

# Reintegrating Nuclear Knowledge Through Contemporary Art Transforming Repositories into Living Archives

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**Abstract** This chapter explores how contemporary art can reintegrate nuclear knowledge into society by transforming repositories of radioactive waste into living archives. It argues that utilising contemporary art as a means of archiving and engaging with the past provides a powerful tool for involving individuals in shaping a shared future. The chapter examines different countries' approaches to nuclear semiotics, with a focus on Italy's ongoing search for a permanent disposal site. It analyses the *Art Spaces. Nuclear Decommissioning. Science at the service of the future generation* exhibition held in Italy in 2017 as an example of artistic engagement with radioactive waste, drawing from interviews with participating artists. The chapter delves into the complexities of the Italian nuclear landscape, explores strategies for sharing Italy's nuclear legacy, and emphasises the capacity of contemporary art to stimulate dialogue and involvement. By investigating international influences, the chapter offers insights into effectively using contemporary art as a catalyst for discussing collective legacies and understanding Italy's nuclear repositories.

**Keywords** Radioactive legacies. Archiving method. Art practices. Nuclear knowledge. Cultural heritage-making.

**Summary** 1 Can Contemporary Art Transform Nuclear Knowledge and Engage Society? – 2 Exploring Nuclear Semiotics: Communication Strategies and Artistic Endeavours for Radioactive Waste Management. – 3 The Shift Away from Nuclear Power in Italy and Challenges in Waste Management. – 4 Toxicity and Waste in Contemporary Art. – 5 The Italian Experience with Nuclear Art: *Art Spaces. Nuclear Decommissioning. Art at the Service of Future Generations Exhibition*. – 6 Conclusion.

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## 1 Can Contemporary Art Transform Nuclear Knowledge and Engage Society?

The final material destiny of radioactive waste is to be vitrified and then stored in facilities or permanent isolation from the environment. Usually, this type of waste is buried in relatively deep geological layers in underground repositories and facilities made of granite rock, clay, and salt. At present, each country involved in nuclear activities is ethically and legally bound to store the radioactive waste produced: whilst some countries like Finland have formalised their long-term underground storage plan, others are still deliberating on the most suitable methods for managing their radioactive waste production. Nevertheless, even if the final goal is to store this particular type of material in a safe and isolated environment, scholars such as Peter van Wyck, a Canadian cultural theorist and communication professor, have contended that nuclear waste distinguishes itself from other forms of refuse. Radioactive residues can not be entirely contained or disposed of over a time scale consistent with the human lifespan, consequently, as van Wyck (2005, 19) has stated, “there is always leakage”. Compared to the continuous flow in which matter exists (Nail 2021; Ingold, Simonetti 2022), these repositories are denoted by a hermetic and closed nature, dividing the nuclear materiality from the never-ending flux of matter. While it is fundamental to maintain a distance between the spaces we inhabit and repositories of radioactive waste, I would argue that it is necessary to get closer to them in a metaphorical sense. If nuclear materiality must be removed from the flux, nuclear knowledge must be reinserted into it: it should circulate, be shared among people, and should create connections above the surface.

This chapter explores the role of contemporary art in reintegrating nuclear knowledge into society and disseminating it effectively. It examines how contemporary art has approached the archival of radioactive waste, utilising case studies and insights from artists engaged in this subject. The argument put forth is that repositories and deposits should transform into living archives, fostering cultural engagement and facilitating open discussions on nuclear knowledge. The aim is to make nuclear knowledge accessible to a diverse audience and encourage democratic participation, emphasising the importance of creating inclusive spaces for dialogue regarding our collective legacies. By employing contemporary art as a means of archiving and engaging with the past, it becomes a powerful tool to involve more individuals in shaping their shared future. To achieve this, the chapter adopts the following structure, beginning with a concise overview of different countries’ approaches to nuclear semiotics, such as Finland and France. However, the main focus lies on Italy, where the search for a permanent disposal site for radioactive waste is ongoing and artistic exploration of this topic is still in its early stages. Notably, the chapter explores *Art Spaces*, the only existing artistic exhibition on this subject held in 2017, commissioned by the JRC (Joint Research Center) in Ispra and held in its Interim Storage Facility (ISF). To explore the specific context of Italy, this chapter relies on interviews and testimonies from two artists who participated in the *Art Spaces* exhibition and, drawing from these interviews, delves into the complexities and nuances surrounding the Italian nuclear landscape. It examines the artists’ perspectives, insights, and creative approaches, which shed light on the challenges and possibilities of artistic engagement with

radioactive waste. By incorporating these firsthand accounts, the text provides a multifaceted analysis of the interplay between contemporary art and Italy's nuclear repositories. Building upon international influences and solutions, the essay delves into potential strategies for sharing Italy's nuclear legacy among its citizens. It critically examines the role of incorporating nuclear heritage into cultural heritage and investigates the capacity of contemporary art to stimulate dialogue and engagement, shedding light on the complex relationship between nuclear knowledge, artistic expression, and public involvement.

This chapter is primarily concerned with artistic responses to nuclear waste as a lens through which to interrogate our nuclear legacy. However, it is imperative to pause and reflect on the broader intricacies of nuclear power production. Capital-centric techno-politics often find common cause with state apparatuses, incentivising the adoption of technologies that promise profitability or mechanisms of control. Within our current energy-intensive paradigm, the allure of nuclear power lies in its purported ability to mitigate reliance on fossil fuels, minimise CO<sup>2</sup> emissions, and optimise safety measures. Yet, these benefits are tempered by the ecological damage and latent risks exacerbated by governmental inadequacy and corporate economising. Even the theoretical potential of thermonuclear fusion – touted as a solution to our energy crisis – carries its own environmental impositions. It would necessitate substantial water consumption and depend on lithium, a resource with an estimated global reserve of a mere 17 million tons (Stozhko 2022). While many facets of nuclear power production are complex, including uranium mining and enrichment, which emit substantial pollutants and heighten the risk of nuclear weapons proliferation, the end of the production cycle poses its own challenges. Nuclear waste remains dangerously active for thousands of years, making disposal a difficult and hazardous task. In the end, the profits from nuclear energy are enjoyed by private entities, while the cleanup and environmental risks are shouldered by society at large. This leaves communities dealing with the consequences of nuclear presence and facing substantial costs for new power stations needed to meet the ever-increasing demands for energy in a capitalist production-driven world (Kuletz 2002). Moreover, it is worth noting that the issues surrounding nuclear power production and its repercussions intersect with global issues related to nuclear testing, indigenous rights, and marginalised communities. Specifically, the concept of nuclear colonialism (Hecht 2003) connects with the broader discussion of the nuclear industry's implications, its focus on profit, and the subsequent burden placed on communities and society as a whole (for more on the subject see Endres 2009a; 2009b; Keown 2018; Runyan 2018).

## **2 Exploring Nuclear Semiotics: Communication Strategies and Artistic Endeavours for Radioactive Waste Management**

Nuclear semiotics, a specialised field studying the communication strategies for conveying messages about nuclear waste hazards over vast time measures, derives valuable insights from a pool of distinguished scholars cutting across numerous disciplines including semiotics, linguistics, anthropology, and nuclear engineering. Clarifying the contributions of three notable scholars in the field may elucidate the study further. Thomas A. Sebeok

(1979; 1988; 2001), a prominent semiotician, has been central to shaping the recognition and interpretation of messages corresponding to nuclear waste. One of his most interesting semiotic solutions, also for the proposed approach in this chapter of the human-nuclear relationship, which suggests instead to get closer to the nuclear, is the solution offered by Sebeok in 1984 in the technical report *Communication Measures to Bridge Ten Millennia*. Here Sebeok (1984, 24) put forward the formation of an “Atomic Priesthood”,<sup>1</sup> i.e. a group of nuclear experts who could keep information secret and perpetuate superstitions, in a “ritual annually renewed”, so as to keep people away from nuclear sites. Van Wyck has delved into the intricate connections between nuclear waste disposal, cultural memory, the long-term communication challenges, offering critical insights into the ethical and cultural dimensions of nuclear semiotics (2004). In *Signs of Danger: Waste, Trauma, and Nuclear Threat* the author examined the challenge of establishing a warning system to protect future generations from this hazardous material, approaching the topic from a communication and cultural perspective, combining Deleuzian concepts with the real and virtual nature of nuclear threats (van Wyck 2005). By bringing poststructuralism and risk studies together, van Wyck offered an interdisciplinary perspective on environmental dangers, echoing the urgency and complexity of the problem. His explicit focus on ethical and cultural dilemmas pivoting around nuclear waste has opened up new perspectives and prompted invaluable discussions within the domain of nuclear semiotics. Lastly, Eglė Rindzevičiūtė’s research has focused on the politics and societal implications of nuclear waste communication. Rindzevičiūtė’s contribution on the Nuclear Cultural Heritage project allowed me to see how the nuclear presence can be dealt with through heritage studies, providing ways of responding to pressing challenges experienced by nuclear nations, such as the management of nuclear waste and military arsenals, the future of the nuclear energy industry, and the need to reassess the wider social and cultural legacy of the nuclear past (Rindzevičiūtė 2022). Most importantly, to achieve that and to avoid blindness to inequalities, injustices, and limits, new actors could be introduced in the heritage-making process: contemporary artists and creatives (23). Artists, especially in postcolonial contexts, where creative practitioners engage with no longer useful industrial infrastructures and disempowered communities (Dovydaityte 2020; Volkmar 2022), can also navigate different professional fields, making space for dialogue and introduce new ways of communicating and articulating the values of the nuclear past (Carpenter 2020).

Collectively, these scholars have significantly deepened our understanding of nuclear semiotics, providing insights into effective ways of communicating and addressing the long-term hazards of nuclear waste repositories, which are spaces organised and designated to communicate the risks associated with the site. These are classified based on their approach to controlling access, either by keeping potential visitors out or by allowing them in: this classification includes sites that do not explicitly prevent entry and those that do not fully grant access. For instance, Mazzucchelli and Paglianti (2022) ascribe the Onkalo site in Finland as having adopted a strategy of making disappear every possible trace of the geological repository, consequently interpreting the site as a “place of forgetting” (26) or, as Danish

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<sup>1</sup> See <https://www.theatomicpriesthoodproject.org/>.

director Michael Madsen describes the site in his documentary *Into Eternity* (2010), “the place we should always remember to forget”. On the contrary, the French Agency for Nuclear Waste (ANDRA) has adopted a different solution. In April 2015, ANDRA invited artistic project proposals on “imagining the memory of radioactive waste storage centers for future generations”. These proposals, whether realistic, utopian, or critical, aimed to contribute to ANDRA’s reflection on capturing and transmitting the memory of radioactive waste sites. Notably, these ideas were not obligated to be carried out, emphasising the exploration of diverse perspectives in shaping the narrative for the benefit of future generations.<sup>2</sup>

One of the participants, visual artist Cécile Massart, has dedicated her efforts to the development of temporary marker structures that can undergo transformation across generations and responded to a call for ideas issued by ANDRA for the *Bure Depot*.<sup>3</sup> By addressing the isolation of different kinds of nuclear knowledge, Massart’s series of seven prints visualise a conceptual proposal for an architectural marker, specifically *Laboratories* [fig. 1], to be located within the perimeter of waste storage sites to facilitate multidisciplinary research on nuclear issues for the future. While hosting biologists, scientists, artists, and archaeologists, these laboratories could become the space where knowledge of the place, together with memory, would be maintained, translated, and transmitted through generations.

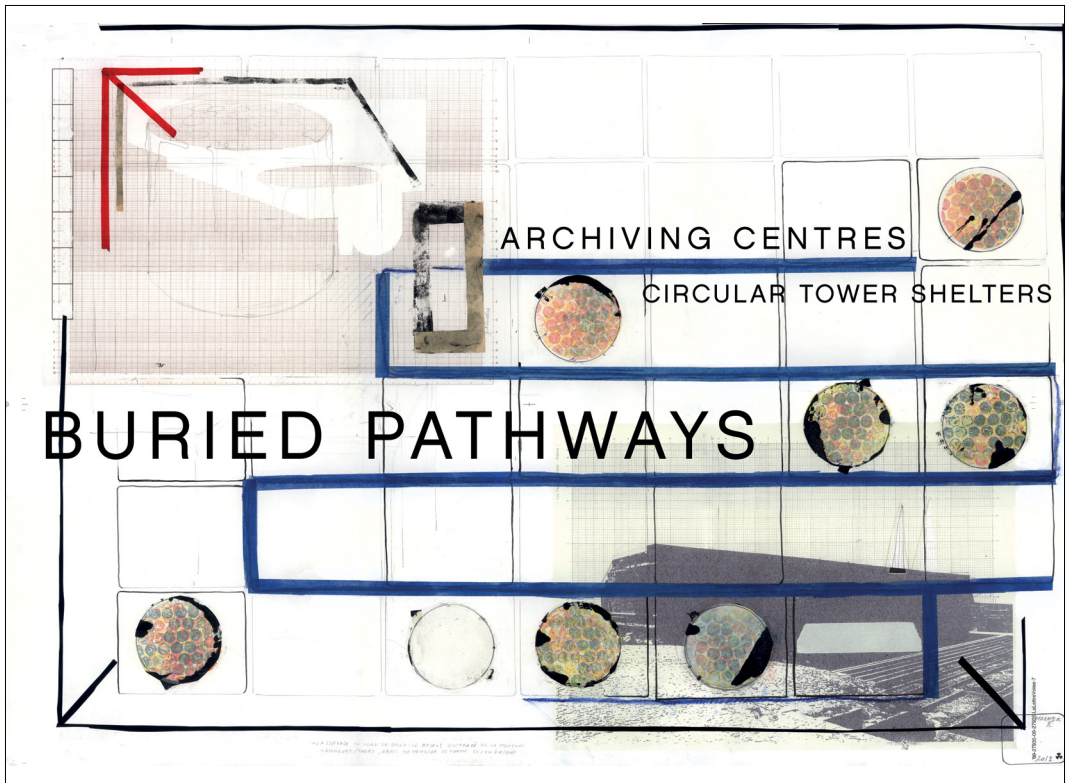
I had the opportunity to interview Cécile Massart and delve into her perspectives on community involvement and democratic spaces within her *Laboratories* project. I asked her how she planned to involve individuals from different backgrounds in her installations. Cécile responded, “All people are free to participate. The aim is to try to live with radioactive waste (and not only radioactive waste) in the future. It is our generation that produces them for a comfort that has never been equaled. For decades, engineers have been developing ways of making the living world safe. We must integrate this, but also be able to express our fears, our disagreements, our reflections on the very nature of the earth and our incomprehension”. Furthermore, I inquired about her thoughts on creating a truly democratic space for sharing. Cécile expressed, “It is a situation that impacts future generations that we do not know, so we are all involved, small and large, migrants, climate refugees, right or left, to ensure some form of ethics, at best, knowledge of the subject to future generations in nuclear countries and find the appropriate communication”.

Cécile’s responses provided valuable insights into her vision for the *Laboratories* and their inclusive nature: her emphasis on freedom of participation and the need for open dialogue regarding radioactive waste demonstrated her commitment to involving diverse voices. Additionally, her

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<sup>2</sup> See <https://www.andra.fr/nos-expertises/conserver-et-transmettre-la-memoire> and <https://www.andra.fr/nos-expertises/conserver-et-transmettre-la-memoire/lart-et-la-memoire-des-dechets-radioactifs>.

<sup>3</sup> Bure is a municipality in France where, in the year 2000, ANDRA initiated the construction of an underground laboratory. This facility was established to explore the feasibility of geological storage in the argillite layer of the region. Over time, the laboratory has evolved into a space dedicated to conducting studies and tests essential for the Cigéo project. Cigéo aims to store Long-lived medium-level waste (MA-VL) and High-activity waste (HA) in a secure and controlled manner. The underground laboratory at Bure serves as a critical research and testing ground for advancing the objectives of the Cigéo project. See <https://www.cigeo.gouv.fr/chiffres-cles-de-cigeo-et-du-stockage-des-dechets-nucleaires-135>.



**Figura 1** Cécile Massart, "Buried Pathways", from the series *Laboratories*. 2013. Printed on paper, 63 × 90 cm. Courtesy Cécile Massart

perspective on the impact of the nuclear situation on future generations and the necessity of ethical communication highlighted the importance of creating democratic spaces for knowledge sharing. By incorporating these firsthand quotations from Cécile's interview, I was able to gain deeper insights into the role of community building and democracy within her artistic project. These perspectives enriched my research, shedding light on the potential of art to engage diverse audiences and address nuclear challenges effectively.

### **3 The Shift Away from Nuclear Power in Italy and Challenges in Waste Management**

Following the 1987 nuclear referendum, nuclear power programs have been halted in Italy, leaving the field clear to increased production and import of natural gas as a source of energy. The causes for the decrease in nuclear development after 1985 concern a series of events with global-scale effects. Among them, the most important one is the increase of interest in oil after 1980 and the Chernobyl nuclear accident, which profoundly transformed how countries worldwide viewed nuclear power (Albino et al. 2014; Prăvălie, Bandoc 2018). In this context, Italy became the first country to go back to a 'non-nuclear energy' status. Two other states followed its lead and

abandoned their nuclear reactors in the following decades, Kazakhstan in 1999 and Lithuania in 2009 (Schneider, Froggatt, Thomas 2011).

The responsibility for nuclear and radioactive wastes and reactor and fuel cycle decommissioning is owned by SOGIN (Società Gestione Impianti Nucleari). The decommissioning strategy adopted in 1990 envisaged the end of the country's nuclear power program and the complete decommissioning of nuclear facilities by 2020, however, the deadline was moved to 2024. Initially, SOGIN (2022) was established to dismantle the power plants of Trino, Latina, Caorso, and Garigliano and with time the dismantling program was extended to other facilities, such as research centres owned by ENEA). SOGIN is also the company that studies the Italian territory to identify, construct, and operate the national near-surface repository to host various types of waste (Low-Level Waste, Intermediate Level Waste) definitively and to temporarily store High-Level Waste until its final disposal in a deep geological formation. According to the time schedule for its realisation, the depository will be operative around 2030, while the vitrified waste will return by 2025.

The discrepancy between the progress of the work and the approaching deadline led to the consideration of two possible scenarios: new agreements to postpone the return of wastes or the improvement (or construction) of new repositories in the existing nuclear sites to store them temporarily (Testoni, Levizzari, De Salve 2019). In 2020, sixty-seven sites were identified in Italy as potentially suitable for hosting a repository (SOGIN 2020). However, a study from Borgogno-Mondino, Borgia and Cigolini has highlighted how the procedure followed by SOGIN has shown significant weaknesses and criticalities, lacking in open data utilisation, and proving that all spatial concerns are based on a "very limited number of data" (Borgogno-Mondino, Borgia, Cigolini 2021, 3). The study focused on the Torino Metropolitan district or TO-10 site (Piedmont region, NW Italy), placed at the top of SOGIN's compiled list, and has shown how the site was not suitable for hosting a safe, long-lasting nuclear repository (19).

#### 4 Toxicity and Waste in Contemporary Art

What has an artist to do with all that is left behind? Waste has become a significant theme in contemporary art, offering insights into the global capitalist forces that shape our world and contribute to environmental degradation (Davis, Turpin 2015; Gray, Sheikh 2018; Boetzkes 2019). For theorist of contemporary art and aesthetics Amanda Boetzkes plastic can be interpreted as a symbol of pollution, artistic medium, and eco-cultural signifier, arguing that plastic makes oil capital visible as a cultural agent (Boetzkes 2019). In *Plastic Capitalism* Boetzkes suggests that contemporary art contributes to ecological consciousness, challenging the dominance of capitalism in addressing environmental crises. Nevertheless, the book does not explicitly address the continued involvement of companies, such as those engaged in neoliberal philanthropy,<sup>4</sup> in funding international museum infrastructure

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<sup>4</sup> Scholars have utilised the work of Gramsci to demonstrate how philanthropy, as a part of civil society, preserves capitalist hegemony by masking wealth concentration and exploitation, acting as is a tool for elites to maintain their political dominance through consensus rather than

and biennial events (Snow 2020). This omission raises questions about the potential tensions between the transformative potential of art and the entanglement of the art world with corporate interests, a critical aspect that warrants further exploration in the dynamic relationship between contemporary art, capitalism, and ecological consciousness.

In the broader field of art related to waste, nuclear waste stands out as a captivating and intellectually stimulating subject matter. Following the bombings of Hiroshima and Nagasaki, some artists and painters developed a unique artistic approach known as nuclear art. As noted by historian of nuclear technology, Robert Jacobs, art and popular culture have exhibited a unique ability to transcend the inherent challenges posed by nuclear issues and the profound implications of nuclear weapons (Jacobs 2010). Artists, despite grappling with the daunting task of encapsulating the horrors and power associated with nuclear waste, akin to the challenge of representing the divine in religious art, have produced numerous creative works that explore this theme. Nowadays, the Nuclear Culture Research Group<sup>5</sup> plays a pivotal role in this domain. Composed of artists, curators, and scholars specialising in nuclear arts and humanities, this interdisciplinary collective operates as part of the broader Nuclear Culture research project, which seeks to advance artistic and curatorial exploration of nuclear culture, both within the United Kingdom and on a global scale. Ele Carpenter leads this initiative in partnership with Art Catalyst, who has curated several exhibitions exploring the multifaceted aspects of nuclear power, using art to illuminate the societal, environmental, and cultural dimensions of nuclear energy and waste. *Actinium* in 2014 called for vigilance about nuclear impacts through art in Japan. *Material Nuclear Culture* in 2016 focused on UK nuclear submarines, examining preservation challenges and offering unique perspectives. *Perpetual Uncertainty*, a traveling exhibition, explored the complex bond between knowledge, radiation, and deep time. In 2020, *Splitting the Atom* in Lithuania discussed various aspects of nuclear power, from resource farming to disarmament.

In sum, the exploration of waste in contemporary art, as exemplified by Boetzkes's examination of plastics, and the thematic focus on nuclear energy in curated exhibitions by Ele Carpenter both demonstrate how art serves as a critical medium for probing complex global challenges and encouraging dialogue about the intersection of capitalism, environmental concerns, and societal perspectives.

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force (Karl, Katz 1987; Fontana 2006; Morvaridi 2012). Furthermore, racial neoliberal philanthropy highlights how this is a racialised process as well (Saifer 2023).

<sup>5</sup> See <https://nuclear.artscatalyst.org/>.



## 5 **The Italian Experience with Nuclear Art: *Art Spaces. Nuclear Decommissioning. Art at the Service of Future Generations* Exhibition**

To inform local communities and stakeholders about the planned and ongoing activities on nuclear decommissioning, with the aim of making them more transparent and accessible to the public at large, the JRC Nuclear Safety and Security department commissioned and held the exhibition *Art Spaces. Nuclear Decommissioning. Science at the Service of the Future Generation* in their ISF. From 29 September to 15 October 2017, 52 artists coming from different backgrounds were hosted in Ispra's ISF to present to the public their artworks related to the nuclear decommissioning and radioactive waste management program. The artworks shared the same starting point, the drum, which was used by artists with different modes of expression to convey a message related to the exhibition's message. Later, the exhibition became itinerant and reached its fourth edition in Italy (Ispra, Masnago-Varese, Venice, Genoa). The opening exhibition was held in Ispra's ISF. As Italy's first nuclear reactor, Ispra-1 operated from 1959 to 1973 at the Ispra Nuclear Research Centre. It played a vital role in studying core physics, materials for commercial reactors, neutron fluxes, and their effects on living organisms. In 2018, the Italian government entrusted the decommissioning of the reactor to SOGIN, which also manages the radioactive waste generated by the reactor. This waste is temporarily stored at the ISF in Ispra until the completion of Italy's national nuclear waste repository. Moreover, ISF was a space-event where people working in different fields met. According to the artists, the space aided participation, as well as allowed artists, JRC workers, and the public to connect. From the information gathered in a survey, when asked about the training received by the artists and their perception of the shared performance space, they recalled how they had been involved in an informative meeting where they were given a comprehensive explanation of the work being conducted at Ispra: technical examples were provided to ensure a thorough understanding, and even individuals without specialised knowledge were able to grasp the storage methods for waste and gain some insight into the research activities taking place at the facility.

The research utilised semi-structured online interviews to delve into the participation, viewpoints, and interpretations of artists who submitted artworks for an exhibition. The diverse backgrounds of participating artists led to varying perspectives on the exhibition's theme: while some artists had connections to the Varese territory, where the JRC is located, others had no direct experience with living near nuclear plants. The interviews covered a range of topics, including personal connections to nuclear environments, experiences working with *Art Spaces*, challenges and opportunities encountered when working with waste materials, and the artistic methodologies employed to represent radioactivity. The discussions also touched on critical observations, doubts, scepticism, and hopes regarding the use of nuclear energy. Their testimonies offered an outlook on how to deal with and think about nuclear contamination, together with opening up a discussion on security and slow violence (Nixon 2011), the relationship between technology and art, environmental sustainability, power dynamics and economic imbalances, new ways of thinking about waste, and what happens when radioactive waste becomes part of our culture, or becomes part of the nuclear heritage.



**Figura 2**  
Gianni Macalli, *The Refuse Light*.  
2017. Mixed technique: bin,  
synthetics, neon light and digital  
print, 95 × 60 cm

During the interviews it emerged that the artists were not completely aware of the potential of their artworks and participation in the exhibition as a first step towards entering the construction of an Italian nuclear cultural heritage, or towards opening the discussion on nuclear knowledge with the public at large. This lack of reflection on this point can probably be attributed to two reasons. Firstly, the purpose of the exhibition was not to focus on the nuclear archive itself, but rather on the decommissioning processes which are ongoing in Italy. Secondly, none of the artists were aware of the Nuclear Cultural Heritage project. Nevertheless, it was possible to initiate a reflection on archiving practices, although only two artists engaged in dialogues that sparked interesting aspects about it.

One noteworthy example is Gianni Macalli, who worked on *The Refuse Light* [fig. 2]. Macalli, who also holds the role of a professor at various educational institutions including high schools and the Academy of Fine Arts in Crema, Bergamo, and Brera, provided insightful explanations during the interview. The underlying intention behind their artwork, as Macalli elucidated, lies in “exploring contemporaneity” by considering the drum as a symbol of waste, thereby carrying a significant thematic weight. Macalli further acknowledged that a container can both conceal and reveal reflections on something perilous. The artist’s primary objective, as emphasised, is to strive towards a “regeneration of a new nature” through the exploration of novel materials, components, liquids, and solids, intending to “present a

new image, a reflection where art or represented concepts invite questioning and contemplation on the subject". During the discussion on the potential of *Art Spaces* serving as a future artistic archive for nuclear waste, Macalli conveyed the belief that the path to achieve this goal lies in "bridging the gap between everyday life and nuclear memory". According to the artist's viewpoint, "the archival process of radioactive waste should become integrated into daily life, enabling a connection between the historical and the domestic, the monumental and the personal".

As the artist pointed out, "embedding the radioactive presence in a social context will facilitate its acceptance. For this, contemporary art may prove useful in achieving the goal". This perspective, shared by other artists in their interviews as well, aligns well with the broader context of heritage-making, specifically in relation to nuclear cultural heritage. Leveraging contemporary art, while ensuring inclusiveness and promoting constructive dialogue, can serve as an effective communication tool to make complex, ambivalent, or divisive issues more accessible. This approach acknowledges the importance of incorporating nuclear heritage into societal discourse through artistic mediums that actively engage the public. By utilising contemporary art, artists aim to create a platform for understanding and reflection, fostering a sense of acceptance and dialogue surrounding nuclear issues. Such an approach acknowledges the potential of art as a means to bridge gaps and encourage a deeper engagement with the complexities of nuclear heritage.

The second example is *For Ever and Ever* by Fausta Squatriti. Born in Milan, she started her artistic research at an early age. During the interview, the artist referred mainly to the tension between life and death, and the conversation with the artist focused on burials, being beneath the ground, and disposal of radioactive waste as if we were talking about funerary practices. As I wanted to understand the steps of making the piece itself, I asked about the choices which led to the creation of the artwork. As the artist explained, "I cut it in half, in a vertical line, and that half I immersed in the whiteness of chalk, a material that refers to the white lime with which corpses were disinfected in mass graves. A drum designed to last for millennia is cracking, the protections put in place are falling apart, tombs coming to light". The introduction of another material, chalk, makes on the one hand visible what is hardly perceptible and, on the other hand, creates a symbolic bridge with meanings related to the theme of death. Indeed, when asked about waste, the artist used metaphors of this kind: "Waste is protected in concrete casings, buried like a corpse that you never want to see again, but until then can you fill the subsoil with drums containing radioactive waste? Until when will it remain intact?"

According to French philosopher Marcel Lefebvre (1991), ideas are affirmed in space and in turn give rise to new mental patterns. This sentiment sets the stage for the artist's exploration, where imagined 'graves', or waste deposits, are likened to 'corpses', or radioactive waste. In this spatial configuration, our mental realm generates a field in a tangible environment, leading to a perception of psychological and spatial division relating to the unseen waste disposals seen as 'graves'. In the dimension of 'beneath', there are the hypothetical images of vertical structures 'above' the surface: buildings and houses correspond to sewage systems or bunker systems, and nuclear power plants' nuclear waste depositories. Beneath are structured like tentacles or rhizomes, hidden from the eyes of those who inhabit the

surface. One of these structures is Onkalo, a monumental underground nuclear waste repository in Finland. To avoid chances of high-dose radiation being exposed to living organisms, the bunker has to be sealed for 100,000 years: what is contained in the bunker, and the bunker itself, will go beyond the scale of human time, losing itself in the toxic unconscious. Focusing on the architecturally constructed cave, Atsuhide Ito (2016, 481) argues that it is a “radioactive underground rhizome”, which “disqualifies the notion of an architectural monument as a triumphant technological achievement to manage height”. In Ito’s analysis of the cavernous space, hidden from the public and out of reach from authority and law, the cave is the place of crossing boundaries between life and death.

Caves, waste repositories, bunkers, and burials at large have to undergo a process of beautification: mourning has to be domesticated. According to environmental historian Marco Armiero, the domestication of memories, plastically built, “goes hand in hand with the fabrication of toxic narratives” (Armiero 2021, 21). Contrarily, it is essential to take into consideration another dominant narrative, which should highlight memories and subjectivities wasted out of history, and highlight how that narrative functions to justify that very exclusion. I’d argue that this claim resonates with Antonia Rigaud’s analysis of Robert Smithson’s Land Art creations in Australia, or ‘new monuments’, which are subverting the classical notions of “monumentality as verticality” and that rather “monumentalize what is traditionally anti-monumental, or even non-material” (Rigaud 2012). The underlying thread that connects and influences our architectural design and control of nature is the idea of spatial construction: this construction weaves in directionality and the creation of meaning within landscapes and poses boundary issues concerning the appropriation of nature (Rigaud 2012). The investigation reveals two spatial realms: the prominent realm of ‘verticality’ and ‘above’ leaning over the realm of the ‘rhizomatic’ and the almost secret references whispered to ‘the underground’.

Having discussed the grey area between the visibility and invisibility of waste depositories as ‘graves’ or the symbolic ‘underground’, solutions to mark their existence have proven fascinating and challenging. Their perceived enigma echoes in the eloquent perspective of author Darren Jorgensen. Jorgensen, who has concentrated significantly on indigenous art forms, introduces a unique, yet often contested approach to mark and denote these “underground graves”. According to Jorgensen, one of the commonly proposed solutions to signal and mark underground nuclear waste dumps are “giant monuments: massive concrete structures, surrounded by rings of monoliths inscribed with the signs of death” (Jorgensen 2009). Yet, this overwhelming endeavour to make an unseen danger tangible often leads to failed interpretations: remains of ancient civilisations have been dug up by professionals and not alike, and structures built to be difficult to get to or to avoid attention have been discovered, reached, and, most of the times, not understood by visitors. Such unwanted revelations only stress the fact that problem-solving in this realm is not as simple as setting up warning systems. By addressing these issues, not only does Jorgensen point out how the human condition has changed over the centuries, but also the tight relationship between monuments and power. These, as per Jorgensen’s description, often stand as memorable testaments to the “ruling classes who are anxious not to be forgotten, or at the very least to appease the gods that lie in wait for them after their death” (Jorgensen 2009). Thus, Jorgensen’s

perspective, coupled with the commentary on Rigaud's understanding of monuments, embellishes our analysis which centres around exploring the tension between visibility and invisibility when interacting with waste lucidly symbolised as 'graves'.

In conclusion, to achieve a signal design that will last for at least enough time continuous work is essential. This goal could be reached through the creation of Cécile Massart's *Laboratories*, or by bridging the gap between day-to-day life and nuclear presences, but also by moving from verticality to beneath, and likewise from the centre to the margins. In this way, one could move from the 'wasting relationships' described by Armiero, letting the subaltern enter the nuclear discourse. To facilitate this rapprochement, as also advocated by the Nuclear Cultural Heritage project, artists and their work may be needed.

## 6 Conclusions

Making sense of these toxic and radioactive legacies turned out to be a complex task, as it is difficult to predict the future activities of humans and materials, whereby a highly imaginative process and constructing a future narrative is necessary. Accomplishing the right archiving method is essential to consider different fields at the same time: the structural forms of permanent markers, the establishment of public records and archives, and governments' regulations regarding land and resource use, together with other methods of preserving knowledge about the location, design, and contents of a disposal system (Joyce 2020). The result should be "imposing, impressive, yet unattractive" and "menacing" enough to transform a radioactive waste site marker into something more than a place, transforming it into a message (Joyce 2020) for future generations. Art practices could play a critical role in creating new discourses around nuclear presence and radioactive waste, one that is closer to social issues of "nuclearity" (Hecht 2010). Although arts-based approaches are not a definitive solution, they can bring benefits to discussions, research, and the development of diverse knowledge practices. To be effective, they must be transformative and inclusive, representing everyone without replicating oppression but serving as a bridge between experiences and imagination. While the main objective of *Art Spaces* was not to convey messages for the future creation of nuclear archives, the presented artworks have the potential to initiate reflections on the nuclear situation in Italy. Through visual arts, a nuanced exploration of nuclear representation, site, scale, materiality, and inheritance can uncover hidden layers of our shared existence, including knowledge creation, nuclear legacies, and economic cycles.

Through the testimonies and data that emerged from the interviews with Italian artists, it was possible to open up a space for discussion on issues related in a more or less visible way to nuclear decommissioning: contamination, security, power, and economic imbalances, and relations between science, technology, and art. In particular, Macalli's *The Refuse Light* has shown how by integrating radioactive presence into a social context through art, the goal of acceptance and deeper engagement with nuclear issues can be achieved, making them more accessible and facilitating a connection between personal experiences and historical significance. Lastly, in Squatriti's *For Ever and Ever*, deep geological repositories of radioactive waste

were read also as burial sites: these spaces offered ways to think about vertical structures and rhizomatic labyrinths beneath, together with the relationship between monuments and power. I would argue that communication through artistic language has made it possible to approach topics that may seem difficult to decipher or to tackle them through alternative ways than those of technical-scientific language.

*Art Spaces* has been a first step, but it was not a space for contestation or dialogue where communication about nuclear knowledge occurs. Instead, it is a space where it is observed. Opening Ispra's ISF to the broader public constituted a moment of (re)connection with the community of citizens or visitors, but there was not a real exchange between the 'insiders' and 'outsiders'. More than offering an exhibition to the public with the role of observer, in a top-down approach, radioactive waste storage sites should strive to become spaces where real interdisciplinary is built. If it is fundamental to halt the material flow of radioactive waste for environmental well-being, nuclear knowledge should remain uninterrupted, accessible, shared, and inclusive.

In considering steps forward, one potential solution for Italy is to adopt methods similar to those employed by France, which involve incorporating art into the discourse surrounding nuclear archives and the disposal of radioactive waste. This approach encourages engagement with local communities and various stakeholders, facilitating a broader understanding of nuclear issues. An exemplary initiative in this regard is Cécile Massart's *Laboratories*, which has effectively utilised art to address these concerns. Additionally, although the Italian territory was not examined in the Nuclear Cultural Heritage project, the concept of nuclear cultural heritage-making holds promise as a means to confront and address the legacies of the nuclear past. This approach recognises the significance of actively engaging with and preserving nuclear heritage in order to promote understanding and dialogue surrounding these complex historical issues. By utilising various cultural practices and interventions, nuclear cultural heritage-making offers a potential pathway for Italy to navigate its nuclear legacy in a meaningful and constructive manner. Lastly, considering the promising findings, expanding our research could involve exploring the perception of communities near the ISF to gain deeper insights and create more accurate mappings. Engaging with Ispra site workers and decommissioning experts would open a dialogue and offer alternative perspectives from labourers, technicians, and specialised individuals.

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