dimensions that are difficult to quantify". The author correctly interprets this as conduct akin to the environmental offence under Article 325, replicating the contaminating act in simplified form. Nevertheless, she adds that Article 343 excludes cases where "radiation affects a large number of individuals indiscriminately (e.g., a radioactive leak exposing all residents of a city or geographic area to ionizing radiation), which would fall under Article 341"[37].

In my view, except in cases where the conduct occurs within a narrowly confined spatial scope that can only affect one or several individuals, Article 341 should be applied. In fact, the behaviors described in the first clause are already encompassed by Article 341, as the verb "to release" used therein includes actions such as discharge, emission, or introduction into the air, soil, or water. It would certainly be advisable to incorporate the notion of environmental endangerment, although, as previously noted, mammals are among the most sensitive organisms to radiation. Thus, by penalizing the risk posed to human beings, environmental harm is already implicitly addressed. Nevertheless, its explicit inclusion remains desirable, if only to make visible the environmental risks associated with the release of ionizing radiation.

The offence does not require actual harm to life, health, or property; a concrete risk suffices. In my opinion, the nature of ionizing radiation and its effects justifies the use of endangerment-based legal structures to protect life, health, and property. It is scientifically established that radiation exposure damages or destroys cells and may lead to the development of cancer, leukemia, and other conditions. However, as previously discussed, these effects often manifest long after exposure and cannot be definitively attributed to radiation. Therefore, liability must be based on the creation of risk.

Given that this is a result-based offence, there appear to be no particular obstacles to recognizing liability for omission. Indeed, the failure to adopt necessary measures

[36] DE LA CUESTA AGUADO, M. P.: "Reforma de los delitos relativos a la nergía nuclear y radiaciones ionizantes", en ÁLVAREZ GARCÍA/GONZÁLEZ CUSSAC (Dir.): *Comentarios a la Reforma Penal de 2010*, Tirant lo Blanch, Valencia, 2010, p. 412.

[37] Ibidem.

to prevent a radiation leak may be considered equivalent to actively causing such a leak. As Morales Prats observes, “the handling of nuclear energy is a paradigmatic example of a technical activity domain in which a permitted risk framework is established, with the sources of danger entrusted to specially trained professionals who thereby assume specific duties of control and assurance”. He further notes that “the establishment of guarantor positions arising from specific legal or contractual obligations is also beyond dispute”[38].

Consequently, where the failure to prevent the uncontrolled release of ionizing radiation results from the breach of a specific duty to act, criminal liability for commission by omission may be established under Article 11 of the Criminal Code. For example, Article 36 of Act 25/1964 of 29 April on Nuclear Energy provides that “the holder of nuclear or radioactive installations or of activities related to ionizing radiation shall be responsible for their safety”. It further states that “Nuclear and radioactive installations and radioactive mineral operations must conduct their activities in such a way as to maintain the required safety conditions, adopting the necessary measures to prevent nuclear and radiological accidents and the provisions to mitigate their consequences should they occur; and must comply with all regulations concerning nuclear safety and ionizing radiation”.

Similarly, Article 66.1 of Royal Decree 1836/1999 of 3 December, approving the Regulation on Nuclear and Radioactive Installations, stipulates that “The supervisor of a nuclear or radioactive installation is obliged to halt its operation at any time if he or she considers that the required safety conditions have been compromised”. Paragraph two adds that “The operator of a nuclear or radioactive installation is authorized to do the same if, in addition to the aforementioned circumstances, it is impossible to inform the supervisor with the required promptness”. The holder of the nuclear installation bears significant safety obligations, as outlined in Articles 7 and 11 of Royal Decree 1400/2018 of 23 November, approving the Regulation on Nuclear Safety in Nuclear Installations.

Regarding the configuration of the concrete risk result, it must be noted that the mere presence of a legal asset within the radius of the hazardous conduct is a necessary but insufficient condition to establish concrete risk – particularly in the case of supra-individual assets[39]. For this reason, a sector of legal doctrine has proposed a “normative

[38] MORALES PRATS/GARCÍA SOLE: De los delitos relativos a la energía nuclear. *Op. Cit.*, p. 1329.

[39] PLATZGUMMER, W.: “Die Vorverlegung des Strafrechtsschutzes durch Gefährdungs- und Unternehmensdelikte im österreichischen Strafrecht”, en *Die Vorverlegung des Strafrechtsschutzes durch Gefährdungs- und Unternehmensdelikte*. Walter de Gruyter, Berlin-New York, 1987, p. 42; SCHÜNEMANN, B.: “Moderne Tendenzen in der Dogmatik der Fahrlässigkeits- und Gefährdungsdelikte”, en JA, 1975, pp. 796 y s.

theory of risk"[40]. According to this theory, concrete risk exists where the harm to the legal asset is averted only by chance. SCHÜNEMANN refines this by asserting that concrete risk arises when one can no longer rely on the non-occurrence of harm[41]. DEMUTH adds that it emerges when "the point is passed at which harm could still be reliably prevented through normal defensive measures"[42].

Unlike Article 343, Article 341 does not refer to the possibility of death, injury, or damage. In cases where such outcomes occur, an ideal concurrence of offences should be considered, as a single act has both endangered and harmed legal assets. This solution is only admissible where, in addition to the harm, it can be established that one or more individuals were exposed to radiation without suffering injury or death. If the conduct could only have affected one person and that person dies, the harm would generally absorb the endangerment, unless the penalty for the endangerment offence is greater – in which case, a concurrence of legal provisions resolved by alternativity would be more appropriate.

Finally, regarding the relationship with the offence of involving large-scale destruction or endangerment of public safety (estragos), as Muñoz Conde has noted, we are dealing with a concurrence of legal provisions that must be resolved by applying the principle of specialty in favor of Article 341[43].

6. Disruption of Nuclear Installations

Article 342 of the Spanish Criminal Code provides: "Anyone who, without falling under the scope of the preceding article, disrupts the operation of a nuclear or radioactive installation, or interferes with activities involving materials or equipment that produce ionizing radiation, thereby creating a situation of serious danger to the life or health of individuals, shall be punished with imprisonment of four to ten years and special disqualification from public office, profession, or trade for a period of six to ten years".

[40] Expression coined byWOLTER, J.: Objektive und personale Zurechnung von Verhalten, Gefahr und Verletzung in einem funktionalen Straftatsystem. Duncker & Humblot, Berlin, 1981, p. 217.

[41] SCHÜNEMANN, B.: JA 1975. Op. Cit., pp. 796 y ss. In the same sense, ROXIN, C./GRECO, L: *Strafrecht. Allgemeiner Teil*. T. I. 5ª ed. C. H. Beck, Munich, 2020, p. 339.

[42] DEMUTH, H.: *Der normative Gefahrbegriff. Ein Beitrag zur Dogmatik der konkreten Gefährdungsdelikte*, Bochum, 1980, p. 218. In the same sense, RODRIGUEZ MONTAÑES, T.: *Delitos de peligro, dolo e imprudencia*. Servicio de publicaciones de la Facultad de Derecho de la Universidad Complutense de Madrid, Madrid, 1994, pp. 37 y s.

[43] MUÑOZ CONDE, F.: Derecho penal. Parte Especial. *Op. Cit*., p. 639.

This provision constitutes a subsidiary offence in relation to that established under Article 341[44]. According to De la Cuesta Aguado, the statutory wording is problematic, as the supposed second modality – despite being a reformulation of the first – "aims to extend criminal liability to any activity involving radiological risk, which, due to the breadth of the formula, would render the first modality superfluous"[45]. As previously noted, this provision encompasses conduct that does not result in the release of nuclear energy but affects the safety components of the installation, although such conduct alone is insufficient to cause the emission of ionizing radiation[46]. Consider, for example, an individual who, without prior notice, diverts the flow of a river whose water is used as a coolant in a nuclear power plant, or someone who causes a malfunction in the diesel generator that supplies electricity to the installation in the event of grid failure. Electricity is essential for cooling both the reactor core and the spent fuel pool.

De la Cuesta Aguado further asserts that "other disruptions to the installation that alter its operation without generating risk situations shall be considered atypical," citing strikes or demonstrations near a nuclear facility as examples[47].

In my view, the reference to the creation of serious danger to life or health should not be interpreted as requiring a concrete endangerment, but rather an abstract one[48]. These are not cases in which the threshold has been crossed such that the outcome can no longer be prevented through ordinary defensive measures.

Article 11 of Royal Decree 1836/1999 of 3 December, which approves the Regulation on Nuclear and Radioactive Installations, provides a useful guide for defining what constitutes a nuclear installation:

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[44] GONZÁLEZ RUS, J. J.: Los delitos contra la seguridad colectiva. *Op. Cit.*, p. 783; DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1129.

[45] DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1129 y s.

[46] According to DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1129, "the disruption must directly or indirectly affect the process related to the production of ionizing radiation or the nuclear fuel cycle – which generally leads back to the risk of radiation – and must specifically impact the safety associated with the generation of nuclear energy or ionizing radiation".

[47] DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1130.

[48] DE LA CUESTA AGUADO, P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1131, after stating that Article 341 constitutes a concrete endangerment offence, and that the same does not apply to Article 342 – since it "does not require verification of a direct danger to life or health, but merely the creation of a hazardous situation for these legal interests" – the author adds that "we are therefore dealing with an offence of endangerment and result, in which the result is determined by the emergence of a dangerous situation. That is, it must be established that, within specific spatial and temporal coordinates, a state or condition arose which, had it affected individuals, would have likely caused injury or death (offence of suitability)." In contrast, CARDENAL MONTRAVETA, S.: De los delitos relativos a la energía nuclear. *Op. Cit*., p. 1565**,** considers this to be a concrete endangerment offence**.**

(a) Nuclear power plants: any fixed installation for the production of energy through a nuclear reactor.

(b) Nuclear reactors: any structure containing nuclear fuel arranged in such a way that a self-sustaining nuclear fission process can occur without the need for an additional neutron source.

(c) Factories using nuclear fuel to produce nuclear substances and factories engaged in the treatment of nuclear substances, including facilities for the treatment or reprocessing of irradiated nuclear fuel.

(d) Facilities for the storage of nuclear substances, excluding locations where such substances are stored incidentally during transport.

(e) Devices and installations that use nuclear fusion or fission reactions to produce energy or for the development of new energy sources.

7. Limited Exposure to Ionizing Radiation

As previously discussed, Article 343 originally penalized individuals who exposed one or more persons to ionizing radiation. The 2010 reform introduced the current wording, which presents several interpretative challenges. The article now penalizes anyone who "through the discharge, emission, or introduction into the air, soil, or water of a quantity of materials or ionizing radiation, or through exposure by any other means to such radiation, endangers the life, integrity, health, or property of one or more persons, or the quality of air, soil, or water, or animals or plants".

De la Cuesta Aguado interprets the provision as encompassing two distinct modalities of conduct[49]. First, it describes a radiological contamination offence involving the discharge, emission, or introduction of ionizing radiation into the air, soil, or water. In his view, Article 343 reproduces in abbreviated form the conduct typified under Article 325, whereby the behavior consists of releasing radioactive materials onto soil or water or emitting ionizing radiation intended to disperse such substances through the air.

Second, the provision encompasses conduct involving the exposure of individuals or property to ionizing radiation through means other than those specified in the first clause. De la Cuesta Aguado clarifies that "for the purposes of this offence, typical conduct includes direct exposure of a person to an unshielded radioactive source (e.g., in a medical context); exposure through ingestion of radioactive substances or food, or direct contact with previously contaminated objects; or chain exposures, in which subjects or

[49] DE LA CUESTA AGUADO, M. P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1132.

objects have not been exposed to the original radiation source but have come into contact with items directly or indirectly contaminated by it"[50].

Legal doctrine generally considers this a concrete endangerment offence[51]. Accordingly, the provision requires the creation of a risk to the life, health, or property of one or more individuals, or to the quality of air, soil, or water, or to animals or plants.

In my opinion, as currently drafted, the typical conduct consists of exposing – by any means – life, health, property, or the environment to ionizing radiation. Thus, rather than two distinct behaviors, the provision describes a single offence, with the reference to "discharge, emission, or introduction into the air, soil, or water of a quantity of materials or ionizing radiation" serving merely as an illustrative example of such means.

A separate issue concerns the legislative solution adopted to correct the error introduced by Organic Law 15/2003, which added a second paragraph to Article 325 and was subsequently transferred to Article 343 in 2010. This solution appears inadequate. It is unclear why radiological contamination conduct was incorporated into a provision originally intended to address highly localized radiation exposure, rather than into Article 341, which is more appropriately limited in scope. That the first explicit reference to environmental protection in the context of radiological contamination appears in this provision is, in my view, not a positive development.

8. Offence Related to the Production, Possession, and Trafficking of Nuclear Materials or Radioactive Substances

Paragraph 1 of Article 345 of the Spanish Criminal Code penalizes anyone who "acquires, possesses, traffics, supplies, handles, transforms, uses, stores, transports, or disposes of nuclear materials or other hazardous radioactive substances that cause or may

[50] Ibidem.

[51] DE LA CUESTA AGUADO, M. P.: Reforma de los delitos. *Op. Cit.*, p. 413. Case law also considers that we are dealing with a form of concrete endangerment. See Provincial Court of Tarragona, Section 4, Order 226/2020 of 13 March 2020 (ECLI: ES:APT:2020:1411A). In this order, the indictment of the defendants for the offenses under Articles 343 and 344 was dismissed, as such charges require "sufficient indicia that the emission, discharge, or release of nuclear energy or radioactive elements has occurred, and that such an event has endangered the life, physical integrity, health, or property of individuals, or has posed a threat to the quality of air, soil, water, animals, or plants." In the present case, the factual account clearly identifies the release of ionizing radioactive elements – an uncontested fact in the criminal proceedings and one described in detail in the challenged decision. However, upon reading the order and analyzing the investigative measures carried out during the preliminary phase, it becomes evident that the indicia supporting the existence of such concrete danger are significantly weakened, to the extent that the Court deemed them insufficient – especially in light of the quantity and quality of the counter-evidence contained in the case file – to justify the indictment of the appellants".

cause death or serious injury to individuals, or substantial damage to the quality of air, soil, or water, or to animals or plants". This provision constitutes a blank criminal norm, as the typification of such conduct depends on its contravention of "laws or other general provisions". Among these, one may cite, for example: Act 25/1964 of 29 April on Nuclear Energy; Royal Decree 1836/1999 of 3 December, approving the Regulation on Nuclear and Radioactive Installations; Royal Decree 229/2006 of 24 February, on the control of high-activity sealed radioactive sources and orphan sources; Royal Decree 1616/2009 of 26 October, regulating active implantable medical devices; Royal Decree 243/2009 of 27 February, on the monitoring and control of transfers of radioactive waste and spent nuclear fuel between Member States or destined outside the Community; Royal Decree 1085/2009 of 3 July, approving the Regulation on the installation and use of X-ray equipment for medical diagnosis; Royal Decree 1308/2011 of 26 September, on the physical protection of nuclear installations and materials, and radioactive sources; Royal Decree 1400/2018 of 23 November, approving the Regulation on nuclear safety in nuclear installations; Royal Decree 102/2014 of 21 February, on the responsible and safe management of spent fuel and radioactive waste; and Royal Decree 451/2020 of 10 March, on the control and recovery of orphan radioactive sources[52].

According to Viveiros, two of the verbs – "possess" and "store" – correspond to possession-type offences. This classification, he argues, has practical implications both substantively and procedurally. Substantively, "possession offences may be committed through acts (typically commissive) establishing voluntary custody over the object, or through acts (typically omissive) maintaining such custody. The latter is particularly relevant in cases of imposed custody"[53].

Excluding an offence from the category of possession-type offences means that it only criminalizes acts of establishing custody, not maintaining it. Consequently, in such cases, imposed custody does not give rise to criminal liability for the individual who retains factual control over the object. Procedurally, non-possession offences apply exclusively to conduct establishing custody over prohibited objects and do not encompass situations of imposed custody. Therefore, such offences require proof that the individual established dominion over the object in a manner that is typical, unlawful, culpable, and punishable.

In contrast, possession offences allow courts to "dispense with proof of acts establishing and/or maintaining custody when the specific circumstances of custody over

[52] An exhaustive compilation of the relevant legal framework is available in https://www.csn.es/normativa-del-csn/normativa-espanola.

[53] VIVEIROS, C.: *Los delitos de posesión: una investigación dogmática y políticocriminal*. Tirant lo blanch, Valencia, 2023, pp. 61 y ss.

the object sufficiently support a judicial conviction that the accused engaged in such conduct". This evidentiary flexibility is not permissible in offences that cannot be classified as possession-type[54].

Jurisprudence has noted that "the particularity of Article 345 lies in its anticipatory protection, typifying abstract endangerment conduct. One such example is the use of radioactive isotopes without administrative authorization"[55].

Case law has clarified that "since we are not operating within the domain of administrative powers of control or regulation, the mere absence of a license cannot constitute the entirety of the offence. There must be an infringement of the protected legal asset, namely, that the conduct carried out by COGESUR (the firm) and challenged in this proceeding endangered collective security in the field of nuclear energy"[56].

In the case at hand, the company lacked authorization from the Nuclear Safety Council because the individual responsible for supervising the installations, although having completed the required training, had not yet received formal certification. The court did not consider this fact decisive, as the individual was deemed qualified, having received the necessary instruction. More problematic, however, was the failure to contract a dosimetry service, which is intended to monitor potential harm to personnel. The court emphasized that the absence of such a service "directly endangers the life and health of others". Nevertheless, the court rejected the applicability of Article 345, reasoning that "the facilities where the equipment was stored were adequate, notwithstanding the lack of signage, which in itself does not compromise storage safety; and the workers operating the equipment were supervised by a qualified individual (no evidence to the contrary was presented). It is also significant that this was not a case of illegal trafficking of radioactive material, but rather the operation of a machine approved by the administration, which is not inherently harmful when used by competent and trained individuals. Finally, we consider that dosimetry becomes relevant once the machine is in use, not beforehand, as it serves as a monitoring and control measure. Therefore, its prior absence should not be deemed determinative, especially given that no harm was reported among the individuals who operated the equipment. This conclusion is supported by the Regulation on Health Protection Against Ionizing Radiation"[57].

This reasoning is not entirely convincing. It is incorrect to assert that the offence does not apply simply because no harm occurred, as the provision does not require actual damage. Operating without a dosimetry service constitutes a hazardous act, as radiation

[54] VIVEIROS, C.: Los delitos de posesión. Op. Cit., pp. 47 y ss.

[55] Audiencia Provincial de Cádiz, Sección 1ª, Auto de 31 Mayo 2004.

[56] *Ibidem*.

[57] Ibidem.

leaks would go undetected, thereby exposing individuals. That said, in this particular case, it cannot be affirmed that a concrete risk materialized, since the equipment was verified to be functioning properly and no harmful radiation doses were received.

Paragraph 2 of Article 345 establishes a separate offence: the unauthorized production of nuclear materials or radioactive substances.

Finally, Paragraph 3 provides for punishment of the conduct when committed negligently[58].

9. The Subjective Element of the Offence

Insofar as negligence is expressly punishable, it is clearly indicative that we are dealing with offenses committed with intent. This implies that, from a subjective standpoint, the offense requires endangerment dolus (dolus periculi) for its application, which presents considerable challenges due to the difficulty in distinguishing it from harm dolus (dolus malus). It is commonly held that harm dolus encompasses endangerment dolus. But does the reverse hold true? Is there at least eventual dolus in those who act with endangerment dolus?[59]

The answer depends on how intent is conceptualized. Traditionally, intent is understood to consist of both an intellectual and a volitional component. From the standpoint of the intellectual element, both legal doctrine and case law have generally agreed that intent to endanger and intent to harm share identical content, as a person who is aware of the danger their conduct poses to another's life is also aware of the real possibility of causing death[60].

For the courts and a sector of legal scholarship, the distinction lies in the volitional element, since acceptance of the risk of harm does not equate to acceptance of actual harm[61]. Some scholars equate intent to endanger with conscious negligence,

[58] GONZÁLEZ COLLANTES, T.: Energía nuclear y radiaciones ionizantes", en GONZÁLEZ CUSSAC, J. L.: Comentarios a la Reforma del Código Penal de 2015. Tirant lo blanch, Valencia, 2015, p. 1094, Smith provides the example of security guards at a nuclear facility who, without justified cause, abandon their posts and fail to secure the doors of the storage area containing nuclear materials or radioactive substances, thereby facilitating the unlawful appropriation of such materials by third parties.

[59] VOGEL, J.: Comentario al parágrafo 15, en *Strafgesetzbuch. Leipziger Kommentar*. 12ª ed., De Gruyter, Berlin, 2007, marginal 129; RODRÍGUEZ MONTAÑÉS, T.: Delitos de peligro. *Op. Cit*., pp. 48 et seq.

[60] STERNBERG-LIEBEN/SCHUSTER: Comentario al parágrafo 15, en SCHÖNKE/SCHRÖDER: *Strafgesetzbuch. Kommntar*. 30ª ed. C. H. Beck, 2019, marginal 98; RODRÍGUEZ MONTAÑÉS, T.: Delitos de peligro. *Op. Cit*., pp. 74 et seq.

[61] *Ibidem*. This position is acknowledged by the German Federal Court of Justice (4th Criminal Division) in its judgment of 31 January 2019 – 4 StR 432/18, stating that: "from a conceptual standpoint, endangerment refers to nothing other than the immediate possibility of harm or injury. Therefore, when someone possesses dolus related to the danger of death, there is no room to deny the cognitive element of dolus eventualis in cases of

thereby structurally aligning it with negligent attempts.[62] Although this is the position adopted by case law, judicial reasoning often ultimately disregards the volitional element.

The Spanish Supreme Court (Criminal Chamber, Section 1) has stated:

"In reality, the will to achieve the result is merely a manifestation of the most common form of intent, in which the perpetrator seeks to bring about a specific outcome. However, this does not preclude the classification as intentional of those acts in which the perpetrator intends to carry out the typical conduct that leads to the result, or performs the typical conduct while foreseeing the possibility of the result occurring. What is decisive for establishing criminal intent, under this classical construction, is the existence of a will directed toward the execution of the typical conduct using means capable of achieving it. This will is concretized in the proven decision to act with knowledge of the potential of the means to produce the result and the decision to employ them. If, in addition, the intention to achieve the result is proven, we are dealing with intentional intent in result-based offences. However, this does not exclude a normative concept of intent based on the knowledge that the conduct undertaken poses a concrete danger to the protected legal asset. In this second modality, intent lies in the awareness of the specific danger that the conduct entails for the legal asset – in this case, life. Indeed, to impute a homicide offence as intentional, it suffices that the individual knows they are doing enough to plausibly cause a fatal outcome and, therefore, foresees the result as a consequence of that risk. That is, they intellectually encompass the risk that normatively identifies the subsequent result. In the knowledge of the risk lies the implicit knowledge of the result, and the perpetrator's decision is undoubtedly linked to that result".

This reasoning is not exclusive to Spanish jurisprudence; similar arguments are found in German case law.

10. Imperfect Forms of Execution

Is it admissible to punish attempts in endangerment offences? While a comprehensive analysis of this issue exceeds the scope of this study, it is worth noting the positions adopted in legal doctrine, many of which arise in the context of traffic safety offences.

homicide. Indeed, one who is aware of a life-threatening situation and accepts it is also aware of the possibility of a fatal outcome." A similar view is expressed by the Swiss Federal Supreme Court in its judgment of 8 March 1968 (BGE 94 IV 60 S. 60).

[62] LAURENZO COPELLO, P.: *Dolo y conocimiento*. Tirant lo blanch, Valencia, 1999, pp. 298 et seq.

In this context, Molina Fernández argued as early as 1998 that, although theoretically possible, attempts should not be punishable in either abstract or concrete endangerment offences. He reasoned that such offences already represent an anticipatory protection mechanism, and punishing attempts would amount to penalizing "an attempt of an attempt of a negligent act"[63].

The Supreme Court, in Judgment 48/2020, relying on doctrinal views that equate "the objective structure of abstract endangerment offences with that of an unsuitable attempt," concluded that it is not possible to apply the concept of attempt to Article 379[64]. The Court reasoned that punishing "an attempt of an unsuitable attempt," or "the risk of a risk," would result in penalizing conduct that is not objectively dangerous to any individual asset. However, this does not mean that the Supreme Court categorically excludes the punishment of attempts in all abstract endangerment offences. As the Court itself notes in the same judgment, "There is no obstacle to characterizing as a punishable attempt the execution of conduct that is rationally suitable to immediately generate a prohibited abstract risk, when, due to fortuitous circumstances beyond the perpetrator's control, the creation of that risk does not materialize". Indeed, the Court has affirmed the punishability of attempts in public health offences, citing judgments dated 23 May 2001, 13 March 2000, and 23 July 2010.[65]

From a general perspective, Corcoy Bidasolo argues that punishing attempts in endangerment offences would constitute an unacceptable anticipation of criminal protection[66]. Similarly, Quintero Olivares, after noting that concrete endangerment offences involve initiating a causal process that does not culminate in harm – just as in attempts – questions whether attempts should be punishable in such cases. He begins by noting that, absent these offences, attempts in negligent crimes would not be punishable. He rightly observes that these provisions contemplate typical situations which, if proven to have been pursued intentionally or at least with eventual intent, would give rise to an attempt

[63] MOLINA FERNÁNDEZ, F.: "Delitos contra la seguridad del tráfico", en BAJO FERNÁNDEZ, M. (Dir.): *Compendio de Derecho penal. Parte Especial*. Vol. II, Centro de Estudios Ramón Areces, 1998, pp. 721 y 729. In the same sense, DE VICENTE MARTÍNEZ, R.: *Derecho penal de la circulación*. 2ª ed., Bosch, Barcelona, 2008, pp. 423 y s; SANZ-DÍEZ DE ULZURRUN LLUCH, M.: "Conducción manifiestamente temeraria", en GUTIÉRREZ RODRÍGUEZ, M. (Coord.): *Protección penal de la seguridad vial*. 2ª ed., Tirant lo blanch, Valencia, 2013, p. 215.

[64] Decision of the Supreme Court's Second Criminal Chamber 48/2020, de 11 de febrero (ECLI:ES:TS:2020:386).

[65] *Ibidem.*

[66] CORCOY BIDASOLO, M.: *Delitos de peligro y protección de bienes jurídico-penales supraindividuales: nuevas formas de delincuencia y reinterpretación de tipos penales clásicos*. Tirant lo blanch, Valencia, 1999, p. 721.

of the corresponding intentional offence. In his view, "It makes no sense to speak of attempt in a concrete endangerment offence, as it would amount to punishing 'the attempt of the attempt,' notwithstanding arguments that such offences are intentional (due to 'intent to endanger') and result-based (due to risk creation). This does not align with material reality or with the accepted subjective attitude in such offences"[67].

11. Concurrence of Offences

If, in addition to endangering a protected asset, death or injury occurs – e.g., due to exposure to extremely high doses of radiation – an ideal concurrence of offences must be recognized[68].

In cases of limited radiation exposure, if only one person is affected and suffers death or serious injury due to the high doses received, Article 343 would not apply. Instead, the conduct should be punished as homicide or bodily harm, typically under negligence, unless the conduct was executed with the intent to cause such outcomes[69].

Greater complexity arises in the relationship between environmental crimes and offences related to nuclear energy. Since the 2010 reform, Article 343 includes conduct that causes or may cause serious harm to "the quality of air, soil, or water, or to animals or plants". In my view, this necessitates a concurrence of legal provisions to be resolved through the principle of alternativity.

As for Article 341, although it does not explicitly reference environmental harm, I believe that – unlike Article 343 – it does not concern localized exposure. It is difficult to conceive that the release of nuclear energy would affect only humans and not other living beings, plants, or animals. Therefore, I consider that a concurrence of legal provisions resolved through the principle of absorption (consunción) would be appropriate.

Article 345 also presents issues in relation to Articles 566 and 574 of the Criminal Code. When the conduct described in Article 345 overlaps with that in Article 566 and involves nuclear or radiological weapons or ammunition, a concurrence of legal provisions should be resolved in favor of Article 566. A relationship of specialty arises concerning the manufacture, commercialization, storage, or trafficking of nuclear materials or radioactive substances when these constitute weapons or ammunition.

[67] QUINTERO OLIVARES, G.: "La incriminación de la tentativa y los delitos de peligro", en Almacén de Derecho, (last accessed februar 18, 2025 https://almacendederecho.org/la-incriminacion-de-la-tentativa-y-los-delitos-de-peligro).

[68] GONZÁLEZ RUS, J. J.: Delitos contra la seguridad colectiva. *Op. Cit*., p. 781.

[69] GONZÁLEZ COLLANTES, T.: Energía nuclear. *Op. Cit*., p. 1091.

Furthermore, when the conduct of appropriation, possession, transport, supply, or handling of nuclear materials or radioactive substances is carried out for terrorist purposes, the provisions of Article 574 must be considered[70].

12. Criminal Policy Proposals

The successive reforms concerning offences related to nuclear energy and ionising radiation have served to obscure and complicate the interpretation of the provisions set forth in Articles 341 et seq. of the Criminal Code.

Moreover, any consideration of potential amendments to the regulation of offences related to nuclear energy and ionising radiation within the Criminal Code must take into account the obligations imposed upon Member States by Directive (EU) 2024/1203 of the European Parliament and of the Council of 11 April 2024, on the protection of the environment through criminal law, which repeals Directives 2008/99/EC and 2009/123/EC.

In my view, the first paragraph of Article 343 ought to be repealed, and Article 341 should be amended to include an express reference to the environment as a legally protected asset, alongside the protection of human life and health. Article 343 should be limited, as it traditionally has been, to localised exposures and, therefore, to conduct of lesser gravity.

Furthermore, insofar as all matters relating to nuclear energy have been consolidated within a specific section under offences against collective security, the reference to the release of radiation contained in Article 325 of the Criminal Code should be eliminated. An alternative approach would be to incorporate all such offences under the category of environmental crimes. Nevertheless, I consider the former option preferable, as certain types of conduct do not lend themselves easily to such integration. Acts such as exposing individuals to radiation during radiological consultations or the manufacture of radioactive materials do not necessarily pose environmental risks, or at least not to a degree sufficient to warrant such classification.

[70] Article 573 defines terrorist aims as follows:

1. To subvert the constitutional order, or to seriously suppress or destabilize the functioning of political institutions or the economic or social structures of the State, or to compel public authorities to carry out or refrain from carrying out a specific act.

2. To seriously disturb public peace.

3. To seriously destabilize the functioning of an international organization.

4. To provoke a state of terror among the population or a segment thereof.

Additionally, given the unresolved nature of the debate surrounding the existence of a distinct form of intent relating to endangerment as opposed to harm – and the consequent tendency of endangerment offences to omit reference to this element – it would be advisable, in my opinion, to eliminate explicit references to intent and negligence from the statutory definitions, leaving such determinations to judicial interpretation, at least until a consensus is reached on the matter. Should this proposal be rejected and the distinction between intentional and negligent conduct maintained, all intentional acts should be enumerated first, followed by a general provision addressing negligent conduct.

Moreover, considering that the majority of such conduct occurs within corporate contexts, the criminal liability of legal persons should be generally established for all offences under Section 1 of Chapter I concerning crimes against collective security.

Finally, as rightly noted by de la Cuesta Aguado, it would be appropriate to introduce a specific offence concerning individuals responsible for the inspection of nuclear or radioactive facilities. Such a provision should criminalise the omission of mandatory inspections, the omission, falsification, or concealment of risk situations identified during inspections, the authorisation of activities without compliance with necessary safety requirements, the failure to suspend operations upon detection of risk situations, and the failure to adopt necessary corrective measures. This would resemble existing provisions under environmental criminal law and, given the critical importance of inspections in such a sensitive domain, appears indispensable[71].

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[71] De la CUESTA AGUADO, M. P.: Delitos relativos a la energía nuclear. *Op. Cit*., p. 1124.

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