

RSA JOURNAL

RIVISTA DI STUDI AMERICANI

Journal of AISNA / Italian Association of North American Studies

31/2020

*American Apocalypse(s): Nuclear Imaginaries
and the Reinvention of Modern America*

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MISRIA SHAIK ALI

Memorializing Decommissioning: A Nuclear Culture Approach to Safety Culture

The waters of the Hudson river bear thick histories of the colonization of Turtle Island, revolutionary war and industrialization. The Indian Point Energy Centre (IPEC) is located almost midway along the 315-mile-long Hudson river in Buchanan, Westchester County. Commissioned in 1962, IPEC houses three reactor units and Independent Spent Fuel Storage Installations (ISFSIs).¹ Before IPEC, on the land that was named as Indian Point stood the Indian Point amusement park – a recreational space for the Hudson River Day Line’s passengers which began its steamboat operations on the river in the 1860s. In the 1920s, the owners of the day line, the Van Santvoords and the Olcotts, purchased around 240 acres of a forest by the Hudson. After learning that the Kitchawank Tribe, an Algonquian tribe, lived there, they felt that it would be “catchy” to name the land as Indian Point and built the amusement park on it.

In 1954, the investor-owned utility company, Consolidated Edison, Inc., selected Indian Point as the site for New York’s first nuclear power plant. IPEC’s Unit 1, which was commissioned in 1963, was decommissioned in 1974 following defects in cooling pipes and protests by the Hudson River Fisherman Association against the plant’s unsafe operations that led to fish-kill in the Hudson. IPEC’s unit 2 and 3 were commissioned in 1974 and 1976 respectively. IPEC is now owned by Entergy Nuclear North East, a subsidiary of Entergy corporation, and is located on the land of the Algonquian Kitchawank Tribe.² Underneath IPEC lies the 26-inch diameter Algonquin Gas Transmission pipeline owned by Spectra Energy, a private energy company. After five decades of protest against IPEC’s safety violations by the Indian Point Safety Energy Coalition (IPSEC), the Stop Algonquin Pipeline Expansion (SAPE) and the Riverkeepers, the plant is

slated for complete shutdown in 2021: in April 2020 Unit 2 was shut down and is now being decommissioned.³

The current conversations around decommissioning in the US nuclear order are oriented towards finding absolute, universal technological fixes defined by the need for a national, permanent deep geological repository (DGR) and consolidated interim storage sites.⁴ In the 1970s, the United States Court of Appeal (DC Cir) ordered the Nuclear Regulatory Commission (NRC) to devise the waste confidence rule, according to which the NRC will work towards finding a national DGR. It was an effort to avert the fear that if new plants were licensed locally, states might become permanent radioactive waste repositories without a national DGR to move the waste away from the reactor's site (*Minnesota v. NRC* 602). The 2007 review of the 1984 waste confidence rule promises a DGR within the next 160 years and, until then, advocates for a "continued storage" of spent nuclear fuel at the reactor's site or at an away-from reactor site in ISFSIs. The ISFSIs at IPEC are currently managed by the private company Holtec, Inc., which has also been maintaining IPEC's decommissioning.⁵ With the next 147 years marked for in-situ and away-from-reactor ISFSIs, the advocacy for Hardened On-Site Storage (HOSS) put forth by IPSEC and SAPE reveals "a situated technical practice" for ISFSIs as a critique to the current fixation on a national DGR (*Haraway* 3).⁶ This fixation fetters the US nuclear order to pursue Yucca Mountain as a suitable site for DGR, against the resistance of its indigenous peoples.

Yannick Barthe et al. analyze how, in Sweden, the idea of the DGR – originally conceptualized by American nuclear physicist Alvin Weinberg – has become an institutional fixation, with its promise of technological fix as "absolute safety" (197). This, they claim, impedes the positive effort of social assessments of technological processes by citizens in technological controversies (*Rip* 349, 361-63). In arguing against the faith in technological fixes embedded in the episteme of safety culture, Susan Silbey analyzes three key conceptualizations of culture in safety culture – as causal attitude, as engineered organization, and lastly, as emergent and indeterminate. In framing cultures as emergent, indeterminate and open, she calls for researchers to address the "situated interests" that mobilize "to produce countervailing power" in managing hazards (362).

“Effective safety communication” is a trait of the “positive safety culture” which has shaped the USA’s nuclear order since the “Policy Statement on the Conduct of Nuclear Power Plant Operations, 1989” was issued by the NRC.⁷ Effective safety communication strives to establish a “safety conscious work environment” by encouraging employees to “speak up” and provide “feedback.” Like other traits of safety culture, this trait restricts the work of ensuring safety to employees, so that “the people and the environment” can be protected from ionizing radiation emerging from nuclear operations. The narrative construction of these traits by the NRC as that which needs to be practiced by its employees (the Self) simultaneously constructs the Other (the people and the environment) as passive recipients of the benefits accruing from such practices. People and the environment are not recognized as active agents of knowing radiation contamination, its dangers and safety concerns through their memories of safety events and the imagination of danger – an argument I explicate in a later part of the article.

In this article, I examine the pertinent importance in tweaking safety culture using a nuclear culture approach. Under such an approach, negotiations on safety regulation attend to the memories of safety events and imagination about danger and radiation that shape the concerns and the advocacy put forth by marginalized stakeholders. How can nuclear institutions meaningfully address the protection of people and the environment if there is a lack of engagement with the local people living around them, their memories of safety events and their imaginations about danger? Using Michelle Murphy’s regimes of perceptibility, I respond to the above question and trouble the dominant nuclear regimes of perceptibility at IP (defined by safety culture) with the advocacy for HOSS, “a situated technical practice,” emerging from people’s ways of knowing, sensing and remembering danger and safety events at IP (Haraway 3). Safety culture is framed using a list of nine traits that are fixed, determinant and closed. Against this, I propose nuclear culture as one that attends to the “Other” and the possibilities of emergence that come with listening and attending, thereby allowing for the “culture” of nuclear operations to accept (rather than deny) emergence and indeterminacy of unknown dangers and risks. I critique the politics of expertise through the lens of cultural criticism, thereby allowing for conversations between the social sciences and the humanities to nuance the discourse of radiation protection.⁸

Memorializing Decommissioning: Attending to Memory and Stuff

Besides providing a cultural critique of safety culture and its memory and imagination, I also contrast them with the memory and imagination of the nuclear culture that is emerging at IP. Ivan Illich, in *H2O and the Waters of Forgetfulness*, argues against the development of a mid-city lake at Dallas, Texas. He claims the water that would be used to make the mid-city lake is actually water of forgetfulness, that is, water that undergoes not just the industrial purification of dirt but also of memory. Taking cue from Gaston Bachelard's analysis of matter as the "stuff to which our [collective] imagination gives shape and form" (qtd. in Illich 3) in order to explicate matter as culturally constructed, Illich draws a distinction between waters of forgetfulness or *Lethe* and waters of memory or *Mnemosyne*, associating Lethe with industrialized cultures. Bachelard explicates imagination as a dialectical process between form and matter or between "formal and material imagination" (1). I use this dialectical process of *materialization* to explicate the ways in which waters as stuff are imagined within safety culture and nuclear culture at IP, and why HOSS advocacy is a materialization of IP's nuclear culture. The concept of stuff wraps in the materiality and the discursivity of water, HOSS and other stuff, and grounds "stuff" in the imagination of emergent cultures, which is both discursive and material.

This article, hence, is about the "stuff" whose names epitomize the violence of the colonization of Turtle Island – the waters of the "Hudson," IP, and Algonquin Pipeline – and how the debates around the decommissioning of IPEC offer new directions for "memorializing the process of decommissioning," by tweaking safety culture using a nuclear culture approach.⁹ Evans T. Pritchard, indigenous historian of the Algonquins, tells the story of the US Colonization of Turtle Island as seen through the eyes of the "Others." He remarks:

This [book] is about the land that [Henry Hudson] discovered, the people who encountered him, and the river that flowed beneath him, both ways, upstream and down. The land is Turtle Island, the River is the Mohicanituck (... "Great Waters Constantly in motion," as interpreted by DeLaet) and the people are the Eastern Algonquin people. It is their story. (2)

It was an effort to talk about Mohicanituck, named today as “Hudson,” on whose fish the regional Algonquin community were dependent, and about their encounter with European colonizers. Pritchard names native people as “Algonquian” people, names their many “villages” and accounts their “reactions” to colonization that have not been recorded in popular history. The very re-orientation of the 250-acre of the Kitchawank tribe’s land towards commercial usage came with the naming of it as IP. Sarah Kavanagh explicates how “faux-Indian names” are used to materialize the imaginary of Indian-ness as belonging to the past (170). By roping in Robert Berkhofer’s “White Man’s Indian,” she argues that, while Indian ghosts are created through nationalistic acts of commemorating, native bodies, their histories and their land claims are erased.

As a critique of the memory practices of scientific environmentalities that seek to “humanize the violence of technological obsolescence through museumization” (Visvanathan) of those who are rendered obsolete, Shiv Visvanathan remarks that museums embalm life to encourage forgetting while memory is active, open-ended and inventive.¹⁰ Further, in arguing for commemorating heritage as a *mnesymé* (well of remembrance) of people, Visvanathan calls for an ethical understanding of the violence of museums, i.e., how they render obsolete those lives they “preserve.” He thus demands a move towards “inventive memory” where “emergence and otherness” are creative possibilities for democratic memory practices. Hence, this essay is also about those “stuff” which the “Others” of the NRC and IPEC advocate for and imagine with – namely the members of IPSEC, SAPE, the indigenous peoples, and people of color whom the current mode of decommissioning at US targets – including HOSS and Mohicanituck (Hudson that’s constantly in motion). Seeing Indian Point, the protection against ionizing radiation at IP and the process of decommissioning IPEC through the eyes of such Others offers a nuclear culture approach to safety culture.

The HOSS advocacy explicates a “situated technical practice” that offers alternative directions to the current mode of decommissioning, a national DGR, that the US nuclear order is fixated on (Haraway 3). This also requires the white bedroom communities around IP that have benefited from the presence of IPEC since the 1970s, in the words of Marilyn Elie (lead IPSEC activist) to be “custodians of the radioactive waste” and to stay with the

trouble of radiation in order to prevent the dumping of radioactive waste in the lands of indigenous and people of color communities. In *Staying with the Trouble*, Haraway argues for “a time for freshness” with tentacles of underground beings spreading the grounds of the Anthropocene to make oddkins and to embrace experiments of staying with the troubles of geological epochs (2). Making oddkins requires one to encounter the other, become with the other in “unexpected collaborations and combinations,” and this can be initiated by “inheriting the past without denial” (4). In the worlds of Anthropos and Capital impressed by demiurgic and savior imaginaries of “techno-fixes” (or “techno-apocalypses”), Haraway reminds us to “embrace situated technical projects and their people” (3).

By roping in arguments made by Visvanathan and Haraway, in the final section on Heritage as making oddkins, I explicate HOSS as a *mnemosyne*, a well of remembrance, where past incidents of safety, danger and radioactive contamination congregate to *materialize* the HOSS aboveground. Nuclear institutions, its governmentalities and environmentalities, fixated on technological processes that are embedded in imageries and imaginaries of techno-fixes and apocalypses, render radiation contamination imperceptible.¹¹ However, in nuclear cultures, mutated and injured bodies, in form and matter, become signs of irradiation posing an anti-thesis to radiation’s invisibility orchestrated by the nuclear industrial-complex. Hence, in knowing irradiation, it becomes crucial to analyze the perceptual, epistemic, psychic, material and semiotic ways of knowing radiation by peoples inhabiting nuclear cultures. This article, hence, loops alternative ways of measuring, sensing, remembering and knowing radiation contamination at IP in order to trace the emerging nuclear culture at IP, using the works of Visvanathan, Haraway, Jonathan Crary, Murphy and Illich.

I. Water

In this section, I explicate how water as stuff is imagined by the safety culture and nuclear culture at IP. In *H2O and the Waters of Forgetfulness*, Illich analyzes the rationales for constructing a mid-city lake at Dallas,

Texas, by constituting urban space and urban water as the stuff the city imagines with. In line with Ivan Illich, to theorize IP as a nuclear culture where danger and safety are emergent and indeterminate, I juxtapose the waters or rivers that concern the IP resistance with with the complex spatiality of IP.

The Hudson waters bound IPEC. Besides nationalistic histories, the Hudson enfolds stories of environmental activism that talk to “making oddkins” in the valley. In the 1960s and 1970s, activist groups like the Scenic Hudson and the Hudson River Fisherman’s Association (HFRA), via their resistance to the Storm King hydroelectric project of Con Edison, unprecedentedly compelled the Federal Power Authority to attend to the environmental impacts of energy developments, epitomized by the signing of the Hudson Peace Treaty in 1980 (Revkin). Although the HFRA was successful in its appeal to the then Atomic Energy Commission for mandating cooling towers requirements for IPEC to reduce fish-kill in the Hudson (Lifset 174), as an incentive to compel Con Edison to withdraw the hydroelectric project, the National Resource Defense Council waived the requirements rendering the HFRA’s struggle unsuccessful. The negotiations on appropriate energy infrastructures in environmental controversies have historically put the concerns of anti-gas, anti-nuclear and anti-dam movements at contestation. Today, environmental groups at IP have reconciled such oddness/differences to form what they call “The Unity Group.”

IP as Complex Spatiality of Danger

The source of environmental activism against energy infrastructures at IP goes beyond IPEC. Dr. Courtney Williams, lead activist at SAPE, has been involved in resistance movements against the high-pressure Algonquin Incremental Market gas pipeline expansion (AIM). Spectra Energy initiated the expansion in 2017 by replacing the already existing 26-inch diameter Algonquin Gas Transmission pipeline with a 42 inch-diameter AIM pipeline in the region. AIM cuts through IP and is “within 105 feet from critical safety infrastructure [NPP] at Indian Point” (“Stop

the Algonquin Pipeline Expansion”), making IP a complex spatiality of danger. Williams’s words talk to the complexity of everydayness at IP:

In 2013, [SAPE] was holding an info session at our local library about a gas pipeline expansion in the area. By that time, we realized that we were living 400 feet from this Algonquin Gas Transmission pipeline, which we didn’t know when we bought our house because there’s no law in NY state requiring disclosure of this kind of thing. So, my husband went to the info session... and came home and said, ‘either we should sell our house or move away right now. These people are crazy, because they’re saying that the pipeline company wants to build a new gas pipeline underneath the NPP,’ and we didn’t sleep much that night. We looked into it and realized that the pipeline ran under the NPP and the company was planning to expand. (Williams, “Interview”)

Today, the 40-year-old Algonquin Gas Transmission pipeline lies beneath IPEC as an auxiliary pipeline sending alarm sirens of danger across IP. Williams explains:

Like anytime we hear a loud noise, explosion, we worry [that we need to evacuate]. We have Sirens that we have to test or that they test that [sirens] supposedly. Well, so they test the sirens routinely, but the difference between the siren for the firehouse and for the NPP is that the siren for the NPP... is like a steady way. Whayyyyyy... for firehouse, it goes whaywhaywhay. (Williams, “Interview”)

Hearing the sirens of the energy facilities creates confusion amongst the local people whether there is an emergency, or a testing is being carried over. Sirens from police vehicles, sirens from fire trucks or ambulances also cloud their sense of danger.¹² Living in constant emergency requires people in risk cultures to sharpen their senses, creating fields for experiencing, knowing and remembering the emergent dangers in their surroundings.¹³ A knee-jerk categorization of such sensorial orientations as caused by fear by nuclear regimes of perceptibility indicates the inability to engage with the lived experiences of the people beyond the scientism of the issue and explicates the constant effort by the nuclear industry to shape the manner in which human subjects perceive and attend to dangers of irradiation. Murphy defines

regimes of perceptibility as “produced by assemblages” – “arrangements of discourses, objects, practices, and subject positions that work together within a [...] knowledge tradition” (10, 25) to render the phenomenon of exposure perceptible by including some objects, action and knowledge while excluding others. Murphy builds the concept from Cray’s work on *Suspensions of Perception* where he argues that, in using scientific discourses and technological apparatuses, modernity shapes the ways or orientations one uses to *attend* to matters of concern. Environmental activism at IP, as this article shows, is a contestation between ways of knowing and sensing radiation contamination by local people and the dominant nuclear regimes of perceptibility that prescribe scientific modes of knowing and sensing radiation as the “God-trick” or the only path to truth (Haraway 42).¹⁴

Paul Blanch’s story provides a way to excavate how dominant nuclear regimes of perceptibility shape perception, memory/forgetfulness and everydayness at IP. In November 2015, Blanch, an ex-consultant to Entergy and a whistleblower, revealed that the NRC’s approval of the AIM pipeline to be sited besides IPEC relied on a “partially handwritten [...], undated [and] [...] unsigned” risk assessment report compiled by Entergy; the report concluded that the siting poses “no undue risks,” if the isolation valve is shut “within 3 minutes,” in the worst-case scenario of a rupture in AIM pipeline (qtd. In Momma). Such a rupture may lead to a station blackout, cutting electricity supply, and may also damage the back-up diesel generators required for the safe shut down of IPEC. Citing the 2010 San Bruno pipeline rupture, Blanch claims that field verification procedures delay the timely shutdown of the valve. Further, Entergy stated that only the safe shut down of the NPP is within “the jurisdiction of NRC” (Entergy’s 10 CFR).

If nuclearity is “a technopolitical phenomenon that emerges from political and cultural configurations of technical and scientific things” and “a property distributed among things” (Hecht, *Being* 15), local peoples’ ways of knowing at IP that draw rhizomatic connections between technological processes of IPEC and AIM through compiling worst-case scenarios explicate the nuclearity of the AIM and interrupt the “hybrid forms of power” that get to designate something as nuclear; this is a process of making oddkins (Hecht, “Cosmogram” 103; *Being* 14-15). While

Entergy's safety analysis draws boundaries and differentiates between the jurisdiction of AIM and IPEC at IP, local people in nuclear cultures, who draw connections across temporalities and spatialities of danger, emerge as active agents of producing knowledge for knowing, remembering and sensing danger, not passive recipients of radiation dosages or hazards whose protection the safety culture addresses.

As active agents of knowing danger, the Unity Group has proposed the need for a Citizens Oversight Board (COB) to overlook the decommissioning process, to Entergy, NRC and New York State.¹⁵ However, a Community Advisory Panel (CAP), consisting of 25 politicians, Entergy employees and bureaucrats with no representation from IP's local task force, has been instated to oversee the decommissioning. The Nuclear Energy Innovation and Modernization Act which will come to effect in 2021 requires the NRC to report on "the best practices for establishing and operating local community advisory boards" (5577). As of today, Unity Group's advocacy for a COB and the above-ground HOSS stands rejected with the formation of CAP. The rejection thereby undermines IP people's ways of knowing risks, danger, and ensuring nuclear safety.

Risk analysis reports like the one discussed first of all control *ways of remembering danger* (detailed in the section on memory). Secondly, the risk assessment image, even if intended by the "experts" to be a communication material for "lay" understanding, explicates an age-old technique of nuclear industry and regulatory institutions where the information supplied is authenticated by "powerful boundaries of secrecy and alleged expertise": this technique undermines "the naïve and subjugated knowledge" of nuclear cultures as at IP emerging from lived experiences, memory and sensoria (Abraham 4). In line with Abraham's call for scholars of Critical Nuclear Studies to attend to such neglected, subjugated knowledge, this paper explicates a "nuclear culture" approach to nuclear safety that attends to the ways people living in complex areas of danger know and visualize ionizing radiation. Foucault claims that the attention to subjugated knowledge renders critique possible, and in so doing reconciles differences and addresses marginalization (7-8). In the following sections, I discuss the rhizomatic connections made by activists at IP by engaging with oddkins to make sense of the dangers emerging from its complex spatiality.

IPSEC and SAPE are two key activist groups at IP resisting the reduction of IP to an energy mine. However, to stay united in their struggles was a decision consciously taken by both the groups. As Williams states, SAPE & IPSEC literally are

in the intersection of gas infrastructure and nuclear infrastructure. There have been efforts by probably the industry and marketers, say 'like, oh if you don't want gas infrastructure, we need NPPs because it's clean,' that has pit activist communities against one another. Here in the Hudson Valley, we have strongly resisted that, and we started a new group called the Unity Group; united for clean energy. (Williams, "Interview")

Marilyn Elie also echoes Williams's sentiments. The kinship between SAPE and IPSEC, in the form of the Unity Group, emerges from IP's complex spatial terrain of danger, and "place-making" at IP is defined by the danger "events" that emerge from its complex spatiality (see Massey).

Memory and Waters of Forgetfulness

After decades of struggle against critical safety practices that concretize risk and danger at IP, Riverkeeper, NY State, Entergy signed an agreement calling for the shutdown of IPEC by 2021. In his opening statement, Riverkeeper's attorney Mark Lucas states that

[t]he facility [IPEC] at issue indisputably leaks radioactive matter into the groundwater and into the Hudson. [IPEC's] unabated thermal discharge [hot water] impacts the natural habitat resulting in degradation of the resource and the aquatic biota, including threatened and endangered species. (Lucas)

Safety practices at IPEC, embedded in the imaginaries of a safety culture that includes technological fixes, construct the Hudson as a body of H₂O or cooling water that is sucked into the reactor. H₂O, for Ivan Illich, is an industrialized, commercialized, domesticated and modernized meaning of water, purified from dirt and memory for "human survival"

(76). Survival at IP today depends on the purification of the Hudson waters' toxicity stimulated by industrial-anthropogenic activities, making it into the Hudson of the Anthropocene. In Greek mythologies, when *Lethe*, the waters of forgetfulness, like the Hudson of the Anthropocene, washes away people's memories, the memories do not disappear but rather accumulate in the well of remembrance, *Mnemosyne* (30). While the toxic waters of the Hudson are purified from their dirt, there is a compulsive need for memories of radioactive contamination of the Hudson waters to be retained as signs, and hence commemorated with a "Mnemosyne", the aboveground HOSS.

The Hudson has lost its significance as a river that is constantly in motion, flowing both upstream and downstream and simultaneously stirring the mud deposit that lies in its depth. In fact, this unique significance, recognized by its indigenous name *Mabicantuck*, is reversed to rhetorize the river as intrinsically unclean by industrialists, supplementing the dominant nuclear regime of perceptibility. Secondly, IPEC's radioactive waters that are discarded into the Hudson give them a degree of imperceptibility, with no signboards around, until nuclear regimes of perceptibility acknowledge the contamination, stabilizing it as institutional memory ("Environmental Impact"). Lack of accurate safety information from the government other than just rhetorical communications and the confidentiality of safety information to ensure nuclear security compel the sustained flow of information to render radiation perceptible between nuclear cultures. Hence in nuclear cultures, accidents, like Fukushima, are rather "a near past" that informs present experiences of *becoming irradiated*.¹⁶ In a similar way, the "forgotten" Texas Eastern auxiliary pipeline under the surface of the Arkansas river adds to IP people's knowledge about institutions' responsibility to ensure safety:

This happened in June 2015. This is an image of auxiliary pipeline under the Arkansas River blowing up and Spectra didn't even know it had happened. When this pipeline blew up, it blew chunks of cement that damaged the Tugboat. When the tugboat captain saw all the damages, he called the Coast Guard. The Coast Guard examined the situation and said, 'I think there's a gas pipeline near here.' So, they called SE... and only then [SE] realized that their pipeline had blown up.

The Texas Eastern Pipeline (TEP) connects the East Tennessee Natural Gas Pipeline in the Southern US with the AIM pipeline that extends up to Nova Scotia, Canada, along the eastern seaboard. Spectra Energy's plan to replace the existing Algonquin Gas Transmission pipeline with the AIM pipeline makes the Algonquin Gas Transmission one an auxiliary pipeline under IPEC. Since auxiliary pipelines "are not normally in use," to quote from SE spokesperson Phil West's response to the TEP rupture, the IP people fear that Algonquin Gas Transmission under IPEC may as well be beyond the active attention of Spectra Energy: in Blanch's words, "Entergy and Spectra have not fully considered that worst-case scenario" (qtd. in Thielman). Scientific institutions that treat accidents in isolation, as events happening elsewhere, do not pay attention to the knowledge repositories constructed by local people as "worst-case scenarios" by collating information and stories of danger. Such reports' rhetorical insistence on the safety-ness of critical infrastructures, rooted in technological rationality, regulate people's memories of danger (articulated through worst-case scenarios) by erasing the discursive, institutional and technological resonances between safety events in risk cultures (see Rice and Jahn 136-55).

Radiation, TEP and the Algonquin Gas Transmission pipeline are stuff that are "beneath the surface." The specific recommendation of the Unity Group that is key to *memorializing decommissioning* is the need for an aboveground HOSS storage at the reactor's site and *not underground*.¹⁷ As Elie remarks, "this [spent]fuel needs to be stored above ground. So, people can see it and it won't be forgotten about and that's it. *There is no good solution*". By storing the spent nuclear fuel *underground*, Marilyn's concern is that it might be forgotten in the vast timescale required for radioactive decay. STS underground studies point to problems of conflating underground and invisibility and argue that "cultural imaginaries about the underground" reinforce "a distance" between visibility and the underground (Kinchy et al. 31). They claim that the "invisibility of the underground makes it analogous to studying other 'invisible' forces like... radiation" (31). In the recent literature on nuclear studies, scholars ask: "is radiation invisible at all?" (see Kuchinskaya).

Works in sensory studies explicate the need for shifting sensorial analyses' attention from "body" and the "thing" to "transmission flows" and "field of sensorial experience" (Hamilakis 115; Ingold 97-104; Hahn 171). In sensorial fields of experience, heterogeneous elements like "material substances, airwaves, gestures, and movements, as well as discourses, affects, memories," *relate* and get entangled through "encounter with one another" in the institution's safety practices to render radiation perceptible (Hamilakis 115, 118). Following this, ontological inquiries into the (in)visibility of the underground or the radiation has little to do "with objects themselves," whether they be underground or radiation, but instead concerns the relationality established by regimes of perceptibility. Such regimes frame the fields of experiences and regulate memory through techno-scientific practices of safety that insist on technological fixes.

At IP, where both radiation and underground pipelines have been orchestrated to be invisible, the notion of (in)visibility is one that concerns regimes of perceptibility rather than radiation/underground pipelines themselves. In addition, real-time decay heat monitoring and sensing technologies as parts of aboveground HOSS advocacy clarifies that the Unity Group do not simply believe that formally *materializing the invisible stuff*, radiation, aboveground would render radiation visible; it's not simply a matter of inversion. Along with formally materializing HOSS aboveground, other parts of the Unity Group's advocacy – including sensing technologies, safety mechanisms and safeguards, citizenry's practices of overseeing decommissioning, lived and sensorial experiences and memories of danger, and memorializing decommissioning, to name a few – mesh together in cultivating a new regime of perceptibility at IP that attends to people's ways of knowing and sensing radiation contamination neglected in the past by dominant regimes of perceptibility. In order to memorialize the violence of non-transparent and secretive nuclear regimes of perceptibility, the Unity Group, imagining with the aboveground HOSS, a *stuff*, calls for its materialization as a dialectic between its form, above ground, and HOSS's material arrangements.

III. Heritage as Kinship

In September 2007, environmental justice organizations from every US State released the “Principles of Safeguarding Nuclear Waste at Reactors” advocating for HOSS as a key principle of interim storage of nuclear waste at in-situ or away-from-reactors ISFSIs. The advocacy states that HOSS is “rooted in values of community protection and environmental justice” and is meant to protect nuclear waste storages from “terrorist attacks and earthquakes” (“Overview”). The HOSS advocacy, fearing the exposure to and contamination of communities that are not already exposed to radiation, stands against the movement of radioactive waste to “away-from-the-reactor” sites, especially Yucca Mountain.¹⁸ The HOSS advocacy recognizes that a national and consolidated DGR mandated by the Nuclear Waste Policy Act of 1987, the interim storage in dry-casks where radioactive wastes are “tightly packed,” and the reprocessing of spent nuclear fuel which is “a proliferation threat” are environmentally unjust, and hence are non-solutions (“Principles”).

The Unity Group has expanded on the principles of HOSS to include rolling stewardship and aboveground dry-cask HOSS facilities constructed horizontally, making them unappealing to terrorists’ attacks. Rolling stewardship, formulated by nuclear scientist Gordon Edwards, is a way of decommissioning which involves consensually taking responsibility to oversee radioactive decontamination of nuclear infrastructures by the current generation of citizens in nuclear cultures.¹⁹ Edwards explicates that the existing techno-scientific practices of spent fuel rods’ storage leads to “abandonment” of nuclear waste which further weakens the collective memory and proposes rolling stewardship as a way of prolonging “the memory of radioactive waste” as radioactive decay occurs over protracted temporalities (66). In such a way, the *materialization* of aboveground HOSS in the Unity Group’s advocacy comes to be a critique of the dominant nuclear regimes of perceptibility that delegates the responsibility of radiation protection to its employees (the Self). By tapping into America’s haunting legacies, HOSS is a stuff that IP imagines with to make oddkins spatially and temporally possible in order to “stay with the trouble” of radiation. Such stuff are mnemonic devices that interrupt dominant

regimes of perceptibility. They preserve the fraught memories of living with radiation contamination by embalming stuff like HOSS in such a way as to generate the remembrance of the haunting legacies of environmental racism and injustice.

Conclusion

Commemorating heritage in “a time of freshness” with stuff that cultures imagine with, and to make oddkins temporally and spatially, come about by attending to haunting legacies and “inheriting [them] without denial” (Haraway 3). Nuclear museums or “exhibitory complexes” that fill the corridors of the US – from Los Alamos to Oak Ridge – are “material and symbolic tools” that “sought rhetorically to incorporate the people within the processes of the state,” thereby materializing and further consolidating nationalistic imaginaries (Bennett 99). Such atomic and nuclear museums tell the jingoistic and demiurgic tales of nuclear nationalism. Visvanathan’s theory of heritage is one that intends to rescue the notion of heritage “from [such] jingoism of the nation state which conscripts it for identity formation”, “a bureaucracy that forges it into a technical entity,” and lastly, a “tourist fixation.” Heritage as “a mnemosyne of people” provides possibilities for “form[s] of trusteeship and caring for a world” where heritage “go[es] beyond the textuality, the materiality of history to capture [...] kinship with a different time” (Visvanathan). Such a notion of heritage is one that pays attention to the memories of Others, who have been marginalized by technological operations, by memorializing stuff through acts of trusteeship and care that reconcile differences.

HOSS as a *mnemosyne* of the people at IP committed to making oddkins is a situated technical project that alters safety culture’s imaginaries by interrupting its regimes of perceptibility, inflicting on them stories of danger collected from across the USA’s space and time. A situated technical project that inherits haunting legacies without denial is also a heritage project. Situated technical projects emerge from the tension between “a cosmic faith in technological fixes” and “a position that game is over” or “it’s too late.” The Unity Group, through COB, is taking up the duty of

oversight and staying with danger via rolling stewardship, at least until the USA looks for technological processes for radioactive waste storage other than empty or indigenous lands. HOSS advocated by the Unity Group is a mnemonic device that alters the practices and processes of nuclear operations in order to memorialize the haunting legacies of the USA which are further perpetuated through environmental injustice and racism. The HOSS advocacy by means of interrupting IPEC's safety culture renders Indian Point as a nuclear culture.

Situating Nuclear Cultures

1. Nuclear cultures are open and emerge from the emplaced experiences of danger and safety, where ways of knowing irradiation emerge as a resurgent force from the dialectical interplay between existing systems and practices. They are not closed systems of autopoietic functioning and processes that minimize *a priori* risks.
2. Nuclear cultures recognize people as active agents of knowing irradiation and converses with “naïve or subjugated knowledges” about safety, danger and risks rather than neglecting them.
3. Nuclear cultures appropriate myths that communities could playfully engage with. While technological rationality constitutes today's nuclear safety culture, kinship is one of the myths that make up nuclear cultures, thereby altering the dominant regimes of perceptibility.
4. Here, stakeholders confront oddkins allowing them the multivocality that attends to marginalized lives for subsequent experimentation with symbiosis.
5. A nuclear culture approach is that which not only reinvents the memory practices of safety culture but also reorients its processes and operations in more democratic ways by means of paying attention to the other.
6. Lastly, nuclear cultures compel attention to the complexity of “becoming irradiated” as they strive to be recognized as nuclear by the current nuclear safety order.

Future research on nuclear sites can enlarge nuclear cultures by adding stories, experiments and struggles from nuclear geographies, nuclear criticism and other layers of nuclear cultures. The suspension of perception enforced by centering nuclear safety in *talking about irradiation* sharpens the dialects of the nuclear industry, leaving people's experience of irradiation under-theorized (Jasanoff and Kim 2). The next 147 years, marked for in-situ and away-from-reactor ISFSIs in the American nuclear order, demands approaching nuclear safety via nuclear culture that shifts safety imaginaries from absolute, demiurgic, consolidated technological solutions to experiments and imaginations that are situated and interspersed by different anti-genocidal or anti-exclusionary social groups, based on kinship, espousing a shared care for living on a damaged planet and thereby constructing a new postmodern set of ethics.

Notes

¹ Independent Spent Fuel Storage Installations are used at interim storage facilities, either within the reactor's site or in away-from reactor sites, to store spent fuel rods that were used in the reactor to generate electricity. They are stored in such facilities until the radioactivity of spent fuel rods decay into stable elements.

² Kitchawank Tribes are part of the Wappingers Confederacy and occupied parts of today's counties, namely Westchester, Putnam and Bronx.

³ IPEC committed nearly 40 safety violations between 1980 and 2016. Established in 1976, Riverkeeper is a non-profit environmental organization, that protects the Hudson from degradation. IPSEC and SAPE are local advocacy groups at IP that strive to ensure the safety of energy infrastructures at IP.

⁴ See "Recommendations of the Blue-Ribbon Commission." During the hearings, David R. Wright, the current President of the NRC, supported the need for a national DGR at Yucca Mountains stating that the cost of deploying security for waste stored in dry-casks (ISFSIs) temporarily at the reactor's site was constraining.

⁵ In 2017, Holtec, Inc. sought the approval of the NRC for establishing an Interim Storage Facility which would house up to "8,680 metric tons uranium of commercial spent nuclear fuel" at Lea county, New Mexico. The area is used for cattle grazing and the NRC is currently carrying out the economic and environmental impact assessment of the site.

⁶ The advocacy for HOSS states that the “on-site storage of irradiated fuel rods [be it in on site or away from reactor ISFSIs] in dry casks should be made safer and more secure by adoption, by NRC, of regulations to mandate HOSS. HOSS is a system whereby more space between the containers increases security, and earth mounds or berms form a barrier between the containers and any public-access points such as [...] water-front. HOSS also mandates real-time heat and radiation monitoring and would also provide for local community over-sight of the waste installation such as a citizen advisory board” (“Talking Points”).

⁷ On safety culture and decommissioning, see “Safety Culture.”

⁸ In the collective effort at bringing about a strategic research agenda for the social sciences and humanities in radiological protection in 2019, the Society for Radiological Protection called for ways to “develop avenues for systemic collaboration [...] between technical and non-technical communities” and explore the “interrelation between behavior, perception of risks, economic aspects, knowledge, culture, historical memory” (Perko et al. 2, 7).

⁹ On “nuclear culture,” cultural history and critique of “atomic culture,” see Boyer, and Messmer. On “British nuclear culture,” see Willis, and Maguire. On constructive critique of the use of nuclear culture as a property of nuclear zones, see Martin and Davies, and Hughes. On artistic practices and nuclear cultures, see Carpenter, and Gibbs and Robert. In my work, I situate nuclear cultures as emergent rather than as a virtue or property of a zone that is nuclearized and is informed by Science and Technologies Studies (STS), Sensory Studies and Critical Nuclear Studies, thus adding to the on-going effort for a shared meaning of nuclear culture.

¹⁰ Luke defines environmentalities as “instrumental rationalities [embedded] in the policing of ecological spaces” (65).

¹¹ On nuclear and images/imagery, see Lifton; Weart; Berger. On nuclear and imaginary, see Carpenter, “Shifting the Nuclear Imaginary,” and Hales.

¹² Attending to the difference in sirens is crucial for emergency response. Emergency protocols of IPEC require evacuation while those of AIM pipeline require people to stay indoors.

¹³ See Pink on emplaced knowing: knowing occurs through both embodiment and emplacement in the environment.

¹⁴ On sensorial ways of scientific and technical knowing in NE, see Parr, and McKenzie and Spinardi.

¹⁵ The UG has proposed amending “the Public Service Law to create a Board to oversee aspects of decommissioning.” The COB would meet at least 10 times a year and consists of 15 voting members including “first respondents, labor unions, environmental organizations, economically disadvantaged community and the general public” and 8 designated State and county officials serving *ex officio* (“Citizens Oversight Board”).

¹⁶ Berlant claims that today’s eventualization is defined by a disturbed time called the

historical present where the on-going present defines what events come to be our near past and near future events.

¹⁷ See endnote 6.

¹⁸ Excluding places where storing radioactive waste in reactor sites is dangerous and unsecure like Praire, Minnesota (see State of New York, et al.).

¹⁹ See *Minnesota v. NRC* 602 F.2d 412.1984, Waste Confidence Decision (49 FR 34688), and 1990 and 2007 reviews of the 1984 decision.

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