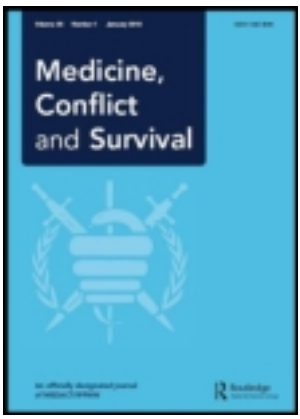

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The biomedicalisation of war and military remains: US nuclear worker compensation in the 'post-Cold War'

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This paper analyses the recent legislation and administration of United States nuclear worker compensation – the Energy Employees Occupational Illness Compensation Programme Act (EEOICPA) – in order to show the domestic impacts of war and the social order that has been established to respond to the Cold War legacy of occupational exposures, illness, and death. Examining the epistemological politics and material effects of compensation, an insufficiently analysed aspect of the Cold War, I argue that the system designed to redress the occupational exposures of nuclear workers accomplishes something else: obscuring the ethical problem of misinformation and missing data from the Cold War era; mobilising an industry of knowledge and market–economic opportunities in the arena of biomedical exposure assessment and dose reconstruction for parts of the former US nuclear complex; and, lastly, dematerialising and depoliticising geographies of the Cold War and its differential impacts through an individualistic epidemiological reprocessing of radiation exposures. The paper shows how the general claims procedure, combined with two methods mandated by EEOICPA – dose reconstruction and the probability of causation – effectively de-link workers from each other, and worksites from homes, pin compensation to a cost–benefit logic, implicate genuine scientific complexity and uncertainty in an ongoing denial of the toxic legacies of war, and ethically undermine the social justice aims of the legislation. The article ends by considering some of the ways that US nuclear workers have responded to living as the remains of *both* US bomb production and the compensation system.

Keywords: cancer; compensation; dose reconstruction; national security; radiation exposure

Introduction

The domestic organisation of life for national defence has left the marks of war deep within the US. War has unequivocally happened 'at home', threatening the health, safety, and environment of the nation. Massive contamination

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remains from the production, maintenance, and disposal of weapons systems, the privileging of production goals over ecological concerns, and decades of improper and unsafe handling, storing, and disposal of hazardous wastes (US Department of Energy 1995). The domestic legacies of war, however, are often hard to see. Toxicity can be difficult to detect, a history of secrecy and misinformation makes it difficult to weigh evidence and substantiate claims, military sites are scattered across the country, largely in rural areas that do not command public attention and the burden of inhabiting risks and attritional hazards of such sites falls largely on the poor and marginalised communities. Furthermore, the 'post-Cold War' restructuring of the US military and emphasis on environmental stewardship and security – what is often referred to as the 'greening' of the military – suggest that the residual negative impacts of war have not contaminated the nation. A prominent example of this is the decommissioning of former military arsenals and nuclear facilities and the transfer of this land to public use as nature refuges. The remediation of military natures implies that the nation is clean and properly bounded, pure and environmentally stable (Krupar 2013). A second example has been the passage of a bill to provide compensation to US nuclear workers who suffer from various illnesses related to their years of work producing the atomic bomb. Such concessions suggest that the sacrifices to the health and livelihood of such former workers can be safely placed in the past and do not represent ongoing material threats to public health and contemporary forms of life within the nation state.

This article investigates the administration of US nuclear worker compensation in order to show, broadly, the domestic toxicity of war and to investigate, more specifically, the social order that has been established to respond to the Cold War legacy of occupational exposure, illness, and death. Regardless of the legislation's acknowledgement of the sacrifices to the health and livelihood of such former workers, the labyrinthine claims procedure demonstrates a politics of deferral and denial for the body burdens – bioaccumulative toxins – of these workers, and the geographies of exposure that condition the 'post-Cold War' present. The article endeavours to provide an overview of how the claims procedure works in order to show the current biomedicalisation of the Cold War's domestic impacts.[1] Compensation involves the gathering and epidemiological processing of workplace exposure, worker medical data, and worker-related environmental health information via the science and industry of dose reconstruction and exposure assessment. The article details how the legacy of misinformation in the US atomic buildup, combined with the historically-accumulated unknowns about workplace exposure and unreliability of worker medical records, are instrumentalised by parts of the former weapons complex to intensify market–economic opportunities in the field of biomedical exposure assessment and analysis. I argue that such lacunae in the data from state–scientific–bureaucratic histories of secrecy and mismanagement are used to expand clinical and bureaucratic regimes, in what might be called value-generating obscurantism, through complex subcontracting, the development of obfuscatory

software, and the use of epidemiological techniques that incorporate questionable 'benefit of the doubt' measures. The article investigates the 'productivity' and epistemological politics of this industry of knowledge and speculates on its effects, namely the dematerialisation of geographies of war and depoliticisation of uneven body burdens of the Cold War. In the context of legislation that has social justice as its purpose, the article questions the ways that the genuine administrative, scientific, legal, and social complexity involved in coming to terms with the domestic toxic legacies of war boils down to a cost–benefit logic, implemented via a complex bureaucracy and largely opaque political economy. The article ends by considering some of the ways that workers are responding to the compensation system, by engaging in collective politics that draw on their vulnerability as the living remains of US bomb production *and* compensation, disobey the individualising procedures of dose reconstruction, and document the misinformation and arbitrary forms of denial that appear in the claims procedure.

Overview of EEOICPA

In 2000, US Congress passed the Energy Employees Occupational Illness Compensation Programme Act (EEOICPA) to provide compensation to US nuclear workers who suffered from various illnesses related to their years of work with deadly materials necessary for the making of nuclear weapons.[2] The legislation marked the end of a dark chapter in occupational health in America, namely the systematic denial of occupational illness compensation claims among workers in the factories and laboratories of the atomic bomb complex (Silver 2005, 267). At one time, much of the nation was drawn into the assembly line for making nuclear weapons, with more than 300 sites nationwide involved in mining, milling, refining, and enriching uranium, making and machining plutonium and bomb parts, special materials handling centres, assembly, research and development, as well as testing grounds (Dean 1953; Groves 1962; Schwartz 1998; Masco 2006; Kelley 2007; Johnston 2007). Historically, the Department of Energy (DOE) and its predecessor the Atomic Energy Commission claimed 'sovereign immunity' and actively assisted DOE contractors in opposing the claims of workers who sought compensation benefits (Alvarez 2001; Flynn 2001; Makhijani 2001; Parascandola 2002a). DOE-contracted site operators were typically indemnified by the DOE, meaning contractors held limited liability for running these sites because the federal government agreed to cover costs from damages and lawsuits. The 'civilian' status of nuclear workers was strategically evoked to repudiate responsibility for the welfare of these workers; they were not eligible for veteran benefits, and federal workers' compensation programmes generally did not include nuclear workers. Many workers were additionally unable to receive any form of state workers' compensation benefits, due to inadequate exposure data, the uniqueness of the hazards to which they were exposed, and long latency

periods of disease and illness. Workers who attempted to pursue compensation for illnesses due to exposures basically confronted an iron curtain of information (Silver 2005). Since the massive downsizing of the weapons complex in the early 1990s, when nuclear weapons sites were closed and decommissioned en masse, many of these workers have faced unknown futures, in terms of their health, with no form of care or compensation on the horizon.

An atmosphere of distrust and mounting environmental and health concerns about the weapons complex has pervaded the 'post-Cold War' period, which brought forth a series of revelations about the many kinds of sacrifices people have been subjected to unwittingly in the name of national security (Welsome 1999). In this context, a public constituency for a federal programme to compensate sick nuclear workers was galvanised by a series of public hearings around the US, held by then-Energy Secretary Bill Richardson and then-Assistant Secretary of Energy for Environment, Safety, and Health Dr David Michaels (Silver 2005). The aim of these meetings was to publicly acknowledge the harm done to workers and to correct the DOE's former culture of secrecy (Welsome 2000). If a production imperative and maintaining public confidence took precedence over worker health and safety during the Cold War, the moral imperative to rectify exposures that occurred without knowledge or consent, and to provide for sick nuclear workers, was now made a US national priority. DOE policies – popularly known as 'defend and deny' – would now shift to 'recognition and recompense' for thousands of sick workers who earned their livelihoods in government-owned, contractor-operated weapons production plants, where large quantities of radioactive and toxic materials were used.

Although Congress held hearings about radiation-induced cancer in atomic workers as early as 1959, those efforts ran aground on issues of 'indeterminate causation' – the inability to distinguish radiogenic cancers deserving of compensation from cancers that would have occurred in the absence of occupational exposure to ionising radiation (Subcommittee on Research and Development of the Joint Committee on Atomic Energy 1959). Forty years later, the 106th US Congress would adopt a framework intended to yield consistent, scientifically informed causation determinations for cancer claims. The EEOICPA legislation provided an unrebuttable presumption that certain cancers are work-related, and, reading more like a confession than a legal document, recognised the harm caused by radiation and toxic chemicals in the bomb factories of the US. However, in spite of these efforts to facilitate moral and financial recompense to workers, the implementation of EEOICPA has been so complex, even convoluted, that it has been referred to as a 'strange beast' with 'weird appendages' by those who first designed and advocated the legislation (Michaels 2008).

EEOICPA includes two separate benefit programmes: Part B and Part E (US Department of Labour n.d.).[3] Part E replaced the original Part D, which was deemed to be ineffective. The 2000 law originally sought to create a

technical assistance programme run by the DOE to help former contractor employees file state workers' compensation claims for occupational illnesses. After a series of Government Accountability Office (GAO) reports revealed the extent of DOE's ineffective management and confirmed constituents' complaints of delays, Part D was abolished by Congress, and Section E was erected in its place (Government Accountability Office [GAO] 2002, 2003, 2004a, 2004b, 2006; Michaels 2008).[4] Control was completely removed from the DOE and placed under the Department of Labour (DOL). The DOE's only role in EEOICPA now is to provide support in the 'retrieval of records'. Part E covers illnesses that were caused, aggravated, or contributed to by exposure to any toxic substance while working at a DOE facility. Radiation-induced cancers are separated out and funnelled into Part B. The tracks have separate and distinct criteria for eligibility: Some recipients of Part B compensation may be entitled to additional benefits under Part E, and those disqualified from Part B might also qualify for Part E benefits. This article focuses largely on Part B because its administration demonstrates ongoing investments in separating radiation exposure assessment and, I will argue, a complex political economy of obscurantism that works through Part B's methods of dose reconstruction and probability of causation (explained below). Essentially, Part B involves a paradox: It is scientifically impossible to figure out whether an individual's cancer was caused by radiation exposure or not, which is compounded further by faulty or missing data and general distrust of science due to Cold War-era secrecy, *yet* EEOICPA insists that such a determination must be made all the same, which moves exposure assessment into murky epistemologies and assumptions.

Part B covers current and former workers who have been diagnosed with cancer, beryllium disease or silicosis, and whose illnesses were caused by exposure to radiation, beryllium or silica while working directly for the DOE, that department's contractors or subcontractors, a designated Atomic Weapons Employer (AWE), or a beryllium vendor. Individuals or their survivors found eligible under part B may receive a lump sum compensation payment of $150,000 and medical expenses for their covered condition. Part B compensation is supposed to be fast-tracked for beryllium disease or silicosis, or for workers that have any of 22 specified cancers (e.g., bone cancer, renal cancer, or leukaemia at least two years after exposure; lung cancer; various radiogenic-induced diseases, provided onslaught was at least five years after exposure).[5] If a claimant can prove that he/she worked 250 aggregated days of employment in a class or classes of workers that have qualified for 'Special Exposure Cohort' (SEC) status, then this, too, falls within the fast-tracked channel of EEOICPA's Part B.[6] SEC designation was designed to address radiation exposures incurred under circumstances that make reconstructing information about dose scientifically infeasible or morally unnecessary as the basis for compensation claims – due to, for example, poor or non-existent exposure records. Many

nuclear workers argue that such circumstances are not the exception but the rule within the history of the US nuclear complex.

Cancer claims not covered by SEC status are statutorily required to undergo an exposure assessment. This mandate was interpreted to entail radiation dose reconstruction and scientifically-informed probability of causation (POC) per individual cancer claim (US Department of Health and Human Services 2003; US Department of Labour 2003). Controversial within the scientific community, these procedures are intended to yield reliable results using methods familiar to occupational health professionals and, by extension, toxic tort cases that draw on strategies of epidemiology. The National Institute for Occupational Safety and Health (NIOSH) is the key player here, charged with reconstructing radiation doses and DOE site profiles, collecting radiation dosimetry records, and conducting worker interviews. NIOSH subsequently developed self-claimed scientific guidelines for determining whether a worker's cancer is related to occupational exposure to radiation. Using various strategies of estimation and quantitative risk assessment models, NIOSH has developed a software system known as the Interactive Radio-Epidemiological Programme (IREP) that calculates and assigns each claimant a probability that his/her cancer is job-related (NIOSH nd).[7] After data has been collected from various site profiles, workers' files, radiation monitoring records, and qualitative information from worker interviews, a worker's 'dose' is reconstructed – an estimated type and level of radiation exposure received by the worker and the associated radiation dose to each organ affected by cancer. This information is then entered into IREP, which requires data about a given radiation dose, the type and energy range, as well as information about the work process and the workers, from age at exposure, number of years of exposure, and age at time of diagnosis, to the claimant's sex, race, and history of smoking (Kocher et al. 1995; Parascandola 2002b; US Department of Health and Human Services 2002, 2003). IREP then produces a final figure, a percentage – what is considered the POC – of the likelihood that the cancer is radiogenic. The results are sent back to the DOL, which handles the final ruling and communications with claimants. The basis of whether one's claim for compensation is accepted or not is expressed in the terms of whether the cancer is, in the official phrasing, 'at least as likely as not' to have been caused by exposure to hazards at work, meaning the claimant must prove 50% probability or greater that the illness or death was caused by on-the-job exposure to radiation. Otherwise, no compensation. (Figure 1).

EEOICPA requires that a balance be struck between scientific accuracy and expediency in resolving claims, yet, for many workers and their advocates, the methods of exposure assessment make the entire process arduous and a tremendous burden on those already struggling with illness. Nuclear workers have pointed out the stakes are a matter of life and death. The DOL's 2010 Annual Report to Congress (10 years after the legislation was passed), lists the statistics of Part B: 113,609 claims had been filed, which after eligibility requirements

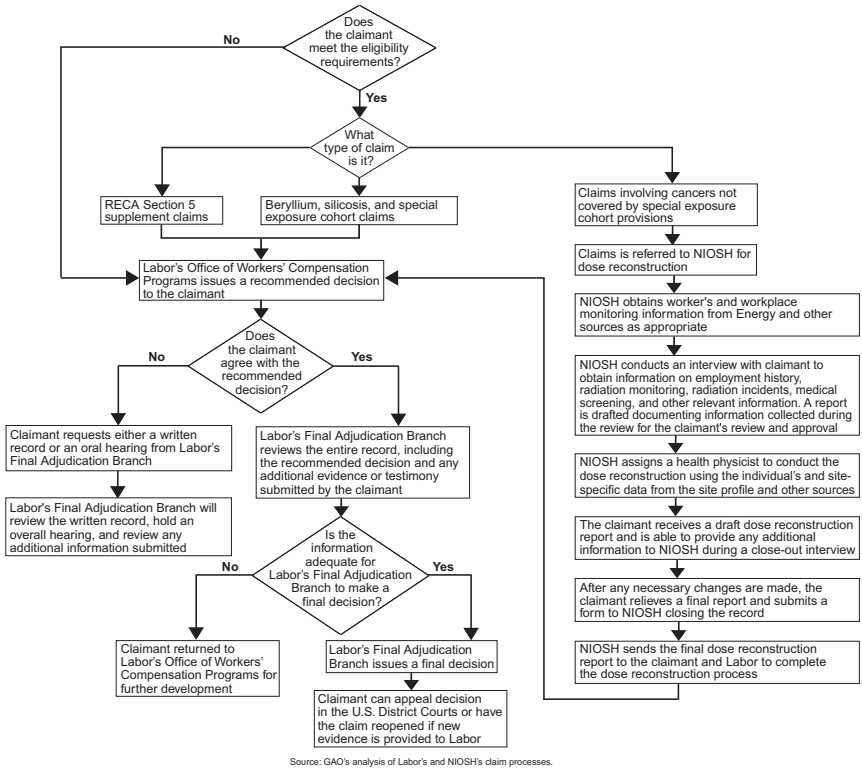

Figure 1. Flow chart of EEOICPA Part B. Source: US Government Accountability Office, "Energy Employees Compensation: Many Claims Have Been Processed but Action Is Needed to Expedite Processing of Claims Requiring Radiation Exposure Estimates," GAO-04–958 (Washington, DC, 2004), 34.
Note: Misspelling in original.

were taken into consideration, were reduced to 95,353; out of that total, only 47,907 were approved, while over 20,000 were denied (POC was not greater than 50%) and well over 8000 were rebuffed due to insufficient medical information to support the claim. As of July 2011, the numbers reported on the DOL Office of Workers' Compensation Programmes website for Part B had increased to 119,022 claims filed, with 51,618 approved and 34,551 denied (US Department of Labour 2010).[8] Rehearsing these statistics provides important clues to the politics of epistemology and the biomedical industry of exposure assessment incurred by EEOICPA. Compensation procedures simultaneously seek to keep workers alive yet not grant them much; the process uses worker data – especially historically-accumulated gaps of data and partial, unreliable, or deficient records – as the means to facilitate a knowledge economy characterised by obscurantism, including lists of 'no links' between exposures and disease that

assert the absence of evidence is evidence of absence, to the technically-accurate exegesis of uncertainty informed by opaque 'generosity measures' and used to assign all-or-none shares of risk and all-or-nothing compensation.

Dose reconstruction: Value-generating obscurantism

EEOICPA grew out of and in response to a culture of Cold War 'knowledge' that stymied critical and independent evaluations, de-legitimated data that suggested a positive association between nuclear exposures and subsequent development of cancer, and cited only those studies that did not find an association or link (Lyon 1999; Petryna 2002; Wing 2003). Human exposure science was inhibited by national security and company interests. This was a culture that largely refined methods for determining evidence to be inconclusive with respect to human and environmental health impacts, resulting in a legacy of denial and official position of a lack of association between hazardous materials and disease (Parascandola 1997). Within this historical context, understanding how exposures have been rendered imperceptible is as important as consideration of the ways that they have been proven or materialised as discernible events (Murphy 2006; Bauer 2008). Methodological limitations and the contingent invisibilities of exposures are linked to the kinds of research, evidence, and standards of proof that were – and continue to be – demanded for environmental health measures and action on a societal level. In the case of nuclear workers, what counts as evidence of exposure – workplace records or personal testimony or clinical accounts – historically and currently in science, policy, and regulation is a crucial issue in the compensation arena. Nuclear workers bear the burden of proof, yet many have been denied access to their medical records because the materials they were exposed to often remain classified. How, then, are the environmental pathologies and exposures experienced by former US nuclear workers to be discerned, quantified, or determined, particularly in the absence of reliable evidence? The conditions of scientific knowledge production in the Cold War show that the uncertainty of exposure assessment is not merely a void where knowledge has not yet spread; rather, the 'not (yet) known' has been both unknowingly and purposely made, maintained, pursued, and manipulated in many instances (Proctor and Schiebinger 2008). Adriana Petryna (2002, 13) observes, 'state power is as concerned with making bodies and behaviours ever more predictable and knowable as it is with creating – both intentionally and inadvertently – spaces of non-knowledge and unpredictability'. The nuclear age has been as much about the production and regulation of misinformation and insufficient data on workplace exposures and occupational illnesses, as documentation of biological effects.

Contrary to EEOICPA's stated aim of helping workers, holes of information – whether accidentally produced or purposely generated through historical secrecy or denial – can be instrumentalised in the administration of EEOICPA

by state agencies and private industry to suppress exposure links, and to rationalise the indifference of the state and government contractors to historic injustices. The physical reality of contamination born by workers is further refracted through data remediation and biomedical abstraction, ranging from risk scenarios and epidemiological formulas with questionable underlying 'benefit of the doubt' assumptions, to arbitrary data substitutions and multiple techniques of fine-tuning inconclusive findings as proof of no evidence. While EEOICPA appears to increase the welfare of former nuclear workers in the form of medical care and compensation, the claims process often forces claimants to individually face constantly changing compensation criteria, complex biomedical databases and categories, and obscure incentives and accountability measures due to a complex network of privatised subcontracting.

EEOICPA's execution has rationalised systematic unprovability and a cost–benefit approach to preventing harm. 'Care' is contained; the process seeks to minimise errors in determining causation as a proxy for minimising legal costs and lowering the number of cases. On occasion, this drive to reduce complexity and cut costs has surfaced spectacularly, as in the infamous 'Passback memo' between the DOL and the Office of Management and Budget that stipulated Labour was to 'contain the growth and cost of benefits', outlining a plan to base SEC status approvals on budget concerns rather than the scientific basis mandated by law (Udall 2006). Due to the complexity and number of claims under Part E of EEOICPA, several means were also developed to expedite the claims adjudication process. Yet such efficiency measures have often functioned to legitimate systematic denial of possible relationships between some illnesses and occupational exposure to toxic substances. For example, while EEOICPA includes fast-track compensation for certain cancers, a 'No Pay' list of cancers and diseases with 'no readily known link' (conflated with 'there is no link') was also created, as a reference to speed up 'not paying' in the compensation process (US Department of Labour 2006a, 2006b, 2008). Justified as scientifically peer reviewed, the list not only demonstrates that 'no liability' is assumed from the outset but also shows how inconclusive evidence about the relationship between some illnesses and exposures has been codified at times as proof of no evidence. Simply stated, the logic at work is: Since we don't know whether a particular link exists, we assume that it doesn't; because we don't know whether it's true, it therefore isn't true. Although this list and its logic are not inherently different to uses of science where decisions are considered part of the legal process or are open to legal challenge, claimants have contested the black–white character of the list, the process by which it was charted, and the character of evidence upon which the list was based, especially in circumstance where workers perceive their illnesses and embodied experiences to be linked to exposures that are inventoried as not linked. In a system based on evidence, the list is not scientifically invalid per se*,* but given the historical context of Cold War scientific research on exposures and disease

linkages, the category of 'evidence' and trust in the archive of such evidence are reasonably called into question.

After the list was contested, a variation of its logic emerged with the DOL's development of the Site Exposure Matrices (SEM) database, an inventory of site exposure data and 'known links' between different exposures and diseases (Site Exposure Matrices nd). The SEM database can be used to provide evidence that there is no link because it is 'not in the database', that is, all known links have been compiled, and if the link is not there, then it doesn't exist or not enough is known to justify its inclusion. Rather than assert that the absence of definitive proof is 'no proof' for certain, this strategy, drawing on a database of known links, can deny claims based on the logic that we don't know enough to take any action; that the link has not been scientifically vetted and established in the database and therefore can justify no compensation. However, the SEM database has not itself undergone review, making this form of denial ultimately similar to the 'No Pay' list.[9] The sources, reliability, and durability of information on the database are unclear. Furthermore, the SEM draws on yet another database, the National Library of Medicine's Haz-Map[10] that also has not undergone scientific peer review. This involves a potentially major conflict of interest, and has allegedly erased over 100 toxic exposures once considered to be linked to specific diseases under the auspices of scientific advancement (Elisburg 2003a, 2003b; Frank 2009).[11] The possible removal of toxic exposures could be part of the scientific process, but the editing of Haz-Map is not clearly reviewed nor does evidence of erasures based on scientific findings remain (Brown nd). A database (reliant on another database) that has not been peer reviewed can serve to de-legitimate claims of exposure–disease linkages – that which is not in the database – as that which has 'no known peer review'.

The denial of claims can be seen in a more complex infrastructural form with respect to Part B of EEOICPA. In this case, denying compensation can be achieved and legitimated through dose reconstruction, a reprocessing of claimant work histories and exposures as required by the law that involves arbitrary efficiency measures, assumptions, and substitutions of data. As previously stated, claims that move forward under Part B of EEOICPA involving cancer and radiation exposure must undergo dose reconstruction; the resultant data is necessary in order to determine the probability that the cancer's cause was radiogenic. The DOL relies on NIOSH's estimates of the type and level of radiation exposure received by workers and the associated radiation dose to each organ affected by cancer. Such exposure information is extrapolated from documentation of internal and/or external radiation doses, differentiated by type of radiation and energy range, dose pathway (i.e., inhalation of particles, contact with skin, etc.), and the way radiation interacts with each organ or body system (National Academy of Sciences 2006; Cardis et al. 2007; United Nations Scientific Committee on the Effects of Atomic Radiation 2008; Wakeford 2009).[12] In order to reconstruct both internal and external doses, NIOSH must develop

a basic understanding of the work process and aggregate the ways that a worker's presence and activities varied in time and space with respect to the radiation source. Paradoxically, the method of dose reconstruction gives top priority to individual monitoring records, yet there are significant holes in the data because the DOE was not required to keep these records and spent more time/effort on air monitoring. DOE records have large gaps; worker files are sometimes nonexistent or deficient; and site profiles are incomplete and uneven (Miller and Government Accountability Project nd). Many workers claim that radiation exposure went unmonitored, accidents went unreported, and inaccurate information was put on file in the name of national security. Because of the elisions of data about certain sites, as well as for moral reasons, the EEOICPA legislation allows for the establishment of SEC cohorts that qualify for compensation without dose reconstruction. However, NIOSH contends that for cases where dose monitoring records are not available, it can sufficiently reconstruct that information by using reasonable scientific assumptions – which means the claimant cannot be allowed into an SEC (NIOSH 2006). NIOSH maintains that it can scientifically reconstruct doses by assembling and substituting evidence about the types and quantities of radioisotopes to which workers were potentially exposed. Dose reconstruction, then, has become a compilation of default assumptions and substitutions, to come up with a potential maximum dose for each claimant. This hypothetical maximum dose is then utilised to calculate the likelihood that such an exposure could have caused the former worker's actual cancer. The arbitrariness of this process is justified under the banner of 'efficiency' and 'giving the benefit of the doubt' to claimants. (Figure 2).

For example, NIOSH augments missing dosimetry badge information and nonexistent claimant records by substituting the records of coworkers, or an area's air monitoring data provided by the site contractor. A structured telephone interview is also a standard feature of the reconstruction process. Values are often interpolated between data points for nearby time periods. In some cases NIOSH uses data from other facilities to fill in the gaps. NIOSH also claims to use overestimated exposure values in favour of claimants, in order to speed up the process. When faced with equally plausible radiation dose and cancer risk scenarios during dose reconstruction, NIOSH states that it will assume the scenario that results in the highest exposure to the worker. This can entail yet another kind of substitution: The swapping of the cancerous organ under consideration. When a worker's cancer is not in an organ for which NIOSH, in collaboration with the National Cancer Institute, has developed risk models, NIOSH contends that it will select, among comparable organs, the one that is most susceptible to cancer risk from the type of radiation exposure the worker was likely to have had. According to EEOICPA rules, at any point during the steps of dose reconstruction, NIOSH may determine that sufficient research and analysis has been conducted to complete the dose reconstruction. That is, a dose reconstruction is considered complete when NIOSH believes

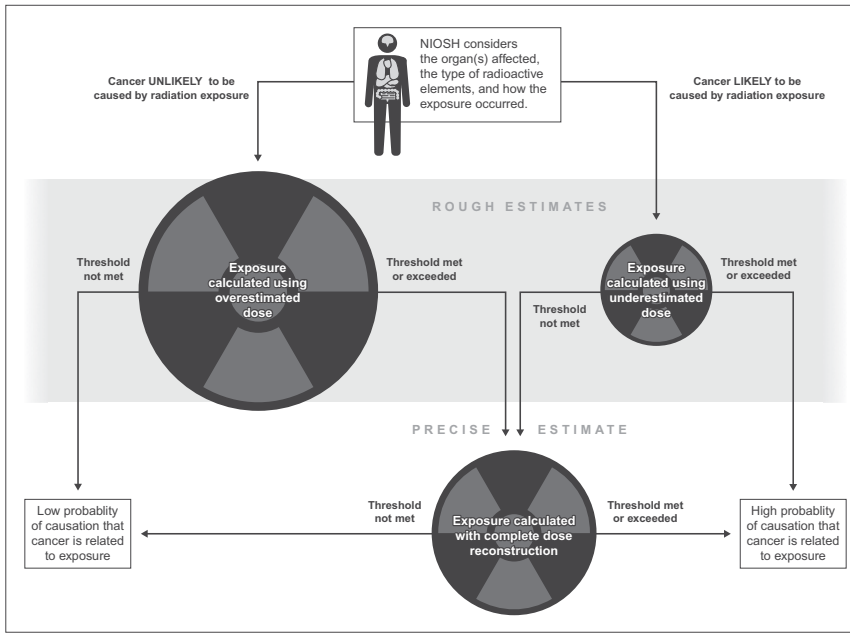

Figure 2. Chart of dose reconstruction. Source: US Government Accountability Office, "Energy Employees Compensation: Additional Independent Oversight and Transparency Would Improve Program's Credibility," GAO-10–302 (Washington, DC, 2010), 20. Note: Misspelling in original.

additional analysis would not alter the findings and change the end result (GAO 2010). While this ruling was implemented in the spirit of efficiency, its arbitrary determination as well as its lack of efficiency in implementation has raised concern. Cases that require dose reconstruction have taken up to three or more years.[13] A GAO (2010) investigation discovered, in 2008, after examining administrative costs, that NIOSH did not keep tabs on the money spent on claims denied versus claims approved.

Clearly, given the unevenness and often insufficient records on workers and sites in the nuclear complex, there is no other option but to do substitutions and draw on other epistemologies during dose reconstruction. However, many workers find no reason to trust the benefit-of-the-doubt measures, and while efficiency is advocated as an ethic of responsibility toward workers, there is also no reason to believe that this efficiency works in favour of claimants. Furthermore, there are calls for an investigation into potential financial conflicts of interest that might stem from NIOSH's subcontracting of dose reconstruction. The concern here is that NIOSH's contractors might have incentives to stall the completion of dose reconstruction, lower estimates, and deny petitions for SEC status – which enlarges the channel of claims that must

go through dose reconstruction and probability of causation determination – in order to extend the length of their lucrative contracts (Frank 2008). NIOSH contracts out parts of dose reconstruction to Oak Ridge Associated Universities (ORAU), a university consortium, to provide telephone interview support and health physicist services, and to evaluate SEC petitions. This federal contract is reported to have ballooned from 70 million to several hundred million (Udall 2006; Kessler 2007). In partnership with national laboratories, government agencies, and private industry, ORAU subcontracted the work to two private companies, MJW Corporation and Dade Moeller and Associates (NIOSH 2009).[14] Such subcontracting could be seen to function as a kind of value-generating obscurantism: A knowledge industry grows to reprocess data of questionable veracity/accuracy about worker exposures and work sites, amassed from the history of bomb-making and secrecy, to refine calculations of uncertainty to fill in missing data through substitutions and default assumptions and to constantly update its own methods of reconstructing doses. Seen in this light, EEOICPA has enabled parts of the former weapons complex to transition to biomedical assessment services that productively *process claims but not necessarily for the 'end' of paying out compensation or even referencing worker livelihood*. The implementation of EEOICPA has in numerous instances employed those who once defended the government and its contractors against claims of occupational illness. The ORAU team in particular has been dominated by consultants entwined with the DOE and its former site contractors: 'In some cases, these consultants have pre-EEOICPA records for working as expert witnesses against state workers' compensation claims at the very sites where they now perform dose reconstructions' (Udall 2006, 9).

EEOICPA's administration has provided new appointments for portions of the nuclear weapons industry, handing over key practices to former DOE-affiliated players who were once a part of the safety programmes whose failings EEOICPA was intended to redress. Dose reconstruction draws attention to the ways that the state can discharge its obligations to claimants by reprocessing claims and mobilising a biomedical data remediation industry, rationalising the delay of adjudicating claims in order to extend and fulfil contractual obligations and services. Here we have a potential logic at work to postpone a final ruling in order to maintain the growth of a dose reconstruction industry. Whether the science at work is 'good' or not becomes moot when the administration is so convoluted and expensive that it would have made more sense – as a more just and potentially cost-effective option – to have mandated a less-scientifically-advanced procedure that paid more claimants and faster, rather than sink money into contracts and practices with murky incentives. As one analyst astutely warned at the outset of EEOCIPA's implementation:

> While this approach seems reasonable on paper, it is impractical and will likely result in widespread injustices. It will take a long time to set up procedures for calculating individual doses, [to] validate models, and extract and validate data.

> The expense will be great and the results controversial and highly uncertain. At the end of this lengthy process, the government – despite a good faith effort and huge expenditures – may find itself less trusted and embroiled in more litigation than before. (Makhijani 2001, 54)

The delay in decisions and/or doing something for claimants has in some cases resulted in workers dying before a final ruling is made. One worker has summed up the impact of EEOICPA on workers thus, 'half these people are giving up because they can't survive, they can't do all of this information and… a lot of people die than do anything else'[15]. Contrary to recognising and compensating the harms accrued by nuclear workers, EEOICPA's administration, in such cases, can be seen to remainder workers, who have already been remaindered by the transitioning 'post-Cold War' nuclear weapons complex.

Probability of causation: Dematerialising geographies of war

The connection between exposure and injury is difficult to perceive. Dose reconstruction and determining the probability that one's cancer was caused by exposure to radioactive materials are procedures intended to render exposures perceptible and measurable. Review of the administration of EEOICPA, however, reveals strategic investments in maintaining lack of evidence as a form of evidence, in order to shut down inquiry. In such cases, the absence of information is offered as all there is to know. Missing information can also legitimate and/or obscure the arbitrariness of decisions, substitutions, and procedures taken to give claimants the benefit of the doubt. In the context of Cold War misinformation, deficient records of health events, and secrecy more generally, there is little reason to trust such generosity measures. Furthermore, dose reconstruction demonstrates that assigning content or filling in gaps of information about workers with substitute data enable the production of value, without compensating sick nuclear workers. The complex layering of contracting and subcontracting of dose reconstruction to the private sector can *diffuse responsibility*, *obscure incentives*, and *rationalise reprocessing claims while doing nothing for workers*. EEOICPA claims are mobilised by an increasingly biomedical-oriented arena of the former weapons complex that operates to remediate data and assess exposure via a cost–benefit approach to compensating harm without assuming custody of workers and without reference to their actual welfare. This abstraction and movement away from the justice-oriented aims of the original EEOICPA legislation is exacerbated by the ways that the POC is determined. While the complexity of attempts to evaluate risk and uncertainty calculations are scientifically valid and not necessarily part of the Cold War legacy of misinformation, such practices are performed by the industry and political economy of obscurantism outlined previously and raise questions about the appropriateness of such scientific procedures and whether science can be used to ensure justice in this case.

Determining the POC, under EEOICPA, has entailed implementing conditions of proof developed in biomedical research, namely epidemiology. Considered to be 'the basic science of public health', epidemiological techniques are used to determine the association between exposure and disease via probabilistic risk estimations, comparing variables of the exposed and background levels, and statistical techniques that account for uncertainty (Bauer 2008). Epidemiology's focus on population health aetiology to investigate environmental conditions with respect to disease outcomes maintains a long tradition of biomonitoring workers – of partitioning human bodies, collecting and treating excised and discharged material in a lab, calculating properties and symbolically reworking the body's materials with abstract numeric productions (Casper and Moore 2009). EEOICPA's epidemiological assessments of exposure further dematerialise body–environment connexions and, by extension, geographies of war, and fail to address the kinds of causations and material properties and correlations that epidemiology is good at showing.

EEOICPA's Part B compensation structure of 'at least likely as not' – one must prove 50% or higher probability that one's cancer was caused by exposure to radioactive materials – uses a threshold criterion that assumes 'no liability' from the start and an 'all or nothing' result: One side is not acknowledged (no compensation), while the other side is acknowledged but assessed as instances of uncertainty of true causation (i.e., each individual is a discrete unit with a statistical calculation).[16] While the choice of a threshold POC scheme for EEOICPA's compensation programme was arbitrary, in that other models could have been used, it is based on a technically-sound mathematical interpretation of the burden of proof. What *is* debatable is the appropriateness, justice, and epistemological politics of using epidemiological estimates of POC and the threshold criterion for EEOICPA's compensation rules (Parascandola 1996, 1997, 1998, 2010).

EEOICPA's Part B applies a formula to calculate the probability that injury was caused by exposure, using population data generated by epidemiological methods: If the disease rate is significantly higher in an exposed population than an unexposed group, then one can infer that the exposure has done some harm. However, it is impossible to tell exactly who has been affected. Epidemiological probability works at the level of the population but not at that of the individual. Yet, under Part B, the POC has been enlisted to do the paradoxical work of parsing out who is to be compensated and who is not. This is largely achieved by ignoring the empirical–material grounds of epidemiology. The POC confuses 'chances' with epistemic certainties/uncertainties, correlations with causes, strength of association with strength of evidence, population data with individual 'assigned share'. Epidemiological evidence provides information about correlations, not singular causes, which puts statisticians, who are interested in mathematical relationships among variables, at odds with tort lawyers or the DOL who must determine the causal connexions among variables and come up with a summary statistic or coefficient that reveals whether and

to what extent a particular act or exposure caused harm (Parascandola 1997, 148). Traditionally, the law requires proof that an exposure was a condition sine qua non – a condition without which the plaintiff's injury would not have occurred; it is assumed that either the exposure was necessary for cancer, or it was not, and if it was not, then it could not have been the cause. Necessity, not chance, is the explanation. Yet this is precisely what epidemiologists are interested in: *Ex ante* probabilities or chances for predicting future events. *Ex ante* probabilities allow for the formulation of preventive strategies – how injuries might be avoided in the future – not what caused a particular person's injury or disease. 'A chancey cause is one that is neither necessary nor sufficient to produce an event, but makes that event more likely to occur' (Parascandola 1998, 39). Accordingly, radiation exposure does not merely cause cancer as a one-time event; rather, it initiates changes that make one more prone to develop cancer. Exposure raises the chances of developing cancer. These 'chances' are physical properties – correlations – that tell us something about material transformations. 'Chance' cannot be reconciled with the POC formula due to the mandate to establish *ex post* not *ex ante* causation (Parascandola 1998). Moreover, probabilities are viewed as epistemic, not as actual physical correlations with predictive value. The POC is essentially a statistical probability mapped directly onto a standard of proof continuum with the accompanying idea of a quantifiable threshold, and, vice versa, a continuum of probability is posited with stronger evidence imparting supposedly greater epistemic probability (Parascandola 1996). This is arbitrary, even erroneous, in that the POC cannot actually measure the strength or probative value of evidence.

The formula for the POC uses the epidemiologic concept of relative risk: The percentage of risk in the exposed population that is attributable to the substance under analysis (Greenland 1999). A percentage of cases can be attributed to a general cause with a high degree of certainty, but particular injuries cannot be attributed to a particular cause with the same confidence. Epidemiological evidence cannot sufficiently prove specific causation because the study of populations does not meet the legal requirement for particularistic proof in the case of individuals. Enough complaints were registered about the application of the POC calculation to determine individual EEOICPA compensation claims that official documents have begun to change terminology, from the POC to 'Assigned Share' (AS). While a more accurate name than probability of causation, AS, some epidemiologists argue, is still a logically flawed concept, subject to substantial bias, and is, therefore, unsuitable as a guide to adjudicating compensation claims for potentially radiation-related cancers. For example, the actual fraction of the AS – the fraction of total disease incidence in the exposed population that can be attributed to the cause in question – only includes *excess cases*, where it is clear that exposure caused the cancer. There is no consideration of cases in which work processes hastened the onset of disease. If a radiation-caused cancer could have occurred without the occupational

exposure, then it is excluded from the calculation. The calculation of attributable risk simply assumes there are no cases where a cause brought about an earlier effect than otherwise would have occurred (Greenland and Robins 1998; Parascandola 1998; Greenland 1999). The 'at least likely as not' clause requires that a cancer be attributed to one cause or another but not both; either the cause is 'fully determinate' or it doesn't contribute at all. Multiplicative synergistic effects and multiple disease mechanisms are not considered; causation boils down to a single event and a single agent. If more than one cancer is present, then they are determined separately and added together. Claimants, in some cases, have been shocked to find that their POC for one initial cancer was significantly higher than a returned POC wherein several additional cancers were tabulated and included. According to NIOSH, when new cancers are added to the equation, then dose reconstruction must be completed again using 'more probable and precise' exposure estimates. Cases are considered to be instances of uncertainty of true causation that can be further refined, rather than true instances of multiple or joint probabilistic causation. Basically, uncertainty is universally assumed (as insufficient causation) in order to reject outright responsibility; probabilities are confused with proof as the reason for refusing individual claims to compensation.

Even though there is currently no way to know the essential difference at the molecular level between those whose cancer was caused by radiation exposure and those whose cancer was caused by some other source, the determination of causation assumes that normal background exposures and vulnerabilities can be separated from those exposures that took place at work. This bounds work site, and fixes workers and the material processes and ecology of the work environment in place and time, through numerical abstractions. Conversely, the blanket application of the POC (AS) formula treats all members of the population as if they were governed by identical cancer risks, when individual vulnerabilities widely vary due to differing social, environmental histories. To complicate this, the IREP software includes factors of age, sex, race, etc, that are associated with different diseases as part of the calculation of normal background vulnerabilities. That is, certain backgrounds and disease susceptibilities *are* attributed to certain populations when assessing worker statistics to produce the POC. Some epidemiologists have pointed out the potentially unjust result of this: Differential vulnerabilities stemming from social–environmental relations that, for example, might involve racial or gender inequities, are quantified, inputted into the software matrix, and potentially used to argue that the cancer is as likely to be caused by outside factors as by work exposures.

In addition, there is much debate about the biological bases underlying background factors and chronic disease – particularly the linear rather than cumulative and collaborative models of cancer development, and the validity and applicability of the disease mechanisms and models of cancer underlying the IREP software (Beyea and Greenland 1999). Embedded in the IREP

programme are certain 'radiation effectiveness factors' (REFs) that are based solely on radioactivity exposure studies from atomic bomb survivors' data. The dose response data from the exposed human populations in occupied post-war Japan – populations that were bombed by the weapons made by US nuclear workers – serve as the template for determining the biological effectiveness of different radiation types and for making judgments about radiation's health effects – and, in this case, for determining the compensation claims of US nuclear workers.[17] As the 'gold standard' for judging other epidemiologic evidence, the Japanese atomic-bomb survivor studies are widely used for risk estimation and modeling and have shaped the scientific culture of radioactivity exposure studies (US Environmental Protection Agency[EPA] 2011). However, the validity of extrapolating cancer risks from studies of A-bomb survivors who experienced high doses from a radiation blast, to nuclear workers who experienced chronic exposures, is highly contentious to some scientists.[18] Furthermore, the study involved extensive estimations of radiation releases – essentially dose reconstructions – based on interviews conducted in an occupied nation by a scientific team funded and directed by the US government (Lindee 1997). Supporters of the use of radiation risk models derived from the study of atomic bomb survivors in Japan point out that the data is modified to account for the numerous and substantial uncertainties involved in the transfer of risk estimates between bomb survivors and nuclear workers. But such data production converts the material effects of war into abstractions – into abstract relations of quantifiable uncertainty. This profoundly depoliticises and obscures the geographies of exposure and mortality that link Japanese bomb survivors with US nuclear workers: One set of data is extracted from place and history to be applied as a template to another. *This disembedded and disembodied data transfer diffuses responsibility for the life and death consequences of nuclear weapons* and *compensation.*

The honing of 'certain uncertainty' in the EEOICPA compensation system demonstrates that specific policy interests are in operation with low tolerance for social responsibility; they seek to manage epistemic risk by supporting a knowledge industry that involves a 'black box' – a largely opaque network of public–private partnerships – of inferences and assumptions, substitutions and deferrals, models and templates that repudiate the fraught geopolitical and biomedical contexts of their own emergence (Latour 1987, 131). The layering of dose reconstruction, in particular, 'cleanses' the land of evidence by obscuring the geographical relations between bodies, sites, and materials: A datascape of exposure abstracts bodies from occupational, wider-geographical, and geopolitical contexts, to render atomised data that is more vulnerable to control, substitution, and even template conscription (Monahan and Wall 2007, 154). Legal institutions measure and manage bodies by using epidemiological techniques to assign individual risks and exposures based on statistical evidence. EEOICPA compensation is essentially a social sorting mechanism that applies biomedical criteria to environmental health issues (Monahan and Wall 2007, 163). This can

be viewed as *part of a more general biomedicalisation of the remains of the Cold War*, wherein epidemiology is enrolled to circumscribe and channel nuclear worker claims into medical models and statistical aggregates, rather than charting local exposure pathways and the material connexions between bodies, environments, and toxins. Under the sign of government accountability and benevolence, EEOICPA exposes workers/claimants to a biomedical sorting process that makes them bear the burden of proof, drains their energies, and calls on them to document EEOICPA procedures and methods with as much – even more – vigilance than their exposures and illnesses. Disavowal characterises the compensation system, rationalising indifference by the state to the bioaccumulation of toxicity of workers – their unfair 'body burdens', permitting ongoing damage to health, environment, and lives, and sanctioning unprovability – no compensation – in so many cases.

Living remains in the 'post-Cold War'

In significant contrast to the care exhibited toward the US's arsenal of ageing nuclear materials, former nuclear workers must figure out how to live as the remnants of the Cold War – as the anachronistic human remainders of an era supposedly over and no longer relevant. The compensation system that has grown to implement EEOICPA acknowledges the sacrifices to the health and livelihood of workers, but has established a social order that largely denies and/or defers the Cold War legacies of occupational exposure, illness, and death. This is achieved through the biomedicalisation of Cold War domestic toxicity – especially the abstraction of the bioaccumulative burden of contamination that these workers bear – and the dematerialisation of geographies of exposure and war. EEOICPA'S burdensome paperwork, questionnaires, computer programmes, and complicated administration are symptomatic of the subjugation of nuclear worker knowledge and experience. Further, the implementation of EEOICPA has meant that any sense of responsibility for the absence or poor quality of evidence available for dose reconstruction is eradicated by risk assessments and mathematical operations of uncertainty. If militarism, as a term, seeks to explain how military control over environments and landscapes is maintained, and how social conflict over those who benefit from and those who bear the cost of war is naturalised, then EEOICPA can be seen to operate in line with an increasingly biomedicalised reprocessing of military remains that depoliticises the domestic impacts of war, administers compensation via manipulable epidemiologic datascapes, and, ultimately, abandons civilian nuclear workers.

In response, nuclear workers have frequently drawn on the patriotic imagery of the 'Cold War warrior' to symbolically assert their right to compensation. This celebratory narrative, oft promoted by the DOE, portrays the nuclear complex employees as having won the Cold War by building the weapons that defended the US against its enemies. Workers utilise this discourse to position

themselves as worthy of compensation and honorary treatment as Cold War veterans, for having sacrificed their health for the nation. The logic and rhetoric of sacrifice asserts a form of accountability that citizens, in this case nuclear workers, can use to ground claims against the government; if the state recognises their deaths and illnesses as sacrifices, then those deaths come to represent something significant or sacred (Taussig-Rubbo 2009). However, it has been very difficult for nuclear workers to widely establish and maintain their heroism, in that overcoming exposure requires that one can claim innocence before exposure in order to emerge as victorious hero (Casper and Moore 2009, 181). This is not always possible for nuclear workers, because they are frequently blamed for their exposures, even if derived from circumstances beyond their control. Workers do not officially qualify as veterans because they were civilians – not formal military personnel – working in the domestic sector of the military–industrial complex. As a result, they are vulnerable to criticisms of their willingness to take on dangerous jobs, and for making weapons of mass destruction. Moreover, the political–economic redundancy of certain aspects of the Cold War military industries, such as modes of citizenship related to the paternalism of the state in the nuclear era, has made many of these workers look dependent and even parasitical on the economy and society: Nuclear worker calls for compensation reach for an outmoded paradigm of industrial citizenship and welfare that now abandons them (Lovering 1990, Law 1999). Because they are not 'pure' enough subjects to be 'real victims' of the Cold War, they are blamed for their over-reliance on the state and for challenging – in their very existence and suffering – the way the figure of the civilian disavows its investment in state power and economies of violence (Thompson 1980, Lutz 2001, 2009). The nuclear worker hangs suspended between supposedly separate military and civilian worlds, denied access to the privileges of either. As a result, sick nuclear workers are frequently relegated to public displays of the monstrous, abject materiality of disease and suffering. In sympathetic venues, nuclear workers are rendered as spectacularly sick bodies, which, while generating compassion and sympathy, tend to separate workers from the sites that they inhabited and diverts attention from the everyday health risks and other legacies of the Cold War still among us (Berlant 2007; Linden 2009; Povinelli 2009; Nixon 2011).

EEOICPA and the growth of biomedical services to manage the living remainders of US bomb production have fostered a range of additional responses, particularly around documentation and illness. These strategies might be seen to work with the residues of state secrecy and the holes of information, and to politically agitate around making new kinds of communities via disease clusters, networks of document watching, and the sharing of occupational memories and evidence. Some workers and their supporters have formed advocacy groups, often drawing on the help of the unions. Two notable examples are the Cold War Patriot Advisory Committee, a non-profit organisation that helps former nuclear and uranium workers, and the Alliance of Nuclear

Workers' Advocacy Groups (ANWAG), which serves as an affiliation of many advocates across the nation to monitor the implementation of EEOICPA and represent and assist claimants under the programme. Worker advocacy web sites provide emotional outlets and tremendous resources to help workers and/or their survivors with their claims (Parr 2002). Countering the gaps of information, secrecy, and elisions of evidence, the groups practice an intense documentary ethics and politics and an environmental forensics focused on the obscurantist industry of EEOICPA (Frohmann 2008). They find, track, and salvage key documents and exhibits, fostering community through information sharing. Contextualised within a larger political history of citizenship projects that now assemble around illness and proliferating categories of vulnerability, suffering, risk, and susceptibility, these worker groups also share medical information and scientific expertise, and they act as public bodies in virtual space (Rose and Novas 2005).

US nuclear workers, with the help of union leaders and legislators, have also collectively pushed for the revision of EEOICPA. Some critiques have focused on the way the POC has been delimited and have argued that other compensation models could have been implemented, such as a proportional compensation scheme for radiation-linked diseases, which might compensate probabilities as low as 20%.[19] In this scenario, some amount of compensation is given/received whether or not exposure to the hazardous substance more than doubles the frequency of occurrence of the injury. A sliding scale – 'proportional recovery' – would mean that different amounts of the total possible benefits payment could be given to claimants, depending on the calculation of causation probability, and *without* the evaluation of uncertainties in the dosimetry data; the idea is that a proportional recovery payment system would overcome the uncertainty of causation calculations by metering out payments, even to POC values below 50%, in order to facilitate a potentially more equitable and generous benefits system. Some epidemiologists have pointed to additional strategies that could have been instituted, such as compensation schemes based on the number of years of life lost, which attend to temporality issues, or compensation structures that incorporate lost chances as a form of legal injury (Shavell 1983; Cox 1987; Greenland and Robins 1988; Robins and Greenland 1989a, 1989b; Greenland 1999; Beyea and Greenland 1999, Greenland and Robins 2000; Robins 2004).

EEOICPA's inclusion of measures to establish SECs, which means those who qualify are exempted from the burden of dose reconstruction, has encouraged another strategy: Numerous workers have organised and petitioned for automatic inclusion in the benefits programme. The SEC measure is seen to enable a more adequately 'just' benefits programme that acknowledges the politics of what has historically *not* been recorded about workers and sites. The SEC measure bypasses the scientific process set up under EEOICPA to allow that certain sites are known to have harmed workers and/or that worker knowledge about site work processes, safety, and health can provide sufficient

evidence to legitimate compensation on moral grounds, when the historical record is inadequate. Although petitions have been denied, SEC-designated sites have expanded from four to encompass 61 facilities as of 15 June 2011.[20] The idea of exposure cohorts has inspired efforts to expand eligibility, enlarging the category of qualified people to include those living near weapons plants and families who were exposed to secondary radiation brought home by car or in clothes. This expansion of the SEC cohorts, along with the documentary ethics and advocacy projects of many workers, exemplify the labour of living as the remains of the US nuclear complex. Such workers draw on their own remains – memories, anecdotes, body counts, personnel records, medical information, physical pain – and collectively amass evidence to make arguments about the programme, in the process often cultivating expertise in epidemiology, law, and policy. Organising around the radical expansion of SEC designation might be understood, then, as a strategic reworking of EEOICPA legislation to form collectives that refuse the individualising burdens of proof, and that work to re-link bodies, technologies, work sites and environments against state efforts to dispel the human costs of the Cold War. This involves more than a politics of injury recognition or sacrifice defined in relation to the state; it does not limit political and ethical responses to that of individual rights and/or individualistic biomedical claims. Rather, it is a collective 'living on' from war: Temporally there is no return to national innocence; and spatially, 'exposure' might foster unanticipated relationships and traces.

Notes

1. 'Biomedicalisation' refers to what Adele Clarke et al. (2010, 1–2) name as the era, since the 1980s, characterised by increasing technoscientification of American medicine, a new neoliberal biopolitical economy of medicine, health, illness, and dying, an intensifying focus on risk and surveillance at individual, group niche, and population levels, transformations of biomedical knowledge and information management, new risk-oriented and biomedical identities and citizenship, among others. Whereas biomedicalisation serves as a periodising concept for my discussion of 'post-Cold War' occupational exposure assessment of nuclear workers, I use the adjective 'biomedical' as a more generic descriptor referring to biomedicine. The overall effort, here, is to examine a topic not addressed extensively in the literature on US militarism, which frequently excludes US nuclear workers in the analysis of the domestic human impacts of the Cold War. In this paper, I draw on numerous critical epidemiological analyses of exposure studies and probability of causation measures of compensation efforts. In doing so, I hope to encourage more interdisciplinary conversation over policy/legislative efforts to address the legacies of the Cold War, specifically human exposures, and the role of scientific fields and methods, types of evidence, and epistemological politics in addressing toxicity, differential body burdens, and justice.
2. The Act was passed on 30 October 2000 and became effective on 31 July 2001.
3. There are/were five sections of EEOICPA in total. Part A is the establishment of the compensation programme and fund. Part C arranges the coordination and forfeiture of compensation and benefits.

4. The Government Accountability Office (GAO) was previously called the General Accounting Office (also referenced as GAO).
5. The Energy Employees Claimant Assistance Project breaks down the complicated channeling of claims on its web site: http://www.eecap.org (accessed 28 July 2011).
6. An SEC class is a group of workers that were employed at a particular facility during a specific time period. Any qualifying SEC worksite may have classes of employees for only certain buildings and certain dates of operation.
7. IREP is based on the radio-epidemiological tables originally developed in the 1980s by the National Institute of Health to adjudicate compensation claims for those living downwind of atmospheric nuclear testing and for those veterans exposed to radiation during nuclear blasts in World War II or bomb tests during the Cold War. While use of the tables was contentious and ultimately struck from the down-winders legislation, it provided a foundation for the IREP mathematical modeling.
8. For the latest statistics, see the US Department of Labour, http://www.dol.gov/owcp/energy/regs/compliance/weeklystats.htm (accessed 31 August 2011).
9. At the time of writing this article, the SEM was under review by the Institute of Medicine's Board on the Health of Select Populations; the results, however, had not yet been published. For future reference, see 'Review of the Department of Labour's Site Exposure Matrix (SEM) Database' IOM-BSP-10–10. The stated purpose is to convene a panel of experts to review the scientific rigour and organisation of the SEM database, including the occupational disease links, the National Institute of Health's and Library of Medicine's review process with regard to Haz-Map (the source of the SEM), and the editorial process used by the Haz-Map developer when including or excluding information in the Haz-Map database.
10. Haz-Map is an abbreviation of 'Occupational Exposure to Hazardous Agents database'.
11. The DOL maintains that because the SEM inventory is drawn from the Haz-Map database, which incorporates peer-reviewed scientific articles, a formal review of SEM is not necessary and would delay claims. However, the ways that Haz-Map has been edited and updated are not always apparent. Furthermore, Haz-Map is a surveillance system of medical literature on occupational health that, without external oversight, is at risk of a potential conflict of interest: The National Library of Medicine researcher who developed the database was working under contract with the DOL to continually update the SEM to reflect current research into the relationship between disease and toxins. For more on information on Haz-Map from its author/editor Jay A. Brown, refer to the powerpoint presentation 'Haz-Map: A Project to Map Occupational Toxicology Information into a Relational Database', http://www.iom.edu/~/media/Files/Activity%20Files/PublicHealth/SEMDOLReview/Meeting%201/Brown%20Presentation.pdf (accessed 12 February 2013).
12. Studies exist on risk of chronic low-dose exposures, covering such subjects as cancer survivors, nuclear weapons test participants, medical workers, crew of aircraft, radium workers, underground hard-rock miners (uranium, gold, etc), Chernobyl emergency and recovery workers, and workers in nuclear weapons and power industries. The US Department of Energy has also conducted research on this in relation to several sites, including Oak Ridge, TN, Los Alamos, NV, and Hanford, WA.
13. Some backlog was inevitable: People began filing claims before the methods and programme of dose reconstruction had been established.
14. Refer to the MJW Corporation website, http://www.mjwcorp.com, and the Dade Moeller website, http://www.moellerinc.com [Accessed 2 August 2011].

15. Charlie Wolf, former project manager at Rocky Flats, with Laura Frank, former reporter with the Rocky Mountain News. Interview by Tamara Banks. Studio 12. KBDI-TV. 30 July 2008.
16. The POC measure emerges out of a history of legislation and court cases involving veterans and the Department of Veterans Affairs, as well as down-winders. Congress determined that these would serve as the underlying model for EEOICPA. It also draws on the 'more likely than not'/'but for' sine qua non convention of toxic tort law. 'Toxic torts' refer to those court cases in which persons assert causes of action and seek compensation for adverse health effects resulting from exposures to toxic substances. Examples include litigation involving Agent Orange, asbestos, swine flu vaccine, silicone implants, and other toxic agents.
17. Successor to the Atomic Bomb Casualty Commission created in 1947, the Radiation Effects Research Foundation (RERF) in Hiroshima has been funded by the governments of Japan and the US – specifically the DOE – to conduct epidemiologic studies that generate data on cancer incidence, cancer mortality, and non-cancer effects in relation to radiation dose. Refer to the DOE Office of Health, Safety and Security website on the RERF, http://www.hss.energy.gov/healthsafety/IHS/hstudies/japan_radiate.html (accessed 2 August 2011).
18. The scientific debates over this data range from disagreements over biologic effects/harm of radiation doses experienced for long durations versus short episodes, to concerns over the likely misclassifications, recording errors, and overall injustices involved in a study that was conducted under extreme conditions and based on traumatic memories that had to be recalled from five or more previous years.
19. For comparison, see the web site of the UK nuclear industry's Compensation Scheme for Radiation Linked Diseases, http://www.csrld.org.uk/default.php (accessed 15 August 2011). Although this author does not necessarily agree with the opinions of the International Atomic Energy Agency, refer to the following online document for a 2004 comparison of the advantages and disadvantages of the US EEOICPA compensation programme, the UK Compensation Scheme for Radiation Linked Diseases, and the Russian Federation Compensation Scheme for Radiation Linked Diseases: http://www-ns.iaea.org/downloads/rw/ppss/iaporp/iaporp06.doc (accessed 13 February 2013).
20. Figures were attained from NIOSH, 'Classes of Employees Currently Included in the SEC', http://www.cdc.gov/niosh/ocas/ocassec.html (accessed 15 August 2011). A notable example is the 'Charlie Wolf Act', named after a former Rocky Flats Plant project manager and sick nuclear worker advocate, who died of brain cancer in 2009. The Charlie Wolf Act proposes amending EEOICPA to expand eligibility and improve procedures for providing compensation. This came after longstanding efforts on the part of many Rocky Flats workers to gain more comprehensive SEC coverage at the former plutonium production facility near Denver, Colorado.

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