

# Hunters Point Naval Shipyard

## The Nuclear Arms Race Comes Home



Aerial view of Shot Baker, OPERATION CROSSROADS, July 25, 1946, ships in foreground; US Army Photographic Signal Corps

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# Executive Summary

Despite the recent revelations regarding the botched cleanup of the Hunters Point Shipyard (HPS), the public has never been fully informed of the extraordinary scope of Navy radiological activities and poor environmental controls that resulted in the contamination in the first place. Many people have been led to believe that these activities were primarily associated with a couple of ships with some radioactivity that were temporarily berthed at Hunters Point and some other unspecified but limited activities.

However, the magnitude of operations with large amounts of a wide array of radionuclides over many decades at HPS was far greater than generally understood. These in turn created the potential for contamination much more extensive than acknowledged by the Navy to date—*by dozens of radionuclides impacting all parts of HPS.*

HPS nuclear activity goes back to the very dawn of the atomic era. Within hours of the “Trinity” blast on July 16, 1945, the USS Indianapolis sailed from Hunters Point to Tinian Island in the Pacific, taking with it half of the world’s supply of highly enriched uranium and the components of the “Little Boy” atomic bomb. On August 6 the bomb was loaded onto the Enola Gay and dropped on Hiroshima.

A little less than a year later, the first post-war nuclear tests were conducted in the Pacific. The second of these tests, in the Bikini Atoll lagoon, went badly awry. Immense quantities of radioactivity contaminated hundreds of ships, disabling a large part of the Navy’s fleet.

Seventy-nine radioactive ships from this test alone were brought to Hunters Point to be “decontaminated,” which involved sandblasting and steam-cleaning the radioactivity off the ships, which in turn had the potential to transfer the contamination throughout Hunters Point. Since radioactivity cannot be neutralized by physical means, “decontamination” in practical effect meant merely moving it from the radioactive ships to Hunters Point.

More than 600,000 gallons of radioactively contaminated fuel oil from these Pacific A-bomb test ships were burned in boilers at HPS, which could spread the contamination widely.

The HPS Naval Radiological Defense Lab (NRDL) based at HPS participated in every nuclear weapons test from 1950-1958. Large amounts of highly radioactive nuclear weapons debris were brought to HPS from these A- and H-bomb tests.

In addition to the nuclear bomb contamination and debris, NRDL’s radioactive materials licenses allowed extraordinary amounts of a wide array of radioactive materials at Hunters Point for weapons effects research and other purposes. For example:

- The licensed amount of strontium-90 was sufficient to contaminate ten trillion tons of soil above EPA’s preliminary remediation goals (PRGs).
- 2000 grams of plutonium-239 were allowed, arguably the most dangerous material on earth; inhaling a millionth of an ounce will cause lung cancer with a virtual 100% statistical probability.

- More than 2400 pounds of uranium were included in the license, enough to contaminate about 200 million tons of soil at EPA's PRGs.

Large radioactive sources were manufactured on site, resulting in spills. Prodigious quantities of radium-226, strontium-90, tritium and promethium-147 were used at HPS for radioluminescent devices and deck markers; many of these ended up dumped in on-site landfills and elsewhere at HPS, or just tossed aside by unsuspecting workers. There were radioactive paint shops to produce these radioluminescent instruments, with radioactive wastes poured down drains and leaking into soil from breaks in sewer lines.

Tens of thousands of containers of radioactive waste were generated at NRDL as well as shipped in from other nuclear sites and stored at HPS for dumping at the Farallon Islands. An entire contaminated aircraft carrier, damaged in the Pacific tests, was berthed at HPS for years and eventually loaded with radioactive waste and scuttled near the Farallons.

There was experimentation on large numbers of animals at Hunters Point, resulting in radioactive excrement that could further impact the site. Human experimentation appears to also have taken place at NRDL.

In addition to the "decontamination" of scores of radioactive ships from the Pacific tests, there were decades of maintenance and repair of nuclear powered vessels at Hunters Point. A nuclear laundry operated to wash contaminated clothing from the decontamination and maintenance operations; the radioactive rinse water was dumped down contaminated sewer and storm-water piping, which leaked into the ground. Hazardous and radioactive wastes were dumped in on-site HPS landfills; in August 2000 one caught fire and burned for weeks.

Our conclusions:

*Key takeaways from this report are:*

- *The extent of radioactive activities at Hunters Point was far greater than the public has been led to believe.*
- *A wide array of radionuclides, numbering in the dozens, was involved, often in extremely large quantities.*
- *No portion of Hunters Point can be deemed to be non-impacted, since the radioactivity was susceptible to widespread migration throughout the site.*
- *Effective cleanup will be a massive undertaking, requiring a level of diligence far greater than that which has been demonstrated by the Navy to date, whose poor environmental and safety practices led to the widespread contamination in the first place.*

# FOREWORD

This is one in a series of reports about the Hunters Point Naval Shipyard. In early 2016, the Program on Environmental and Nuclear Policy at the University of California, Santa Cruz, initiated a project to review a series of issues associated with the cleanup of Hunters Point. Completion of that work was delayed by difficulties in getting necessary data and information from the Navy, EPA, and state agencies, and thus not completed by the time the Program's Director, Daniel Hirsch, retired from the university in June of 2017. Since then, Hirsch and a team of former and current UCSC students have continued to work on the matter, through a nonprofit organization, the Committee to Bridge the Gap.

The extent of radiological activities and subsequent contamination at the Hunters Point Shipyard is far, far greater than the general public has been led to believe. This report examines that history.

It relies heavily on the two Historical Radiological Assessments issued by the U.S. Navy. The first and far more cursory document is the *Historical Radiological Assessment, Hunters Point Annex, Volume I, Naval Nuclear Propulsion Program, 1966-1995*, prepared by the Radiological Control Office, Pearl Harbor Naval Shipyard & Intermediate Maintenance Facility Pearl Harbor, Hawaii, and issued August 2000. It focuses on repair and maintenance at Hunters Point of nuclear powered ships. It is cited in this report as "HRA1."

The second and more detailed document is *Hunters Point Shipyard Final Historical Radiological Assessment: History of the Use of General Radioactive Materials, 1939-2003*, issued by Naval Sea Systems Command (NAVSEA), Yorktown, Virginia." [There is no date of issuance on the document, but it is listed in the California Department of Toxic Substances Control Envirostor website for Hunters Point as August 2004.] It focuses on other activities at Hunters Point that involved radioactive materials. It is cited in this report as "HRA2." Where there are quotes in the report that follows that are not otherwise attributed, they are from HRA2.

HRA2 is 665 pages long. While it has numerous defects, which we address in a separate report, it possesses a wealth of information. Despite this, the significance is generally not made clear; remarkable disclosures are "buried in plain sight." For example, tables are provided listing amounts, in curies, of a wide array of different radionuclides allowed under various licenses held by the Naval Radiological Defense Laboratory. However, a layperson would have no way of knowing how extraordinarily large are those radioactivity amounts. This report attempts to put into a form accessible to community members, policymakers, the news media and others concerned with Hunters Point an understandable summary of its extraordinary radiological history.

For access to other reports on HPS in this series: <http://www.committeetobridgethegap.org>  
For contact: [committeetobridgethegap.org@gmail.com](mailto:committeetobridgethegap.org@gmail.com)

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## **Disclosures**

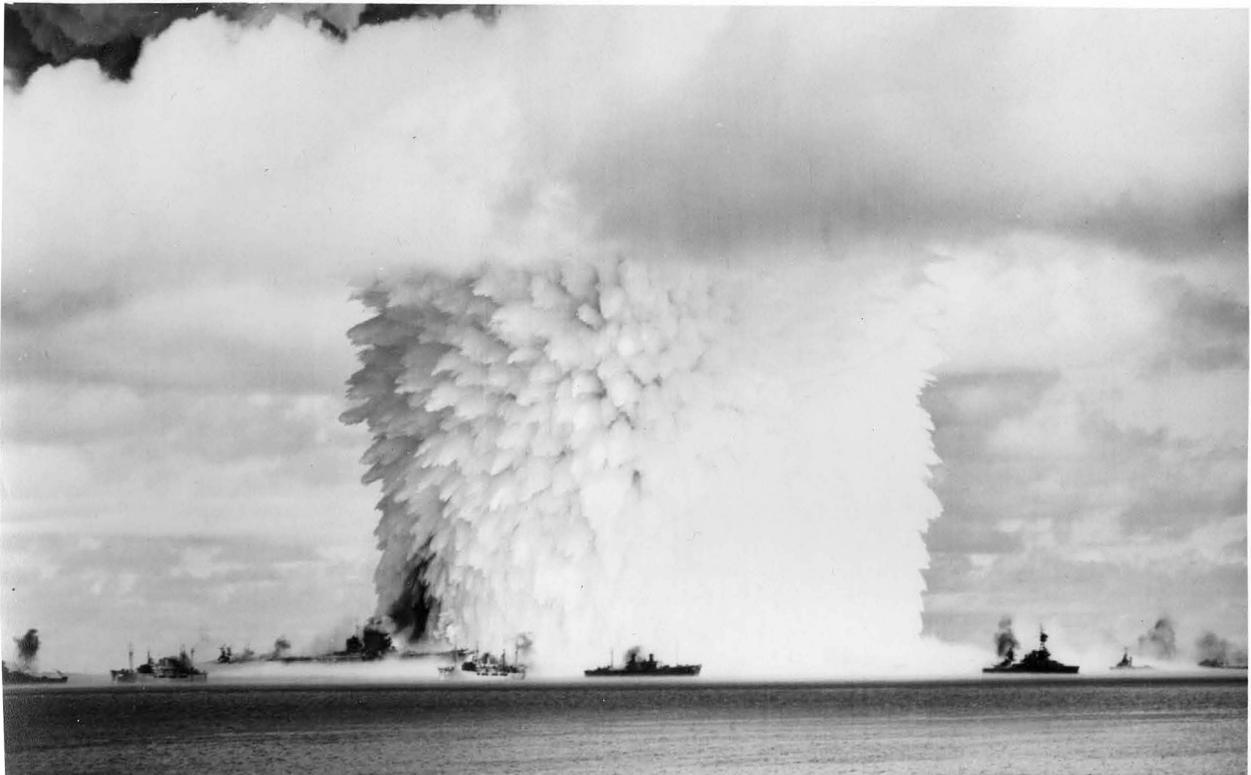
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# Hunters Point Naval Shipyard

## The Nuclear Arms Race Comes Home

On July 16, 1945, the USS Indianapolis departed Hunters Point Shipyard (HPS) carrying components of a bomb code-named “Little Boy,” including half of the highly enriched uranium then in existence in the world.<sup>1</sup> Two hours later, after receiving word that the “Trinity” test of the first nuclear explosion on earth had succeeded earlier that day at Alamogordo, New Mexico, the Indianapolis was allowed to leave San Francisco harbor carrying its cargo to the island of Tinian in the Pacific.<sup>2</sup> On August 6, a plane christened the Enola Gay left Tinian and dropped the assembled atomic bomb on Hiroshima.

A little less than a year later, the first post-war nuclear tests, called OPERATION CROSSROADS, were conducted at the Bikini Atoll in the Marshall Islands in the Pacific, involving 42,000 personnel on more than 240 target and support ships.<sup>3</sup> The tests went badly awry. The first explosion, Shot Abel, detonated in the air, missed its target by half a mile. Nonetheless, there was extensive damage to ships nearby. The second test, Shot Baker, was detonated underwater in the Bikini Atoll lagoon.<sup>4</sup> It created vastly more radioactive contamination than foreseen. As the Navy has acknowledged, **“The Shot Baker underwater burst was far more damaging radiologically.... While extensive damage was expected from the detonation, the severity of radiological effects was not anticipated.”**<sup>5</sup>



*Figure 1- Ships anchored offshore of the Bikini Atoll Islands, with the Shot Baker blast in the background, US Army Signal Corps, July 25, 1946*

The blast initially created “a tremendous bubble of water and steam that broke the ocean’s surface.”<sup>6</sup> As Eileen Welsome describes what happened next, “When the white plume was a mile high, it suddenly collapsed and dropped a million tons of radioactive seawater onto the fleet of target ships anchored in the middle of the lagoon. Instantly a cloud of radioactive steam and spray surged out from the base of the explosion and enveloped the vessels.”<sup>7</sup> As the HRA recounts it, “a huge wave...later called a base surge, rolled over target and support vessels as well as the islands of the atoll.”<sup>8</sup> The resulting radioactive damage debilitated a large part of the fleet:

**Vast quantities of radioactive debris, primarily consisting of fission products (radioactive elements resulting from the fission, or splitting, of the bomb’s plutonium), unconsumed plutonium from the bomb’s fissioning core, and radioactive sand and coral that had been irradiated by the intense neutron radiation from the blast rained down on the target and support ships, islands, and lagoon. This unexpected outcome caused contamination of both target and support ships....<sup>9</sup>**

Twelve ships sank immediately from the impacts of the explosion.<sup>10</sup> Numerous other vessels were badly damaged by one or both tests and so incapacitated that they could not move under their own power. One of these was the USS Independence, pictured below, which took part in both explosions, and about which more will be said later.



*Figure 2- USS Independence wreckage after the Able Shot blast, still smoking (NARA)*



*Figure 3 - Radioactively contaminated USS Independence after A-bomb blast damage. Note two sailors at far right. (NARA)*

The contamination on the huge fleet of ships was far more extensive than just on the exterior surfaces. For example, ships sucked in highly contaminated water from the lagoon after the atomic explosion to be converted into potable water by evaporator systems, contaminating much of the ships' interior: "While support ships were affected by the base surge, the main source of contamination of the support ships was the contaminated waters of Bikini lagoon when the ships entered the lagoon to monitor or work on the target ships and processed the contaminated water through the ships' systems."<sup>11</sup>

Astonishingly, commanders ordered support ships into the intensely contaminated lagoon and directed them to suck in the radioactive water: "Evaporator systems had particularly high concentrations of fission products and plutonium. Even though ships' evaporator systems had been shut down for the test, a command decision to operate the evaporators in the contaminated lagoon to generate fresh water resulted in the systems becoming contaminated."<sup>12</sup>

# An Unprecedented Problem: The Decontamination of Hundreds of Ships — The Beginning of the Hunters Point Contamination

As the Navy concluded, “The heavy contamination of the remaining target ships and the subsequent contamination of the support vessels presented the Navy with an unplanned and unprecedented problem: the decontamination of hundreds of ships.”<sup>13</sup>

Efforts to decontaminate the ships at Bikini proved impossible. As Welsome describes it, they tried by “blasting them with sea water, coffee, rice, cornstarch, lye, boiler compound, diesel fuel, ground corncobs, coconut shells, barley, soap, sulfuric acid, flour, and charcoal. Oftentimes wearing little more than shorts and sailor caps, thousands of young enlisted men boarded the ships with mops and soap and water to scrub the decks.”<sup>14</sup>

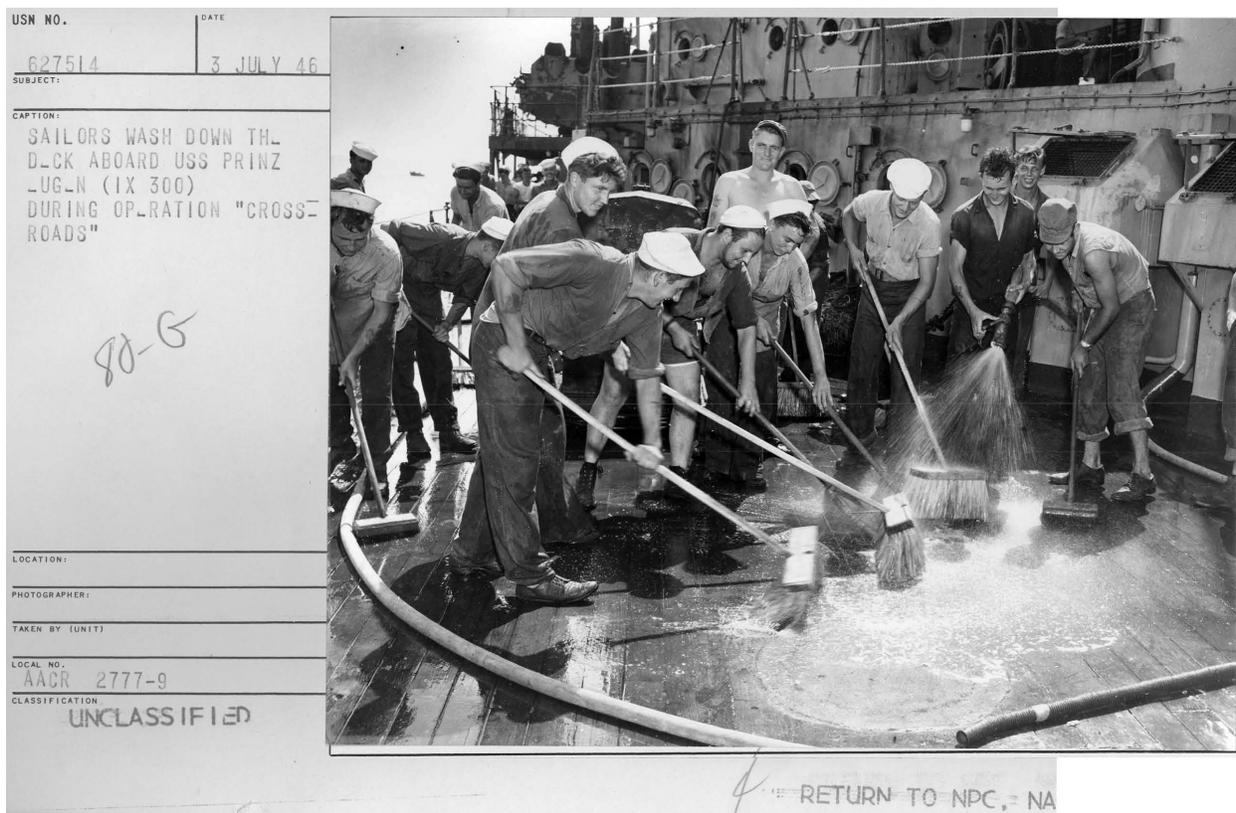


Figure 4 – Group of sailors wash down the highly contaminated deck of the captured German battleship USS Prinz Eugene (IX 300). The ship was so radioactive that it was later sunk. (NARA, Still Pictures Unit, Record Group 80-G, box 2228)

These efforts were futile, in part because many radionuclides tend to adsorb to surfaces, making their removal very difficult. Large numbers of sailors were exposed to significant radiation doses in the ineffectual attempts to decontaminate these ships at sea.

This inability to decontaminate the vessels at Bikini “left the Navy with a fleet of ships incapacitated by radioactivity.”<sup>15</sup> The third planned A-bomb test, Shot Charlie, had to be cancelled because the contamination was so unexpectedly severe that the support ships were too radioactive to use.

The situation was made worse upon the discovery that the contamination on the ships was not limited to beta and gamma radiation from the fission products, as originally thought, but also included extensive alpha radiation from plutonium, causing the Chief of Naval Operation and the Navy Bureau of Medicine and Surgery “a great deal of concern for the safety of Navy personnel working on the contaminated ships.”<sup>16</sup> This would prove ironic in the decision to take the contaminated ships to one of the largest cities in the United States to be decontaminated there.

Thus began the Hunters Point radiological contamination saga. The Navy selected Hunters Point Shipyard to be the primary location for efforts to decontaminate ships from OPERATION CROSSROADS. As recounted by the Navy, “The most heavily contaminated ships were ordered to proceed to HPS.”<sup>17</sup> Radioactivity cannot be neutralized or destroyed by physical means, and therefore decontamination of ships meant merely transferring much of the contamination from the ships and on to Hunters Point. The contamination of Hunters Point by the decontamination of OPERATION CROSSROADS ships was just the beginning of decades of extensive additional pollution, negligent environmental controls by the Navy allowed for a wide array of radioactive and chemically toxic substances to further contaminate the area.

Problems from the nuclear arms race far away were quite literally brought home to San Francisco. More than seventy years later, they continue to confound resolution.

## More Than 80 Radioactive Ships From The Pacific Atomic Tests Were Brought To Hunters Point For Decontamination, Severely Polluting It



*Figure 5 – Aerial View of Hunters Point Naval Shipyard, 1940s, NARA*

The radioactive pollution of Hunters Point began with the efforts to decontaminate the contaminated ships from the OPERATIONS CROSSROADS tests but was compounded by further releases decade after decade. All told, it made Hunters Point one of the most contaminated sites in the nation.

**Seventy-nine ships impacted by those first nuclear tests at Bikini Atoll were brought to HPS for decontamination.** “The most heavily contaminated of these ships were the six target vessels that were towed to HPS because extensive damage prevented them from operating under their own power.”<sup>18</sup> In subsequent years, additional radioactive ships from subsequent nuclear tests in the Pacific were also taken to HPS to try to scrape, steam-clean, and sandblast the radioactivity off the ships—and onto Hunters Point.

High levels of radioactivity existed throughout the ships but particularly in the marine growth on

hulls and the saltwater piping inside. Ships were put into drydocks at Hunters Point and sandblasting was performed to remove the exterior contamination. The radioactive sandblast grit and dust were blown about by the wind, and through that means and others, potentially settling throughout Hunters Point.



*Figure 6- A worker sandblasts a radioactively contaminated vessel in one of the drydocks at HPS.  
Credit: Fritz Goro./Life Magazine Collection/Getty Images*

There were numerous mechanisms for contamination of much if not all of Hunters Point. The sandblasting spread radioactivity through the air where it settled on the land in the area.<sup>19</sup> High pressure steam cleaning of contaminated surfaces caused additional releases.

Acids were used to try to clean the piping inside the ships and saltwater systems. The resulting radioactive acid solutions were allowed to be dumped into the Bay. No special disposal requirements were imposed for much of the contaminated sandblast material and much of it was therefore just buried at Hunters Point.<sup>20</sup>

Decontamination of OPERATION CROSSROADS ships continued from 1946-1951, and work on other ships contaminated by subsequent nuclear weapons tests in the Pacific occurred for years thereafter.



*Figure 7- Drydock 4 at Hunters Point, 1950s (Todd Lappin)<sup>1</sup>*

## **A Hundred or More Radionuclides Were Available to Contaminate All Parts of Hunters Point**

When the nuclear bombs exploded, the uranium and/or plutonium in their cores split apart (fissioned) into scores of other radionuclides (fission fragments) that rained down onto and contaminated the ships exposed. Additionally, some of the uranium and/or plutonium didn't fission, and is part of the contamination that landed on the ships. Finally, the intense neutron burst from the explosions irradiated nearby materials such as the coral and sand in the lagoon, making the various elements in them radioactive (called activation products), also depositing on ship surfaces. And when the inexplicable order was given for the ships to sail into the lagoon and suck in contaminated seawater, the interiors of the ships were also contaminated. Once brought to Hunters Point for decontamination, and spread throughout the site by wind and surface water, that plethora of different radionuclides potentially polluted any and all parts of Hunters Point. Thus a wide range of fission products, activation products, and unfissioned plutonium and uranium, **totaling a hundred or more different radionuclides**, was brought back to or otherwise used at Hunters Point and was available to contaminate the whole site.<sup>21</sup>

## **610,000 Gallons of Radioactively Contaminated Fuel Oil from Pacific A-Bomb Test Ships Were Burned at Hunters Point**

More than 600,000 gallons of fuel oil in the three most contaminated ships from OPERATION CROSSROADS, including the ex-Independence, were contaminated with plutonium and mixed fission products and were taken from the ships and burned in regular boilers on shore at Hunters Point, presumed to have occurred in Buildings 203 and 521.<sup>22</sup> These airborne emissions could have distributed radionuclides through airborne deposition onto surfaces throughout the area.<sup>23</sup> This mechanism for widely distributing radioactivity throughout Hunters Point, coupled with other similar pathways such as releases from the sandblasting of ships, incineration of radioactive carcasses of test animals, and the landfill fire, will have significance elsewhere in our companion report on the failure to sample the great majority of Hunters Point for radioactivity. The contamination at Hunters Point, however, went far beyond that created by OPERATIONS CROSSROADS.

## **Establishment of Naval Radiological Defense Laboratory**

In 1946 the Radiological Safety Section (RSS) or Radiation Laboratory (RADLAB) was established at Hunters Point to study radiation effects, establish procedures for handling radioactive materials, and to conduct decontamination of dozens of naval vessels from nuclear tests in the Pacific. RSS/RADLAB evolved in 1948 into the Naval Radiological Defense Laboratory (NRDL), which operated until 1969. “Extensive and unique radiological operations were conducted throughout NRDL’s history. Its primary mission was to study the effects of atomic weapons on Navy ships and personnel. Radioactive materials were used throughout NRDL’s history.”<sup>24</sup> It also did work on decontamination methods and effects of radiation on living organisms and various materials.

## **Large Amounts of Highly Radioactive Nuclear Weapons Debris Brought to Hunters Point from A- and H-Bomb Tests**

**“Laboratory personnel participated in every nuclear weapon test between 1950 and 1958.”**<sup>25</sup> They brought back to Hunters Point significant quantities of fission products, plutonium and other radioactive debris from the nuclear bomb tests. **“NRDL collected large quantities of fallout material at most U.S. atmospheric weapons tests.** Sample collection ranged from small air sampler filters to large trays with thick layers of collected material.”<sup>26</sup> They analyzed these radioactive bomb debris materials to try to estimate the explosive yield in kilotons of the atomic blasts. Thus, large quantities of scores of radionuclides from fallout material collected from numerous nuclear tests were brought to and available to contaminate Hunters Point.

## Extraordinary Amounts and Wide Array of Radioactive Materials at Hunters Point

The radioactive ship decontamination and the work with nuclear weapons debris were unlicensed activities. Beyond that, however, licenses for NRDL allowed possession and use of a broad range and extraordinarily large amounts of additional radioactive materials.<sup>27</sup> At various times, the licenses allowed 60,000 curies of strontium-90/yttrium-90 (for use in fuel for space nuclear power sources) and another 66,000 curies (for the same purpose). Strontium-90 is one of the most dangerous radionuclides, concentrating in bone and causing bone cancer and leukemia; it is hazardous for hundreds of years. Strontium-90 is dangerous in extremely small concentrations. Similarly, 15,000 curies of cobalt-60, and 3,000 curies of cesium-137, powerful gamma-emitters, were licensed.

To put these immense quantities into perspective, each curie undergoes 37 billion radioactive disintegrations per second, with each disintegration emitting radiation. The cleanup standards set forth by the Navy for strontium-90, cobalt-60, and cesium-137 are measured in small fractions of a pico-curie/gram—millionths of a millionth of a curie.

To put these huge inventories of radioactive material in perspective, EPA's default Preliminary Remediation Goal for cleanup of soil for residential purposes is 0.00361 pico-curie of strontium-90 per gram of soil—3.61 thousandths of a millionth of a millionth of a curie. **60,000 curies of strontium-90, the amount in one license alone, could therefore contaminate  $1.7 \times 10^{19}$  grams of soil, or more than ten trillion tons.** Obviously not all of that strontium-90 is likely to be released, nor be uniformly distributed, but one can readily see that if even a small quantity were to get into the environment, it could contaminate a large portion of Hunters Point.

Similarly, the license included 2000 grams of plutonium-239. Plutonium-239 is arguably the most dangerous material on earth; that amount can make an atomic bomb that can take down a city. It has a half-life of 24,000 years; a millionth of an ounce if inhaled will cause cancer with a virtual 100% statistical certainty.<sup>28</sup>

NRDL's licenses also included 2,426 pounds depleted uranium, 94 pounds of natural uranium, 12 pounds of natural thorium, and 2 pounds of U-235. The depleted uranium alone could contaminate more than 200 million metric tons of soil above EPA's current preliminary remediation goals. A large number of other radionuclides was also involved. None of this includes the wide range of transuranics and fission and activation products from the years of decontaminating the ships from the nuclear weapons tests or from the decades of repair and maintenance work on nuclear powered vessels. "NRDL did extensive work with AEC material that was not controlled by licensing. This included unspent weapons material and fission products collected at weapons test sites in the Pacific Ocean and at the Nevada Test Site."<sup>29</sup> In total, massive amounts of radioactive materials were in use at Hunters Point.

## **Onsite Manufacture of Large Radioactive Sources, Resulting in Spills**

“NRDL created individual sources from bulk quantities of isotopes. They would typically purchase the radioactive material from a vendor or another laboratory and would divide the material at NRDL for use there or for shipment to another, usually Navy, facility [citation omitted]. Most of these sources were short half-lived (less than 3 year half-life), but some had relatively long half-lives (for example, Ra-226, 1,599 years). Because these source materials were not sealed and were manipulated in the laboratory, they were subject to occasional spills.”<sup>30</sup>

Large radiation “sources” are powerful assemblies of significant quantities of radionuclides. NRDL would buy the radionuclides in bulk quantities, divide them into portions and use them or ship them elsewhere. Because they were loose materials, not sealed, inadequate safety measures by the Navy resulted in spills in which the radioactivity contaminated parts of Hunters Point.

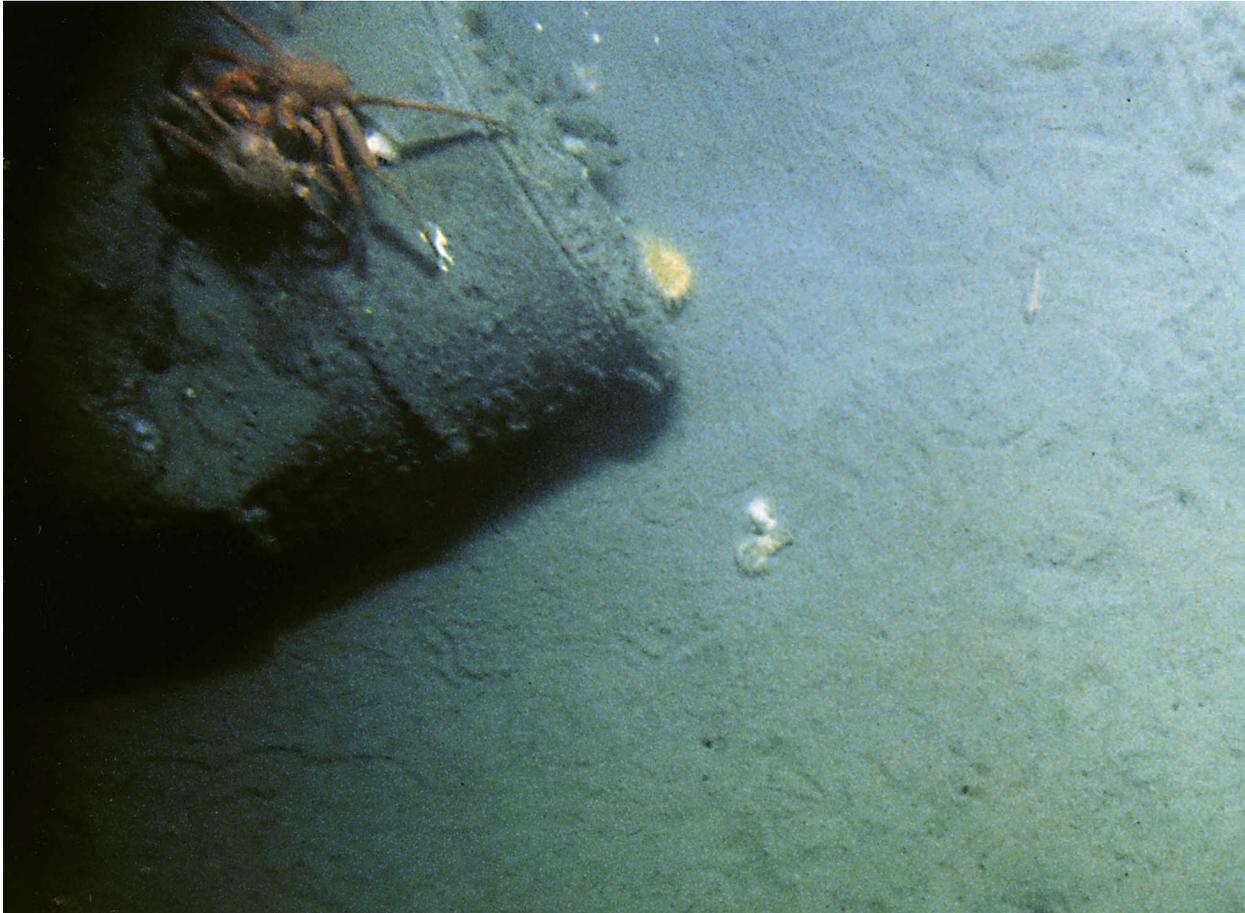
## **Large Amounts of Ra-226, Sr-90, Pm-147 and Tritium Used at Hunters Point for Radioluminescent Devices**

Even before the establishment of NRDL, from the 1930s onward, the Navy used radium for self-illuminating instrument dials and controls, deck markers and walkways, etc. In subsequent years, strontium-90, tritium (hydrogen-3), and promethium-147 were also used. Radioluminescent paint shops were established to paint instruments and surfaces with radioactive paint. Machine shops handled and repaired radioactively-coated equipment; old devices and associated wastes were dumped and buried on site.<sup>31</sup> Furthermore, “liquid waste containing radium was commonly disposed of via building drain systems to sewers. [citation omitted] It was also common practice to leave radioluminescent devices in place on equipment when it was sent to the salvage or scrap yard or processed through smelters.”<sup>32</sup>

[Some of the first scientific knowledge of the hazards of radiation came from tragedies involving radium-dial painters in the first part of the last century. These women would repeatedly put the tip of the brush in their mouth to create a fine point for painting, over time ingesting significant quantities of radium, with high incidence of subsequent radiation-induced disease.<sup>33</sup>]

As we shall see in a companion report, despite the wide array and very large amounts of radioactive materials at Hunters Point, the Navy has declared as “radionuclides of concern” and set cleanup limits for only a few of these radionuclides, allowing unlimited contamination by the many others to remain without remediation. Furthermore, even for some radionuclides for which cleanup standards have been set, particularly the critical strontium-90, the great majority of the measurements made have not included such radionuclides as strontium-90. The Navy has claimed strontium-90 would be found along with cesium-137, for which it was making measurements, as it purportedly only occurs in mixed fission products from weapons testing. However, as indicated above, the records show that Hunters Point had vast quantities of strontium-90 in separated form, both for space nuclear power sources and in lesser quantities but more widespread, for radioluminescent purposes such as deck markers.

## **Storage of Tens of Thousands of Containers of Radioactive Waste—Generated at NRDL and Shipped in from Other Nuclear Sites—for Dumping at The Farallon Islands**



*Figure 8 - A crab on a sunken barrel containing radioactive waste, Farallon Islands (USGS)*

47,500 containers of radioactive waste containing 14,500 curies of radioactive waste are estimated to have been dumped from 1946-1965 at the Farallon Islands outside San Francisco Bay in what is now the Monterey Bay Marine Sanctuary.<sup>34</sup>

“From the late 1940s through 1959, NRDL and HPS conducted radioactive waste disposal operations. **NRDL accepted and consolidated waste from other military installations, as well as educational institutions, research laboratories, and the AEC**, and packaged the wastes for disposal. NRDL then worked with HPS to load the containers onto barges and to ship the material to an ocean disposal site near the Farallon Islands. **NRDL was the primary military agency disposing of waste at the Farallon Islands.**”<sup>35</sup>

“Numerous types and forms of radionuclides and various experimental media were included in the waste. **Carcasses of small animals used in research were packaged in drums**; large ones

were either packaged in larger containers or cut up and put into drums. Concrete was added to the waste to weight the drums. Once at the disposal location, the containers were off-loaded and sunk. **Should a drum not sink, it was fired upon with rifles until it sank. If it could not be sunk, it was recovered and returned to HPS.**"<sup>36</sup>

The canisters corroded and degraded, radioactive materials were released, and radioactivity was taken up by sea-dwelling organisms including fish.<sup>37</sup> The concern over the Farallon Islands radioactive dumpsite, led in part by then-San Francisco Supervisor Quentin Kopp, was multiplied by revelations of nearly 50 other such dumpsites off the East and West Coasts of the U.S. and in the Gulf of Mexico<sup>38</sup> and contributed to the decision by the London Dumping Convention to ban the practice of ocean dumping radioactive waste. The prohibition took effect in 1994.<sup>39</sup> Concerns about leaking contamination from the wastes dumped by NRDL at the Farallons and potential bioaccumulation in fish continues to this day.<sup>40</sup>



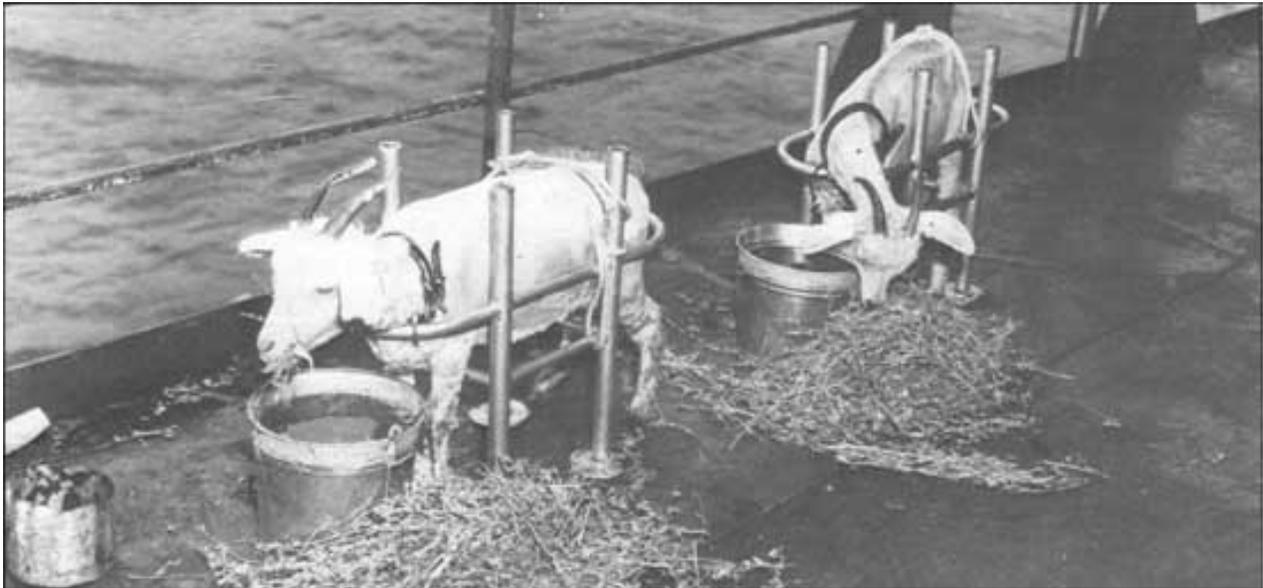
*Figure 9 - A sign in front of the Ex-USS Independence anchored at HPS, reading "Personnel for Radioactive Ships Only" (NARA)*

The ex-Independence, contaminated during the OPERATION CROSSROADS tests and so damaged that it had to be towed to Hunters Point, was subsequently retained there for use for radioactive experimentation, decontamination testing, storage of radioactive waste, and as a laboratory. In January 1951 it was loaded with radioactive waste from HPS and towed out to the Farallons and scuttled.



*Figure 10 - Ex-USS Independence loaded with barrels of radioactive waste on its way to be sunk at the Farallon Islands (San Francisco Maritime National Historical Park)*

## Radioactive Experimentation on Large Numbers of Animals at Hunters Point



*Figure 11- Goats confined to USS Niagara before the Baker Shot. They were left on board, in the detonation zone, for a number of days following the blast, the effects of which were later observed and documented. (NARA)*

“Over the years bees, moths, bats, mice, rats, cats, monkeys, mules, hamsters, guinea pigs, dogs, pigs, sheep, goats, burros, and cows were kept and used as subjects for a wide variety of research involving radioactivity and radioactive materials. Animal experimentation continued up to the disestablishment of NRDL in 1969.”<sup>41</sup>

At HPS, animals were raised and kept in animal pens near Building 704 and in at least nine other buildings.<sup>42</sup> The animals were irradiated with high levels of radiation and injected with radioactive materials.<sup>43</sup> Animal carcasses and wastes were burned in an on-site incinerator.<sup>44</sup> This created the potential for widespread airborne deposition of contamination.<sup>45</sup> Similarly, radioactive excrement and urine from the animals may have contaminated parts of Hunters Point directly and through surface water runoff, as well as by disposal down drains into leach fields and otherwise by leakage of underground sewer pipes.

## Human Experimentation at Hunters Point

In addition to experimenting with radioactivity on animals, it appears some human experimentation occurred as well. The radioactive materials licenses for Hunters Point included, for example, tritium, potassium-40, bromine-82, and sodium-24 for “special human use authorization.”<sup>46</sup>

[Decades later, President Clinton established an Advisory Committee on Human Radiation Experiments that published, in October 1995, a detailed study of such experimentation

nationwide. Among the more controversial of the human radiation experiments identified was work headed by Dr. Joseph Hamilton of UC Berkeley which involved, among other things, injecting plutonium into live subjects. Some of this work was conducted on patients at UC San Francisco hospital.<sup>47</sup> It is not clear from the available records whether any of this work also involved NRDL at Hunters Point.]

## **Decades of Maintenance and Repair of Nuclear Powered Vessels at Hunters Point**

In addition to the vast array of radioactive work conducted by NRDL, Hunters Point was also the site of extensive maintenance and repair work on a range of nuclear powered vessels. The available record regarding potential releases from this work is very spotty. The Historical Radiological Assessment (HRA) for the Naval Nuclear Propulsion Program (NNPP) at Hunters Point, 1966-1995, was prepared by a different Navy division and is of substantially poorer quality than the HRA for NRDL.<sup>48</sup> It primarily asserts, without convincing basis, that the Navy had good controls and therefore “the berthing of and work on nuclear-powered ships at Hunters Point Annex has had no adverse effect on the human population or the environment of the region.” The Navy concluded that “no additional characterization and no remedial actions are necessary as a result of NNPP activities at Hunters Point Annex.” The conclusions are subject to significant skepticism.

A significant number of nuclear-powered Navy vessels were brought to Hunters Point over three decades to be worked on, in berths or in drydocks. Navy standards for releasing radioactivity into the environment in early years in particular were far less protective than modern standards.

## **Nuclear Laundry & Leaking Contaminated Sewer and Storm-water Piping**

The extensive work with radioactively contaminated materials - decontaminating ships, maintaining nuclear vessels, manufacturing large radioactive sources, handling innumerable test animals and their excrement, etc. – contaminated the workers and their clothing. When they would arrive at work they would change into work clothes; at the end of the day they would shower and then be checked for residual radioactivity before being allowed back into their normal clothes to leave.

The water from the contaminated showers would go down drains into sewer pipes traveling under Hunters Point for discharge into the Bay, along with radioactive liquids from the laboratories, radium paint shops, and various other nuclear operations at the site. These drainage pipes frequently leaked, for long periods of time, contaminating the soil around them. The contaminated clothing was collected and taken to a nuclear laundry to be washed. Radioactive effluent from the contaminated laundry likewise went down the drains and into the leaky sewer lines traversing the site to the Bay, contaminating the piping and surrounding soil.



Figure 12- Navy workers crossing the boundary line. Credit: Fritz Goro./Life Magazine Collection/Getty Images

## **Disposal of Hazardous and Radioactive Wastes in Hunters Point Landfills; August 2000 Fire**

For decades, hazardous and radioactive wastes were disposed of onsite in regular landfills. This included numerous radium items, sandblast grit from decontaminating ships from the nuclear testing, and other materials that today would not be allowed in such landfills. In 2000, the main landfill caught fire. It burned for three weeks before the Navy even informed anyone, including the public and the EPA. This triggered a critical letter from EPA, indicating that only after complaint by the EPA did the Navy even release a fact sheet for the public or “install air monitoring equipment to determine the impact of the fire on nearby residents.”<sup>49</sup> This fire is one more example of unanticipated mechanisms that could release contaminants into the air and have them fall out over wide areas of Hunters Point, dropping pollution throughout it.

## **Numerous Other Radioactive Operations at Hunters Point With Potential for Contamination**

Hunters Point also housed several accelerators (e.g., a cyclotron particle accelerator in Building 820, a Van de Graaf particle accelerator in Building 816, a Kevatron particle accelerator in Building 510A) and one or more neutron generators (e.g., Building 506). These devices were used to irradiate test animals. They also used radioactive materials as targets for particle generators, resulting in tritium contamination.<sup>50</sup>

Many facilities at Hunters Point stored radioactive wastes, including liquid wastes. Some of the sandblast waste, for example, was stored in open barrels whereby the wind would blow it around.<sup>51</sup> Other waste also appears to have been stored outdoors, whereby over time it could leak and contaminants migrate via rainwater runoff or air dispersion. Furthermore, because much of the work at Hunters Point was classified, and the disclosures of the historical radiological activity was in the hands of the Navy, which was responsible for the contamination in the first place and must pay for cleanup of any contamination identified, the record available may not be fully indicative of the full range of activities and ensuing pollution that took place. Finally, decades of large-scale excavation of soil, including installing sewer lines and underground utilities, constructing new buildings and tearing down old ones, and of course, the extensive movement of contaminated soil as part of site characterization and remediation had the potential for spreading radioactive and chemical pollution widely throughout the site, by airborne deposition and surface water runoff, among other means.

## Conclusion

Hunters Point, by virtue of its designation as a Superfund site, is one of the most contaminated places in the entire United States. However, few members of the public and few policymakers have been given a clear picture of the magnitude of the radioactive operations that occurred there and the contamination that resulted thereby.

The nuclear era began at 5:29 a.m. on July 15, 1945, when the first atomic bomb was detonated in the New Mexico desert, the “Trinity” Test. Shortly thereafter, the USS Indianapolis left Hunters Point, carrying components of the A-bomb that was to be dropped on Hiroshima. It delayed leaving San Francisco Bay for two more hours until it received confirmation that the “Gadget” had been successful at Alamogordo, then steamed toward Tinian, where the bomb was loaded on the Enola Gay and dropped over Hiroshima. For the first time in history, the power of the atom had been used to annihilate tens of thousands of people, in an instant.

Hunters Point played a key role in the ensuing arms race, in which hundreds of atomic and hydrogen bombs were detonated in the atmosphere and tens of thousands were constructed, threatening life as we know it. Hunters Point was deeply involved in virtually every U.S. nuclear weapons test in the Pacific. And from the very beginning of those tests, the radioactive havoc that those nuclear explosions produced resulted in extensive contamination, significant amounts of which were ironically brought back to San Francisco.

The nuclear arms race was not just “out there,” far away at some distant Pacific island generally unknown to mainlanders; it was carried back home to San Francisco. Because of gross miscalculation of the destructive nature of atomic explosions, and cutting corners on safety, the ships involved in the tests were badly contaminated, so severely that they couldn’t continue to be used. And so, nearly eighty ships were brought back, some under their own power, others so damaged they had to be hauled back, to Hunters Point, where they were “decontaminated.” However, radioactivity cannot be neutralized, it can merely be transferred from one place to another. Thus, decontamination meant moving the contamination from the ships to Hunters Point itself. **More than seven decades later, magnified over the years by much other nuclear work with extremely poor environmental controls, we are still dealing with the results. The nuclear arms race came home, and its consequences are still haunting us to this day.**

Key takeaways from this report are:

- The extent of radioactive activities at Hunters Point was far greater than the public has been led to believe.
- A wide array of radionuclides, likely numbering a hundred or more, were involved, often in extremely large quantities.
- No portion of Hunters Point can be deemed to be non-impacted, since the radioactivity was susceptible to widespread migration throughout the site.
- Effective cleanup will be a massive undertaking, requiring a level of diligence far greater than that which has been demonstrated by the Navy to date, whose poor environmental and safety practices led to the widespread contamination in the first place.

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<sup>1</sup> HRA2: 6-4

<sup>2</sup> *ibid.*

<sup>3</sup> Target ships were ships near the center of the explosions, designed to see the effects of nuclear weapons on ships. Support ships were somewhat further away, to provide support for the test operations.

<sup>4</sup> Eileen Welsome, *The Plutonium Files: America's Secret Medical Experiments in the Cold War*, Dell Publishing, NY: 1999, p. 171

<sup>5</sup> HRA2: 6-13, emphasis added

<sup>6</sup> *ibid.*

<sup>7</sup> Welsome, p. 171

<sup>8</sup> HRA2: 6-13

<sup>9</sup> *ibid.*

<sup>10</sup> HRA2: 6-14

<sup>11</sup> *ibid.*

<sup>12</sup> *ibid.*

<sup>13</sup> *ibid.*, emphasis added

<sup>14</sup> Welsome, p. 172

<sup>15</sup> HRA2: 6-14

<sup>16</sup> *ibid.*

<sup>17</sup> *ibid.*

<sup>18</sup> HRA2: 6-17

<sup>19</sup> See, e.g., HPS worker statements, HRA2: B-12, 13, 36

<sup>20</sup> HRA2: 6-17

<sup>21</sup> HRA2: Table 4-2

<sup>22</sup> HRA2: 6-18

<sup>23</sup> The HRA suggests that the wind blowing during the period of the burns was “generally” out to the Bay, but concedes it is not clear when the burns actually took place. HRA2: 6-19. In any case, wind direction averaged over a day may mask frequent periods when the wind blows in other vectors. Furthermore, the data for the daily average wind direction over the period in question shows numerous days when the wind blew not from the west over the Bay, but rather from the south and the southeast, which would carry the plume over much of Hunters Point. HRA2 Tables 6-3A,B,C,D,E. Finally, even when the wind did travel from the buildings where the contaminated fuel oil was burned toward the Bay, it would have to traverse parts of Hunters Point to get there, with potential for deposition.

<sup>24</sup> HRA2: 4-9

<sup>25</sup> HRA2: 6-25, emphasis added

<sup>26</sup> HRA2: 6-32, emphasis added

<sup>27</sup> HRA2: 6-26

<sup>28</sup> IPPNW & IEER, *Plutonium: Deadly Gold of the Nuclear Age*, International Physicians Press: Cambridge, MA 1992, p. 14

<sup>29</sup> HRA2: 5-11

<sup>30</sup> HRA2: 6-27

<sup>31</sup> HRA2: 5-9

<sup>32</sup> HRA2: 6-7

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<sup>33</sup> See e.g., Kate Moore, *The Radium Girls: The Dark Story of America's Shining Women*, Sourcebooks: 2017, and Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910–1935* (University of North Carolina Press, 1997)

<sup>34</sup> Testimony of Daniel Hirsch before the Subcommittee on Energy, Environment, and Natural Resources of the Committee on Government Operations, US House of Representatives, October 7, 1980, pp. 296-315, 320-323 of Hearing Record; data compilation by Michael Rose.

<sup>35</sup> HRA2: 6-29 – 30, emphasis added

<sup>36</sup> *ibid.*

<sup>37</sup> W. Jackson Davis, John Van Dyke, Daniel Hirsch, Mary Anne Magnier, Sherry Broeder, *Evaluation of Oceanic Radioactive Dumping Programs*, 1982, pp. 87-90

<sup>38</sup> See Hirsch testimony and Rose data table, *supra*; see also John Emshwiller and Dionne Searcey, “Nuclear Waste Sits on Ocean Floor: U.S. Has Few Answers on How to Handle Waste it Dumped in the Sea,” *Wall Street Journal*, December 31, 2013

<sup>39</sup> *Sea Disposal of Radioactive Wastes: The London Dumping Convention 1972*, IAEA Bulletin 2/1994

<sup>40</sup> John Emshwiller and Dionne Searcey, “Nuclear Waste Sits on Ocean Floor: U.S. Has Few Answers on How to Handle Waste it Dumped in the Sea,” *Wall Street Journal*, December 31, 2013

<sup>41</sup> HRA2: 6-33

<sup>42</sup> *ibid.* Some of the larger animals were raised at the military's Camp Parks near Dublin.

<sup>43</sup> HRA2: 6-34

<sup>44</sup> *ibid.*

<sup>45</sup> It is asserted in the HRA that the carcasses of radioactive animals were carefully controlled and disposed of as radioactive waste, first at the Farallon Islands and later at commercial radioactive waste sites. It seems unlikely, however, that all carcasses were so treated. The HRA indicates that carcasses deemed not radioactive were incinerated or buried on site, and the definition of how radioactive the animal needed to be to qualify back then as radioactive waste is not disclosed. Furthermore, the excrement and urine from the animals while alive would also be radioactive, contaminating Hunters Point. Note that large animals were apparently kept in outdoor pens that would be contaminated by the animals' radioactive excrement.

<sup>46</sup> AEC License 04-00487-03, in effect 1958-1970, cited in HRA2: Table 5-1

<sup>47</sup> See, e.g., Advisory Committee final report, p. 256

<sup>48</sup> HRA1

<sup>49</sup> *Associated Press*, “EPA Faults Navy Handling of 4-Week Landfill Fire,” September 12, 2000.

<sup>50</sup> HRA2: 6-29

<sup>51</sup> HRA2: B-12