

*NDB Resurea  
3/29/05*

**From:** <NancyBurtonEsq@aol.com>  
**To:** <rle@nrc.gov>  
**Date:** 3/22/05 3:02PM  
**Subject:** Millstone EIS

Dear Mr. Emch:

Attached is a corrected version of the CCAM comments submitted on March 16, 2005.

Attachments as referenced are being mailed for delivery tomorrow to the NRC, with one exception, that being a report on cobalt-60 found in Jordan Cove sediment by Yale University researchers. That study will be submitted separately.

Please await CCAM's further supplement, to be filed shortly, addressed to issues not covered by the March 16 submission.

Sincerely,  
Nancy Burton

**CC:** <ajk1@nrc.gov>

*10/9/04*

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CONNECTICUT COALITION AGAINST MILLSTONE  
[www.mothballmillstone.org](http://www.mothballmillstone.org)

March 16, 2005

Chief  
Rules and Directives Branch  
Division of Administrative Services  
Office of Administration  
Mailstop T-6D59  
U.S. Nuclear Regulatory Commission  
Washington DC 20555-0001

Re: Millstone Nuclear Power Station/Draft Environmental Impact  
Statement/Supplemental Comments

Dear Sirs:

***The NRC is committed to protecting the public health and safety.***  
**- Statement of NRC's Organizational Values**

The Connecticut Coalition Against Millstone submits herewith its supplemental comments concerning the draft Environmental Impact Statement (SEIS) which the NRC staff has prepared in support of relicensing of Millstone nuclear reactors Units 2 and 3 to extend their terms to the years 2035 and 2045 respectively. These comments were preceded by preliminary comments submitted on March 2, 2005.

Unfortunately, our review of the SEIS and our interaction with NRC's SEIS staff concerning its evaluation of the operational history of the Millstone Nuclear Power Station lead us to conclude that **in this instance the NRC has entirely departed from its self-defined organizational values (see above).**

**Indeed, we are driven to conclude that, in this instance, the NRC staff is not even *remotely* concerned about the effects of Millstone releases of radiation to the public health and safety and to the environment.**

Nor has the NRC staff adhered to the "Principles of Good Regulation" heralded on the NRC's website.<sup>1</sup>

The standard defining evaluation criteria for the NRC staff's environmental review is defined in 10 CFR 51.95(c)(4) as follows:

... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

The NRC staff has preliminarily concluded in its draft Environmental Impact Statement that the adverse environmental impacts of license renewal are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

This conclusion is clearly erroneous and based on incorrect and incomplete information, industry bias and flawed analysis. **It also manifests a profound disregard for the health and welfare of the community.**

**This conclusion ignores substantial available evidence that Millstone operations have had and will continue to have devastating health impacts on a wide scale and will continue to cause irreversible environmental damage on a wide scale.**

Our detailed comments follow. Following the Introduction, our comments appear in sequence conforming to the appearance of topics in the draft Environmental Impact Statement (SEIS). Our comments today address the SEIS up to 5.0 ("Environmental Impacts of Postulated Accidents"). Additional comments addressed to Section 5.0 *et seq.* will be provided subsequently hereto.

### Introduction

The U.S. Nuclear Regulatory Commission ("NRC") is considering relicensing of the Millstone Nuclear Power Station, Units 2 and 3 for

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<sup>1</sup> See NRC's "Principles of Good Regulation," attached.

additional 20-year terms. Without relicensing, Unit 2's operating license would expire in the year 2015 and Unit 3's operating license would expire in the year 2025.

Together with Unit 1, these reactors have had an operational history since 1970 which is among the ugliest in the annals of the nuclear industry.<sup>2</sup> Millstone's radioactive releases have been among the highest of all nuclear reactors in the United States.<sup>3</sup> Millstone's routine radiation releases were linked early-on with cancers and other diseases.<sup>4</sup> Millstone's treatment of its workforce by way of exposing it to unnecessary radiation levels<sup>5</sup> and its treatment of nuclear whistleblowers by ostracism and retaliatory firings have made it notorious within the nuclear industry.<sup>6</sup> While full-time inspectors from the NRC were onsite, Millstone lost two highly radioactive spent fuel rods. These irradiated rods contain plutonium and other fission elements which may be diverted to create dirty bombs. While Millstone's environmental monitoring program was being monitored by the NRC and Connecticut's Department of Environmental Protection ("DEP"), Millstone's personnel brazenly falsified environmental monitoring reports to the NRC and DEP and sabotaged the sample-taking activities.<sup>7</sup>

Connecticut's regulatory apparatus has failed to safeguard the public. Millstone's five-year National Pollution Discharge Elimination System ("NPDES") permit expired on December 14, 1997 – eight years ago - and it has not been renewed. Nevertheless, DEP has permitted Millstone to operate under the 1992 permit in brazen violation of the letter and spirit of the federal Clean Water Act. Former DEP Commissioner Arthur J.

<sup>2</sup> For this reason, each of the environmental issues required for consideration in the Environmental Impact Statement process should be considered to be a Category 2 issue, subject to site-specific consideration.

<sup>3</sup> See Millstone & Me: Sex, Lies and Radiation in Southeastern Connecticut by Michael Steinberg (Black Rain Press 1998),

<sup>4</sup> See Testimony of Ernest J. Sternglass, Ph.D., presented to a Congressional Committee investigating nuclear power issues.

<sup>5</sup> See, e.g., www.mothballmillstone.org, experience of Charles D. Douton, Jr.

<sup>6</sup> See, James Plumb v. Northeast Nuclear Energy Company (Superior Court, Judicial District of New London); Clarence O. Reynolds v. Department of Public Utility Control (Superior Court, Judicial District of New Britain); John DeCore v. Northeast Nuclear Energy Co., U.S. District Court, District of Connecticut.

<sup>7</sup> See "Owner of Connecticut Nuclear Plant Accepts a Record Fine" (The New York Times September 28, 1999), attached.

Rocque, Jr., routinely authorized "emergency authorizations" ("EAs") while recognizing his lack of legal authority to do so.<sup>8</sup> These EAs – of indefinite duration permitting releases of toxic and carcinogenic substances without enforceable limits – permit Millstone's owners and operators to do, *inter alia*, what Northeast Utilities pleaded guilty to doing wilfully and illegally when it pleaded guilty in the U.S. District Court in September 1999 to committing environmental felonies at Millstone and paying a \$10 million fine. Clearly, the Clean Water Act prohibits major waivers of NPDES permit conditions without notice to the public and a meaningful opportunity for public input. Commissioner Rocque issued sequential EAs without notice to the public and he did not provide an opportunity for public comment. To our knowledge, Rocque's successor, DEP Commissioner Gina McCarthy, has done nothing to bring the Millstone operations into compliance with the law. She has permitted the *status quo* to reign. Connecticut Attorney General Richard S. Blumenthal is complicit in the illegal Millstone activities. Mr. Blumenthal successfully suppressed the truth of Millstone's illegal operations in litigation brought to require Millstone operations to comply with existing laws.

Regardless of whether Millstone has been technically out of compliance with the law during much or all of its 35-year operational life, its operations have systematically endangered the public health and safety.

**Millstone operations are a clear and present danger to the public health, safety and welfare.**

Although Millstone's reactors have been operating since 1970, and thus have generated a 35-year history of operations and record of environmental impact, the NRC selected only a *three-year period* (2001, 2002 and 2003) to review to assess Millstone radiological emissions for purposes of its SEIS evaluation. Necessarily, the NRC staff's superficial

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<sup>8</sup> The Coalition attaches hereto the "Emergency Authorization" issued on October 13, 2000 which "legalizes" violations of the expired NPDES permit and which ex-Commissioner Rocque "transferred" to Dominion when it was a paper company without assets. Prior to issuing EAs for Millstone operations, Commissioner Rocque admitted in writing he lacked authority to issue emergency authorizations on an emergency basis for unlimited durations. The EA attached hereto has been in effect on an emergency basis since 2000 premised on a "finding" that it was required to avert "an imminent threat to health or safety."The SEIS makes no reference to this EA.

and selective review deprived it of the opportunity to engage in a meaningful assessment of the environmental impacts of Millstone's complete operating history to inform the evaluation necessary to evaluate the full scope of future effects during a potential period of license extension.

At the same time, the NRC staff virtually ignored the information available to it even in the limited area it selected for review: the years 2001-2003.<sup>9</sup>

The most glaring example we may provide you of this appears as the preliminary comment we provided to you on, together with the declaration of Ernest J. Sternglass, Ph.D.<sup>10</sup> Dr. Sternglass evaluated Dominion Nuclear Connecticut, Inc.'s reports of strontium-90 levels sampled in goat milk five miles from Millstone during 2001, 2002 and 2003. Although one sample measurement reported by Northeast Utilities in 2001 was at a level nearly twice the highest level of measured strontium-90 concentration in Connecticut milk during the height of the atmospheric nuclear weapons testing in the 1960s, this fact is not reported in the SEIS nor is it analyzed, nor are the other high strontium-90 measurements in goat milk sampled five miles downwind from Millstone analyzed.<sup>11</sup>

We perceive a determined lack of dedication by the NRC staff to genuinely understand the full scope of environmental - including human health - impacts of continued operations of Millstone. Documents which we provided to the NRC have apparently been destroyed.<sup>12</sup> Comments made in relicensing proceedings attended by the SEIS staff and documents submitted in such proceedings were ignored or disregarded by the SEIS staff.<sup>13</sup>

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<sup>9</sup> Webster's Dictionary defines misfeasance as "the performance of a lawful action in an illegal or improper manner."

<sup>10</sup> Refer to the Coalition's March 2, 2005 submission and attachments thereto.

<sup>11</sup> Webster's Dictionary defines malfeasance as "wrongful conduct, especially by a public official."

<sup>12</sup> See Response of Richard L. Emch, Jr. to the Coalition's February 5, 2005 queries, Paragraph 7 (attached); Documents responsive to this request were presented to the NRC by the Coalition as attachments to the Affidavit of Cynthia M. Besade dated August 5, 2005.

<sup>13</sup> See Transcript of January 11, 2005 public informational meeting sponsored by the NRC's SEIS staff at the Waterford CT Town Hall.

We continue to be troubled by the fact that documents produced by the SEIS staff in response to our queries about the SEIS submitted to the SEIS staff on January 23, 2005 were withheld by the NRC's own Freedom of Information staff and have yet to be released.<sup>14</sup>

Similarly, we are astonished that the NRC staff most involved with the SEIS declined our invitation to attend the press conference we gave on the Niantic Bay shoreline 1.5 miles from Millstone on March 10, 2005. At our press conference, we introduced Zachary M. Hartley, a 7-year-old boy born with a rare cancer in his jawbone.<sup>15</sup> During critical months of her pregnancy, Zachary's mother swam regularly and unknowingly in the nuclear "mixing zone"<sup>16</sup> which is known locally as the Hole-in-the-Wall Beach. We invited the entire NRC to attend the press conference and address questions to our expert, Dr. Helen Caldicott, world-renowned pediatrician, co-founder of Physicians for Social Responsibility and a leading authority on the health effects of low-level ionizing radiation such as is routinely emitted by Millstone. Zachary's medical records were available for NRC review. Not a single representative of the NRC appeared, not even one of the resident inspectors assigned to Millstone. Dr. Caldicott linked young Zachary's rare jawbone cancer to Millstone's radiological and toxic chemical emissions as being the likely causative agent. Dr. Caldicott acknowledged that, while there cannot be a 100-percent certainty that Millstone caused Zachary's medical condition, cesium-137 which Northeast Utilities found in a fish in the same nuclear "mixing zone" in 1997 – the year of Zachary's mother's pregnancy – and which contamination it admitted was discharged by Millstone, is known to be associated with cancer, including cancer of the bone. We are transcribing Dr. Caldicott's comments and will provide the NRC with a copy as soon as the transcription is available.

In light of the facts which have come light regarding Zachary M. Hartley, the Coalition has requested that the Connecticut General Assembly's Public Health and Environment Committees convene a special public

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<sup>14</sup> The Coalition will address this issue in a subsequent filing.

<sup>15</sup> Press clippings from the Hartford Courant, Norwich Bulletin and The New London Day are attached.

<sup>16</sup> See SEIS at 4.1.3.

hearing to consider our request to close the Niantic shoreline beaches.<sup>17</sup> We understand that the legislature may find it necessary, in order to adequately protect the public health and safety, to enact legislation to close Millstone forthwith. Governor M. Jodi Rell has referred our request to the Commissioner of Public Health; we are asking him to exercise his authority to close the Niantic beaches as a health hazard. We further anticipate that the Connecticut DEP will order that Millstone convert from its once-through cooling system to a closed cooling system, thereby virtually eliminating the discharge of radioactive and toxic chemical contaminants to the Niantic and Waterford shorelines. The SEIS does not address the prospect that Millstone will undergo a major refurbishment in the conversion from the once-through to a closed cooling system. This is a major omission in the SEIS.

We recognize that the events in question in Zachary's life arose in 1997, prior to Dominion's takeover of Millstone in 2001. However, Zachary's sickness is a factor which must be considered in the operational history of Millstone. Under Dominion ownership, Millstone has continued to release the same radioactive and toxic chemical waste byproducts as NU before.

Indeed, Dominion is currently seeking permission from CTDEP to add **new chemicals** to the "mixing zone" and continue the routine discharge of others. Nowhere in the SEIS is it stated that the NRC staff reviewed Dominion's application for renewal of the NPDES permit. Nowhere are these facts assessed in the SEIS.

The SEIS fails to meaningfully consider the routine environmental impacts of Millstone's radiological releases, relying on the "conclusion" in the NRC's Generic Environmental Impact Statement that all the nation's nuclear power plants release radiation within levels permitted under the NRC's regulations and therefore may be expected to continue to do so in the future. These conclusions do not apply to Millstone. See discussion at infra.

Even NRC's Generic Environmental Impact Statement ("GEIS") states that **cesium-137 – for one – may be expected to bioaccumulate such**

<sup>17</sup> See Coalition letter to Connecticut General Assembly Public Health and Environment Committees dated March 4, 2005, attached.

that its buildup in the environment will increase by 35 per cent during the postulated renewal period at each of the nation's nuclear power plants undergoing relicensing.<sup>18</sup>

GEIS section 4.6.1.1 states in part as follows:

To determine whether the added period of operation following license renewal would, by virtue of buildup, result in significant (double) added dose, the ratios of buildup factors for midlives of 30 to midlives of 20 years were evaluated. **These ratios amount to a 35 per cent increase for Cesium-137 and a 6 per cent increase for cobalt-60.**

**In certain cases, the bioaccumulation factors may require reexamination. These principally involve fish (in the human food chain) that are bottom feeders. Bottom feeders may ingest worms and other biota that may remobilize radioactive materials accumulated in the sediments.**

**Accumulation of radioactive materials in the environment is of concern not only to license renewal but also to operation under present licenses.**

(Emphasis added.)

This reference is entirely omitted from consideration in the SEIS. The SEIS omits any analysis of the predicted buildup of cesium-137 or cobalt-60 or any other radionuclides in the environment surrounding Millstone. To the extent that cesium-137 released to the environment will have enhanced effects, the NRC's staff's failure to assess the impact to the health and safety of the community – including Niantic Bay beachgoers who may be pregnant - borders on reckless endangerment.

It is known that cobalt-60 released by Millstone bioaccumulates in the sediment of Jordan Cove and is therefore subject to being ingested by worms and thereby enter the food chain.<sup>19</sup> Yet, the SEIS fails to "re-examine" this phenomenon – and the potential for bioaccumulation of other

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<sup>18</sup> GEIS 4.6.1.1.

<sup>19</sup> See [citation to follow]

radionuclides in the environment surrounding Millstone - consistent with GEIS section 4.6.1.1.

Nor does the SEIS examine the quality of environmental stewardship exercised by Dominion in its other corporate activities.

We suggest you review the October 2003 report by Public Citizen, "Dominion Resources, Inc.; A Public Citizen Corporate Profile." <sup>20</sup> Public Citizen reports that "[I]n April 2003, Dominion's VEPCO agreed to a \$1.2 billion enforcement settlement with the US Department of Justice and the US Environmental Protection Agency for violations of the Clean Air Act." (Emphasis added.)

The report further states that Dominion's VEPCO failed to install pollution control equipment at its coal-fired Mount Storm Power Plant in West Virginia after it made significant modifications that increased power-generating capacity. This was a violation of the Clean Air Act and, "according to the EPA, resulted in the release of 'massive amounts' of sulfur dioxide, nitrogen oxide, and particulate matter."

Dominion's Dominion Energy, owner of the Brayton Point Power Station in Massachusetts, releases 240 pounds of toxic mercury annually from that facility – enough to poison 120 million pounds of fish part of the Dominion network of companies, according to the Providence (RI) Journal of March 11, 2005.<sup>21</sup> Eating mercury in fish and shellfish presents a danger to children and pregnant mothers by harming developing nervous systems. Dominion Energy has been served with a notice of intent to sue by the Conservation Law Foundation, according to the newspaper report.

According to the SEIS, four states and all or parts of 15 counties fall within the 50-mile radius of Millstone (eight in Connecticut, four in Rhode Island, two in Massachusetts and one in New York). An estimated 2,868,207 people live within this area. This equates to a population density of 219 persons/square kilometer or 567 persons per square mile. In the GEIS matrix of rank of sparseness (Category 4) and proximity (Category 4) result in the conclusion that Millstone is located in a high-population area.

<sup>20</sup> A copy of the report is attached.

<sup>21</sup> See "Conservation Group Sues Brayton Point" (Providence Journal, March 11, 2005), attached.

Moreover, the population within a 10-mile radius of Millstone increases seasonally as a result of an influx of approximately 10,500 summer residents. The SEIS contains no figures of the seasonal influx of visitors to the eastern end of Long Island although it is within the 50-mile radius of Millstone.

**In conclusion, it is clear that the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be beyond “unreasonable” – license renewal for Millstone is a license to kill.**

**This conclusion is unassailable when the full scope of available information about Millstone’s environmental impacts is properly considered.**

### **Detailed Comments**

#### **GEIS Is Inapplicable to the Millstone EIS**

The Millstone Draft Environmental Impact Statement analysis largely avoids the **primary issue** presented by the prospect of relicensing Millstone Units 2 and 3 for additional 20-year terms: the effects of routine releases of radiological and toxic chemical releases to human health and the environment surrounding the nuclear facility.

The troubled nuclear industry knew that if the truth about the radiological impacts of nuclear power plant operations could be addressed in relicensing proceedings, no community in American would accept the prospect to hosting a nuclear power plant beyond its initial 40-year licensing term. The GEIS is a fiction contrived by the nuclear industry and adopted by the NRC to deny the public an opportunity to challenge relicensing of nuclear power plants based on radiological impacts to human health and the environment.

The NRC’s Generic Environmental Impact Statement (“GEIS”) was published in the year 1996, or nine (9) years prior to the NRC’s invitation for public comment on the SEIS, at a time when Unit 2 had operated for 26 years, Unit 1 for 21 and Unit 3 for 10 years. Necessarily, when the GEIS

refers to "current levels" of radiation, it is referring to radiation levels which were "current" in 1996 or earlier. The GEIS is not itself current, but is outdated and fails to account for the past nine (9) years of operations within the U.S. nuclear industry.

The GEIS itself is obsolete. Although the NRC staff states in the SEIS it was not required to consider site-specific aspects of Millstone's routine radiological emissions because Millstone site-specific routine radiological emissions were considered in the GEIS at Appendix E, GEIS Appendix E is limited to "routine" radiological emissions during the years 1985-1987. No explanation is given why a report published by the NRC in 1996 relies on 10-year-old data, when its purpose is to project radiation levels five decades into the future. At best, GEIS's radiological analysis of "routine" Millstone radiological emissions is incomplete and superficial.

More significantly, the GEIS fails to account for any of the following facts and circumstances – routine and extraordinary – which have occurred at Millstone since 1996, including the following:

1. The NRC placed the entire Millstone Nuclear Power Station on its "Watch List" and ordered an unprecedented three-reactor two-year shutdown in 1996 because of national media exposure of wilful, systemic disregard for safety standards and licensing requirements; Unit 1 never restarted, Unit 3 restarted in 1996 and Unit 3 restarted in 1999;
2. In 1996, after workers in the site maintenance department at Millstone were diagnosed with brain cancers and Northeast Utilities dismissed the entire department – after securing releases the workers would not sue Northeast Utilities if the company paid them double severance pay – and hired transient contract workers to perform hot and dirty tasks within the plant, two of the workers died untimely deaths due to their brain cancers.
3. On December 16, 1997, Zachary M. Hartley was born with a rare jawbone cancer which required major life-threatening surgery. His mother swam regularly in the nuclear/chemical "mixing zone" otherwise known as the Hole-in-the-Wall Beach on the Niantic Bay shoreline during critical months of her pregnancy with Zachary.
4. In 1997, Northeast Utilities caught a fish contaminated with cesium-137, a deadly carcinogen, it admitted releasing into Niantic Bay, in

the nuclear/chemical “mixing zone” which stretches from the Millstone discharge point to the Niantic Bay shoreline, a popular summer destination for families with young children.

5. On or before 1997, Millstone dispensed with its measurement of strontium-90 in quarterly composited air particulate filters, relying instead on infrequent sampling of goat milk in the community to determine whether its strontium-90 emissions reached harmful levels *after-the-fact*.
6. In September 1999, Northeast Utilities, predecessor to Dominion, pleaded guilty to committing environmental felonies including falsifying environmental monitoring records and releasing hydrazine, a carcinogen, illegally into the Long Island Sound.<sup>22</sup>
7. A Connecticut Superior Court judge enjoined the restart of Millstone Unit 2 in 1999 because he was persuaded that the health and stability of the indigenous Niantic winter flounder stocks were endangered by operations of the Millstone intake structures through entrainment and impingement. Fish Unlimited v. Northeast Utilities.
8. In 2000, two commercial fishermen sued Northeast Utilities for tortiously causing the collapse of the formerly commercially viable Niantic winter flounder fishing stocks; their suit remains pending.
9. In 2000, Northeast Utilities acknowledged that – even under daily supervision by onsite inspectors of the NRC – it had lost two highly radioactive spent fuel rods from the Unit 1 spent fuel pool.
10. In 2000, the Connecticut Department of Public Utility Control (“DPUC”) oversaw a “public auction” by Northeast Utilities to sell the Millstone Nuclear Power Station; the public was excluded from the “public auction”; virtually all key “public auction” documents were redacted and ordered sealed by the DPUC; over public protest, and despite the Coalition’s disclosure that Dominion had the worst safety record in the nuclear industry including the deaths of seven nuclear workers at its nuclear facilities in Virginia, the DPUC approved the sale of Millstone to Dominion Nuclear Connecticut, Inc., (“DNC”) at the time a paper entity with no assets with only a post office box in Niantic, Connecticut; when the Connecticut Coalition Against Millstone obtained a Superior Court hearing date for a judge to consider its challenge to the rigged sale and the prospective transfer of expired environmental permits to DNC, lawyers for Northeast

<sup>22</sup> See “Owner of Connecticut Nuclear Plant Accepts a Record Fine” (New York Times September 28, 1999), attached.

Utilities and DNC met *ex parte* with Superior Court Chief Administrative Judge John J. Langenbach and obtained an order suspending the hearing so the sale could proceed without court review; when the matter was brought to the Connecticut Supreme Court, Justice Christine Vertefeuille, beneficiary of a Northeast Utilities 401K plan, recused herself; Connecticut Attorney General Richard S. Blumenthal, although entitled to automatic party status in the DPUC proceedings, declined participation. So occurred the "public auction" of Connecticut's worst polluter.

11. In April 2001, Connecticut's Commissioner of Environmental Protection, Arthur J. Rocque, Jr., "transferred" an expired NPDES (National Pollution Discharge Elimination System) permit (it had expired four years earlier) and "emergency authorizations" (which he admitted in writing he lacked legal authority to issue) to "Dominion Nuclear Connecticut, Inc.," at that time a paper company with a post office box in Niantic but no assets. Dominion has been operating under the authority of the expired permit for four years and DEP has not renewed the permit in the intervening time.
12. In 2001, Dominion reported concentration levels of strontium-90 contamination in goat milk sampled within five (5) miles downwind of the Millstone Nuclear Power Station nearly twice as high as the highest recording measurement of strontium-90 concentrations in Connecticut milk during the height of the 1960s atmospheric nuclear weapons testing.
13. In 2001, terrorists who had targeted nuclear power plants hijacked a passenger jet and flew over the Indian Point Nuclear Power Plant 29 miles of New York City before slamming into the World Trade Center. The U.S. Department of Homeland Security, subsequently created, designated the Millstone Nuclear Power Plant a terrorist's target of choice.
14. In 2004, Connecticut State Senator Melodie Peters, Chairman of the powerful Energy and Technology Committee, took a paying job with Dominion in public relations to advocate for Millstone relicensing, without giving up her legislative commitments.
11. On August 16, 2003, Joseph H. Besade became the seventh known pipefitter to die prematurely from workplace exposures at Millstone.
15. On August 5, 2004, Cynthia M. Besade reported to the NRC in an affidavit her personal knowledge of some 67 cancers in persons

known directly or indirectly to her, all living within or close to the five-mile radius surrounding Millstone, including childhood cancers and the case of a 17-year-old Waterford high school student diagnosed with ovarian cancer; from one street alone – Seabreeze Drive, north-northeast and less than two miles downwind of Millstone – seven (7) cases of cancer were reported.

16. On August 5, 2004, Richard Heaton drove seven (7) hours from the University of Pennsylvania Medical Center to New London to participate in a press conference and proceeding before the NRC to share the facts of his daughter's rare thyroid cancer which developed following her exposure to Millstone effluents at age 10.
17. In 2004, Dominion rejected the U.S. Department of Homeland Security's offer of a free security enhancement to protect the three Millstone intake structures from terrorist attack.<sup>23</sup>
18. In February 2005, the Coalition discovered that Zachary M. Hartley's rare jawbone cancer, believed caused by his mother's *in utero* exposure to Millstone radiological and chemical effluents in the nuclear/chemical "mixing zone" in 1997, was knowingly excluded from listing in the State of Connecticut's Tumor Registry because part of the orange-size cancerous tumor removed from Zachary's mouth in life-saving surgery was determined to be benign.
19. On March 10, 2005, Dr. Helen Caldicott, world-renowned pediatrician, authority on the health effects of low-level ionizing radiation and co-founder of Physicians for Social Responsibility, declared the likelihood that 7-year-old Zachary M. Hartley's rare jawbone cancer was caused by his mother's exposure to Millstone's radiological and chemical effluents.

Moreover, Millstone is unique in the annals of the U.S. nuclear industry: Millstone has released the highest levels of radionuclides of any nuclear power station in the country at various times over the past 35 years of its operational history.

From 1970 to 1987, Millstone had released a total reported release of 32 curies of radioactive iodine and particulates into the air, which included the highly carcinogenic strontium-90 and iodine-131, together with 6.7 million curies of total fission and activation gases such as xenon and

<sup>23</sup> See "Millstone Owner Turned Down Free Homeland Security Device" (The New London Day, March 9, 2005)

krypton. During the same period, Millstone released 581 curies or 581 trillion picoCuries of radiation in the highest liquid volume of such releases of mixed fission and activation products of any nuclear plant in the United States.<sup>24</sup>

In a single year, 1975, Millstone released a record reported high of 9.99 curies of iodine and particulates into the air and 199 curies of liquid mixed fission and activation products into the Long Island Sound, also a record for all U.S. reactors.<sup>25</sup> *Id.*

While the strontium-90 concentration in milk declined for the United States as a whole between 1970 and 1975, from 8 pCi/l to 3 pCi/l, it rose from 9.8 in 1970 to a high of 15.8 in 1973 and 14.8 in 1974 near Millstone, remaining at 10.7 by 1975. This is far in excess of the U.S. average of 3 pCi/l, ruling out any significant contribution to the local milk from bomb test fallout by France and China that continued until 1980.<sup>26</sup>

The calculated yearly radiation dose to bone of a child due to excess strontium-90 within 10 to 15 miles of Millstone, in excess of the yearly dose for the United States, rose from 33 millirem per year in the first full year of operation to 204 millirem per year by 1974, nearly three times the normal background level of 70 millirems per year in Connecticut.<sup>27</sup>

These doses of strontium-90 alone may be compared with the 15 millirem per year to any organ permitted under current NRC regulations, the 2 millirem produced to bone marrow in a typical X-ray of a child, and the 80 millirem per year to a developing fetus found to produce a doubling of the rate of childhood leukemia in the studies of the renowned Dr. Alice Stewart.<sup>28</sup>

Given all these facts and circumstances, the application of a "Generic

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<sup>24</sup> See Declaration of Ernest J. Sternglass, Ph.D., In the Matter of Dominion Nuclear Connecticut, Inc., Docket No. 50-336-LR, 50-423-LR, ASLBP No. 04-824-01-LR (August 8, 2004)

<sup>25</sup> *Id.*

<sup>26</sup> *Id.*

<sup>27</sup> *Id.*

<sup>28</sup> *Id.*

Environmental Impact Statement" to Millstone, thereby precluding site-specific analysis in the Environmental Impact Statement, is so deeply flawed as to be fraudulent.

The Coalition and others have provided "new and significant" information which compels the NRC to conduct a site-specific analysis of the environmental impacts of relicensing Millstone Units 2 and 3. See discussion at pages 32 *et seq. infra*.

At the very least, the NRC should be required to evaluate the environmental impact of Millstone's radiological and chemical effluents – singly, in synergy and cumulatively - under site-specific analysis to qualify under the standards of the National Environmental Policy Act.

#### **2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls**

In this section, the SEIS describes the liquid, gaseous and solid waste management systems presently in place to collect and treat the radioactive materials which are produced as a by-product of the nuclear plant operations.

The SEIS states as follows:

Radioactive material produced from fission of uranium-235 and neutron activation of metals in the reactor coolant system is the primary source of liquid, gaseous and solid waste. The radioactive fission products build up within the fuel. Most of these fission products are contained in the fuel pellets and sealed fuel rods, but small quantities escape from the fuel rods into the reactor coolant. Neutron activation of trace concentrations of metals entrained in reactor coolant such as zirconium, iron and cobalt creates radioactive isotopes of these metals. Both fission and activation products in liquid and gaseous forms are continuously removed from reactor coolant and captured on several different types of filter media. Units 2 and 3 operate separate liquid and gaseous processing systems. Gaseous discharges for each unit are monitored separately before they are discharged to the stack or to other designated release points for each unit. All liquid discharges are directed to a canal which terminates in the old quarry

and the quarry discharges to Long Island Sound.

Despite these comments, it is clear that station monitoring of radioactive effluents is presently inadequate and incomplete and that some radionuclides are released into the environment without measurement or documentation.

For example, In 1997, Northeast Utilities reported in its Annual Radiological Environmental Operating Report as follows:

**Section 4.5 Air Particulate Strontium (Table 5)**

Table 5 in past years was used to report the measurement of Sr-89 and Sr-90 in quarterly composited air particulate filters. **These measurements are not required by the Radiological Effluent Monitoring Manual (REMM) and have been discontinued.**

Previous data has shown the lack of detectable station activity in this media. This fact, and the fact that milk samples are a much more sensitive indicator of fission product existence in the environment, prompted the decision for discontinuation. In the event of widespread plant related contamination or special events such as the Chernobyl incident, these measurements may be made.”

As Dr. Sternglass has pointed out,<sup>29</sup> in 2001, Dominion recorded concentrations of strontium-90 in goat milk sampled five miles from Millstone at a level nearly twice that of the highest recorded concentration of strontium-90 in milk in Connecticut during the peak of atmospheric atomic bomb testing in the 1960s.

In 1997 alone, there were numerous reported incidences of station radiation monitors being inoperable:

Unit 1 Liquid Radwaste Effluent Monitor (inoperable 6/7/96 – 3/25/97 – 83 days in 1997, 291 days total)

Unit 1 Service Water Effluent Monitor (inoperable 6/9/96 – 7/18/97 – 198 days in 1997, 404 days total)

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<sup>29</sup> See Coalition's March 2, 2005 filing to the NRC.

Unit 2 Steam Generator Blowdown Monitor (inoperable 2/22/96 – 8/26/97 – 237 days in 1997, 551 days total)(NU claims no discharges were made during this period)

Unit 2 Clean Waste Monitor Tank Radiation Monitor (inoperable 5/25/97 – 7/1/97 – 37 days)(NU claims no discharges were made during this period)

Even the GEIS acknowledges that some airborne radioactive effluent releases are not monitored, recorded or documented.

Within the entire body of radioactive airborne effluents released by Millstone over the course of its 35-year operational life, the SEIS only specifically considers those reported by Dominion in 2002 as follows:

Unit 2: Total fission and activation gas activity released 128 Curies  
Iodine-131  $4.90 \times 10^{-3}$  Curies  
Particulates  $1.22 \times 10^{-5}$  Curies  
Tritium 31.2 Curies

Unit 3: Total; fission and activation gas activity released 2.45 Curies  
Iodine-131  $1.52 \times 10^{-6}$  Curies  
Particulates  $6.08 \times 10^{-5}$  Curies  
Tritium 47.3 Curies

These figures do not break down the radioisotopes released, other than for Iodine-131 and Tritium, and do not identify nor quantify which radioactive gases are emitted, such as xenon-137 (with a half-life of 3.9 minutes decaying to cesium-137 with a half-life of 30 years); xenon-135 (with a half-life of 9.17 hours decaying to cesium-135 with a half-life of 3,000,000 years); nor krypton-89 (with a half-life of 3.2 minutes decaying to strontium-89 with a half-life of 52 days). These radioactive materials are long-lived and have cumulative impacts. The SEIS does not analyze these environmental impacts.

The SEIS states: "These releases from both units are typical of annual releases from Millstone and are not expected to increase during the

renewal period.”

Since the SEIS analysis was self-limited to the years 2001, 2002 and 2003, and annual releases for the 32 other years Millstone has been operating were not considered, the statement that “These releases from both units are typical of annual releases from Millstone” is not substantiated.

Moreover, the SEIS statement, that [these releases] are not expected to increase during the renewal period” is incorrect. First, releases of tritium, a known cancer-causing radioactive toxic with a half-life of 12.3 years, are trending upward.<sup>30</sup> Second, as Units 2 and 3 operate for longer periods at full capacity, airborne radioactive emissions will increase. Similarly, if during the renewal period Millstone Units 2 or 3 receive approval for power upgrades, airborne radioactive emissions will increase. The consequences of these reasonably foreseeable circumstances were not analyzed in the SEIS.

Moreover, the SEIS does not identify nor quantify strontium-90 releases, nor note the absence of strontium-90 monitoring from the station stack, while strontium-90 concentrations are regularly found to be inordinately high in goat milk taken from samples five miles from Millstone.

## 2.2.7 Radiological Impacts

In section 2.2.7, Radiological Impacts, on page 2-43, the section concludes, “The applicant does not anticipate any significant changes to the radioactive effluent releases or exposures from Millstone operations during the renewal period and, therefore, the impacts to the environment are not expected to change.”

However, in Dominion Nuclear Connecticut Millstone Station Annual Radiological Operating Report 2003, in section 4.14, Seawater, on page 4-9, it is stated, “since the restart of Unit 3 in 1998 and Unit 2 in 1999, tritium releases in liquid effluents have risen to levels at or above [emphasis added] those observed during pre-shutdown period.”

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<sup>30</sup> See discussion at page 20 infra.

Dominion records indicate that Millstone released 1854 curies of liquid radiation in 2000, an all time high. Such reported releases totaled 1273 curies in 2001, 1537 in 2002 and 1278 in 2003. NRC records for Millstone's liquid tritium releases totaled from 1970-1994 totaled 11,550 curies. The total from 1995-2003 was 8551 curies.

This trend of increasing amounts of tritium releases is dangerous because tritium has carcinogenic, mutagenic, teratogenic and transmutational properties whose effect upon the environment which have not been considered in the SEIS.<sup>31</sup>

The coastline around Millstone is lined with beaches and shoreline communities, with many summer residents as well. Human activities in the area include swimming, boating, fishing, clamming, scalloping. Thus there are ample opportunities for liquid tritium contamination of people and shore and marine life.

It is undeniable that the more the pressurized water reactors of Units 2 and 3 operate, the more tritium by-products they will create and release into the environment.

The current stated policy of both Dominion and the nuclear power industry in general is to operate power reactors as close to maximum capacity as possible. In 2003 Millstone 3 operated at almost 100% capacity. Millstone 2 operated at 80% capacity, but only because it shut down for refueling.

The increasing amounts of tritium discharged into Long Island Sound means that Dominion's claim that it "does not anticipate any significant changes to radioactive releases or exposures from Millstone operations during the renewal period" is false. Therefore the NRC's conclusion that "impacts to the environment are not expected to change" is also false.

Given this history, the NRC should mandate the immediate installation of filters to mitigate liquid tritium discharges from Millstone units 2 and 3. In addition, the NRC should mandate the testing of drinking water, well

<sup>31</sup> See "The Carcinogen, Mutagenic, Teratogenic and Transmutational Effects of Tritium," Citizens Awareness Network, April 1994.

water and groundwater and in marine life in areas affected by Millstone for the presence of tritium. At present only sea water is tested for tritium.

Until these measures have been put into place and monitoring results have been made public until Millstone's current operating licenses expire, or units 2 and 3 permanently shut down, the NRC should not consider granting license extensions for Millstone units 2 and 3, in consideration of the health and safety of the public.

#### **4.1 Cooling System**

The GEIS identifies the issue of scouring caused by discharged cooling water as a Category 1 issue. As a "Category 1" issue, the NRC staff will not review it on a Millstone site-specific basis in the absence of "new and significant information."

The SEIS states the NRC staff "has not identified any significant new information during its independent review of the Dominion ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information."

Yet, scouring caused by discharged cooling water was identified by a technician in the Millstone Environmental Laboratory as an irreversible environmental impact during a recent public presentation on Dominion's environmental impacts presented at the Three Rivers Community College.

Accordingly, the NRC staff should request Dominion to release details to it of this "new and significant information."

##### **4.1.1 Entrainment of Fish and Shellfish in Early Life Stages**

Entrainment of winter flounder larvae at the Millstone intakes is a major issue and it is one which has been the subject of much litigation in the Connecticut courts. Lawsuits have been brought by local fishermen complaining that Millstone intake structures have driven the indigenous Niantic winter flounder population to near-extinction. The fishermen have successfully resisted dilatory and repetitive motions on the part of Dominion and Northeast Utilities to

dismiss their claims.

The SEIS states:

“The staff independently reviewed the Millstone Units 2 and 3 ER [Environmental Report], visited the site, and reviewed the applicant’s NPDES permit. The staff also reviewed relevant scientific articles and agency documents (CTDEP) and NOAA (National Oceanic and Atmospheric Administration) Fisheries (also known as National Marine Fisheries Service [NMFS]), interviewed agency staff, and interviewed a faculty member at the University of Connecticut who has conducted research on entrainment at Millstone.” [Crivello 2003]

Astonishingly, the NRC staff does not report any attempt to consult with the **fishermen** who are targeted in the SEIS for the demise of the Niantic winter flounder population. Had the NRC staff attempted to locate commercial fishermen who fish for Niantic winter flounder near Millstone, it would have learned that the resource has vanished and, with it, the fishermen and a way of life.

Nor, apparently, did the NRC staff make any effort to consult with the experts who have testified in court proceedings to the overwhelming evidence that the suction action of the Millstone intake structures is the predominant cause of the collapse of the Niantic winter flounder population and has been since 1986, when Millstone Unit 3 went online.

Northeast Utilities obtained operating licenses for Millstone in the 1970s based on projections – possibly knowingly bogus – that the Millstone intake structures would have a far less devastating effect on the Niantic winter flounder larvae than has in fact occurred.

Although NRC staff spoke with Prof. Crivello of the University of Connecticut, who has studied Millstone entrainment, the staff does not explicitly identify Prof. Crivello as a paid consultant to Millstone’s owners and operators each time his name appears in the SEIS.

Why did the NRC staff not meet with DEP’s Victor Crecco, author of reports debunking Dominion’s theorizing about the Millstone impacts on the Niantic winter flounder collapse?

The SEIS analysis of the collapse of the indigenous fishing stocks does not mention the discovery of a fish caught in Niantic Bay in 1997 contaminated with cesium-137 – nor Northeast Utilities' acknowledgment that the cesium-137 originated in its nuclear operations.<sup>32</sup>

The SEIS analysis does not mention the build-up of cobalt-60 in Jordan Cove near the Millstone discharge point<sup>33</sup> nor does the SEIS analyze the contribution of cobalt-60 buildup in sediment as a contributing factor in the collapse of the population of the bottom-feeding Niantic winter flounder.

Attributing the collapse of the fishing stocks to elevated water temperatures, the SEIS fails to consider the contribution of Millstone's 24-hour-a-day, seven-day-a-week thermal discharges to the Long Island Sound.

While the SEIS reports that "[T]he CTDEP [Division of Marine Fisheries which has been analyzing this issue for nearly a decade] believes that Millstone is having a significant impact due to entrainment of winter flounder larvae," the SEIS relies on NOAA and NMFS reports – which contain no data of the unique conditions at Niantic Bay but are devoted to a broad, regional analysis of fishing stocks - to discredit CTDEP Division of Marine Fisheries, as follows:

Regulatory agencies concerned with the management of winter flounder have concluded that the resource is overfished and overexploited (NOAA 1998; NMFS 2003) and have instituted measures to reduce fishing pressure throughout Long Island Sound and the southern New England-middle-Atlantic region. Thus, there is ample evidence to suggest that fishing pressure is directly contributing to the decline **both local and regional levels** at and may represent the major impact to this resource. The extent to which Dominion contributes to or exacerbates the problem in the Niantic River system is not elucidated by fish population studies reviewed in

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<sup>32</sup> See Northeast Utilities 1997 Annual Radiological Environmental Operating Report at Section 4.17.2 ("Cs-137 was detected in one sample from the Niantic Bay (location 35). Positive indications are seldom seen in this media outside of the immediate discharge vicinity.")

<sup>33</sup> See [citation to follow]

this SEIS.” [Emphasis added.]

As stated, the SEIS does not identify either a NOAA or NFSS study specific to the Niantic River winter flounder nor the recent fishing habits of commercial fishermen in the area; thus, its failure to accord credit to the CTDEP for its insights appears to be result-driven, to obscure and downplay the fact that the Millstone Nuclear Power State has been the primary factor in driving indigenous fishing stocks to collapse. Or, as Rhode Island expert on Niantic winter flounder, Mark Gibson – a witness whose testimony aided Connecticut Superior Court Judge Robert Hale in issuing a temporary restraining order keeping Millstone Unit 2 shut down during the 1999 spawning season to avoid harmful entrainment effects to the fish population – has stated, Millstone is the worst predator of fish in the Northeast.

The SEIS concludes:

The staff’s evaluation of past impacts of entrainment on Niantic River winter flounder is inconclusive because unresolved questions remain about population dynamics, life history, and unknown factors that may be impacting the population. The available data do not allow us to unequivocally link or decouple population declines with Millstone operations . . . Because the spawning adult population is very low, and in consideration of the 20-year license renewal period, the staff’s conclusion is that the impacts would be moderate.

The Coalition has reference to Figure 2-6 (“Comparison of Winter Flounder Population Trends in Niantic River and Long Island Sound”).<sup>34</sup> This figure illustrates clearly that while the winter flounder fishing stocks in the region are rebounding – perhaps due in part to fishing restrictions that apply throughout the region – the Niantic River winter flounder population continues its collapse.

The facts available to the NRC staff demonstrate that the sole factor which has prevented the Niantic River winter flounder population from enjoying a rebound as has the species elsewhere in the region due to tightened fishing restrictions is the most obvious one: the Millstone Nuclear

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<sup>34</sup> Draft NUREG-1437, Supplement 22, 2-26 (December 2004)

Power Station.

It is submitted that if the SEIS staff had pondered the ramifications of Figure 2-6 in consultation with the Niantic fishermen who have gone out of business and the fishermen's expert witnesses and CTDEP's marine biologist Victor Crecco, in light of all the facts and circumstances, the NRC staff would have been compelled to categorize the impact to Niantic winter flounder from continued operations of Millstone in a license renewal period to be "major" and devastating and probably irreversible.

The weight of credible evidence is that the operations of the Millstone Nuclear Power Station have driven the winter flounder to virtual extinction, a phenomenon not contemplated in the original Millstone environmental impact statement. Future entrainment during the license renewal period will definitely assure that the once-abundant, commercially important resource will never return.

#### **4.1.2.1 Impingement Monitoring**

#### **4.1.2.2. Impingement Mortality**

At the request of Northeast Utilities, CT DEP permitted routine impingement monitoring for Unit 2 to cease in December 1987. Unit 2 did not have a fish return and all impinged marine organisms were presumed lost. Routine impingement monitoring has never been conducted for Unit 3.

The most recent data for Unit 2 involves sampling collected biweekly from July 2000 to June 2001. It is questionable whether the Unit 2 fish return was in operation during such period.<sup>35</sup> Data for Unit 3 involve samplings collected biweekly from January to December 1993.

These samplings do not suffice in frequency to form a data base to support conclusions about impingement during the 35-year operations of Millstone, nor to provide an adequate basis for extrapolation to the future.

Thus, the SEIS statement:

Based on the assessment to date, the staff expects that the

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<sup>35</sup> Report of a commercial lobsterman to the Coalition.

measures in place at Millstone Units 2 and 3 (i.e., aquatic organism return systems) provide mitigation for impacts related to impingement, and no new mitigation measures are warranted.

is not supported by genuine evidence.

#### **4.1.3 Heat Shock**

The SEIS states:

Millstone has remained in compliance with the NPDES thermal and discharge volume limits at the quarry cut. [SEIS at page 4-28]

Yet, the SEIS report is absent any indicia of an independent basis from which to render such a conclusion.

The SEIS states:

The [NRC] staff also independently reviewed monitoring reports for the cooling-water discharge mixing zone. . . .the boundary of the mixing zone cannot exceed a radius of 2438 m (8000 ft) from discharge outlet at the quarry cut.

The SEIS report does not identify a single monitoring report by date or otherwise; any conclusions regarding the cooling-water discharge mixing zone are utterly unsubstantiated.

#### **4.3 Radiological Impacts of Normal Operations**

The NRC SEIS staff review of Millstone data on the most critical issue of "radiological impacts of normal operations" was self-limited to the years 2001, 2002 and 2003.

The NRC GEIS staff review of Millstone data on the most critical issue of "radiological impacts of normal operations" was self-limited to the years 1985, 1986 and 1987.<sup>36</sup>

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<sup>36</sup> See GEISS Appendix E.19

Thus, in its consideration of whether the Millstone Nuclear Power Station should be permitted to operate in the years 2015-2025 (Unit 2) and 2025-2045 (Unit 3), the NRC deliberately failed to consider the "radiological impacts of normal operations" for the years 1970-1984, 1988-2000 and 2004 to the present.

Put another way, the NRC considered Millstone's "radiological impacts of normal operations" for only 6 of the 35 years the Millstone nuclear reactors have been routinely releasing harmful radiation into the environment – just 17 per cent of Millstone's operational history. Twenty-nine (29) years of Millstone's routine releases of harmful radiation releases to the environment are not evaluated in either the GEIS or the SEIS.

By limiting the pool of data considered in the GEIS and the SEIS to a period of time which encompasses only 17 per cent of Millstone's operational history of harmful radiation releases to the environment, the NRC failed to consider all available information. The NRC's evaluation of future impacts based on past impacts rests of an inadequate data base and its conclusions are accordingly unreliable, if not invalid. Certainly, the NRC staff's consideration of "cumulative" impacts (SEIS section 4.8.3) is scientifically unsound if not indeed scientifically fraudulent, since the NRC staff did not review, tabulate or assess the full scope of past impacts to be able to "accumulate" cumulate impacts..

On its website, [www.nrc.gov/who-we-are/values.html](http://www.nrc.gov/who-we-are/values.html), the NRC states that it "adheres" to "Principles of Good Regulation" which include the following:

Independence: . . . Final decisions must be based on objective, unbiased assessments of all information, and must be documented with reasons explicitly stated."

The SEIS and GEIS systematically exclude all available information concerning Millstone's radiological effluents for the years 1970-1985, 1988-2000 and 2004 to the present. No reason for such exclusion is explicitly stated.

The GEIS addresses radiological impacts of "normal" operations of nuclear power plants during a projected renewal period as follows:

Radiation exposures to public (license renewal term):

GEIS: "Radiation doses to the public will continue at current levels associated with normal operations." (GEIS 4.6.2)

Occupational radiation exposures (license renewal term):

GEIS: "Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

The GEIS categorizes the issue of "radiological impacts of normal operations" as a Category 1 issue, meaning that the SEIS reviewing staff need not consider site-specific issues at all in the absence of "new and significant information."

The Coalition believes that "radiological impacts of normal operations" must be considered on a site-specific basis with regard to Millstone Units 2 and 3 as a Category 2 issue. See discussion at page 32 *et seq. infra*. Because the SEIS did not consider the issue as a Category 2 issue, the SEIS is deeply flawed and inadequate and falls far short of meeting the NRC's "Principles of Good Regulation."

Finally, as stated, the SEIS states that the NRC staff is not required to evaluate Millstone radiation releases on a site-specific basis because Millstone releases were subjected to site-specific analysis in the GEIS which found them to be "well within regulatory limits." This statement is most misleading in that it fails to acknowledge that the NRC GEIS staff limited itself to reviewing Millstone's reported radiological emissions for the years 1985, 1986 and 1987 only.<sup>37</sup> Millstone's largest reactor, the 1,220-megaWatt Unit 3 – was still under construction in 1985. By the year 1987, it had not established an operational record; it has since substantially increased output and, hence, "routine" radiological emissions.

GEIS Section 4.6 ("Radiological Impacts of Normal Operation")

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<sup>37</sup> See GEIS, Table E19.

provides in pertinent part as follows:

This section provides an evaluation of the radiological impacts on occupational personnel and members of the public during normal operation following license renewal. This evaluation extends to all 118 nuclear power reactors. Radiation exposures occurring after license renewal are projected based on present levels of exposures. Estimates of additional maintenance, testing and inspections as a result of a variety of age-related changes in operational procedures were made based on the anticipated changes to current operation and are detailed in Section 2.6 and Appendix B. Added maintenance, testing, and inspection will be accompanied by increased exposure time to members of the work force but are not expected to significantly influence dose to members of the public.

As noted,<sup>38</sup> the GEIS was published in 1996. Hence the above statement, "Radiation exposures occurring after license renewal are projected based on present levels of exposures," must be read with regard to 1996-or-earlier levels of exposure, rather than actual "current" exposures. However, the NRC SEIS staff limited its review to 2001-2003 data, rather than actual "current" exposures. As also noted, the NRC GEIS staff only reviewed Millstone's 1985-1987 exposure data.

With regard to the above statement:

Estimates of additional maintenance, testing and inspections as a result of a variety of age-related changes in operational procedures were made based on the anticipated changes to current operation and are detailed in Section 2.6 and Appendix B.

the SEIS fails to identify or evaluate any "additional maintenance, testing and inspections as a result of a variety of age-related changes in operational procedures" at Millstone.

With regard to the above statement:

Added maintenance, testing, and inspection will be accompanied by

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<sup>38</sup> See discussion at page 10 supra.

increased exposure time to members of the work force but are not expected to significantly influence dose to members of the public

the SEIS fails to identify or evaluate any “added maintenance, testing, and inspection” at Millstone and hence fails to evaluate increased exposure time to members of the work force and members of the public during the proposed renewal period.

The SEIS also fails to consider the environmental impact of Dominion’s August 24, 2004 submittal to the NRC requesting approval of the “Nuclear Facility Quality Assurance Program Description.” According to an Request for Additional Information (“RAI”), dated February 24, 2005, this program deletes from the Millstone Quality Assurance program radiological protection responsibilities which include “maintaining records and reports on radioactive contamination levels.” If this application is approved, a safeguard to protect against excessive worker radiological contamination will be lost and there will be no basis for the NRC to conclude now that occupational radiation exposures during the license renewal term will be small and within regulatory limits.

The NRC SEIS staff accepted at face value Dominion’s self-assessment that it would not conduct “major” refurbishment in the future. Thus, the NRC SEIS staff considered neither “major” or “minor” refurbishments. The NRC SEIS staff’s conclusions about the radiological impacts during refurbishment are therefore necessarily flawed. Given the strong likelihood that major refurbishment in the form of a stationwide conversion from once-through cooling to closed cooling systems will be ordered by the Connecticut DEP – to avoid future exposure of pregnant women and others to harmful radioactive and toxic waste effluents in the “mixing zone” and to avoid irreversible impacts to the indigenous Niantic winter flounder – the radiological impacts from such refurbishment should have been fully explored and analyzed in the SEIS.

The NRC’s GEIS further states at section 4.6.1.1:

To determine whether the added period of operation following license renewal would, by virtue of buildup, result in significant (double) added dose, the ratios of buildup factors for midlives of 30 to midlives of 20 years were evaluated. These ratios amount to a 35 per cent

increase for Cesium-137 and a 6 per cent increase for cobalt-60. This added increase due to buildup will not significantly change the total dose to members of the public.

In certain cases, the bioaccumulation factors may require reexamination. These principally involve fish (in the human food chain) that are bottom feeders. Bottom feeders may ingest worms and other biota that may remobilize radioactive materials accumulated in the sediments.

Accumulation of radioactive materials in the environment is of concern not only to license renewal but also to operation under present licenses.

As stated,<sup>39</sup> the bioaccumulation of cobalt-60 in sediment in Jordan Cove near the Millstone discharge point has been established. The SEIS does not address this phenomenon, even though required by the GEIS.

Millstone's monitoring of the aquatic environment in the area of the discharge has also revealed the presence of the following plant-related radionuclides: cobalt-60, zinc-65, silver-110 and cesium-137.<sup>40</sup>

In 1997 and at other times, "[I]ndications of plant releases were observed" in aquatic flora, including detectable levels of cobalt-60, zinc-65 and silver-110. According to the 1997 Radiological Environmental report filed by Northeast Utilities,

The detection of these [radio]nuclides throughout the year, as witnessed by positives detected in other aquatic media, correspond to radioactive liquid discharges from the three Millstone units. Sampling of this media provides useful information because it is very sensitive to plant discharges. However, since seaweed is not consumed, other media are utilized in the determination of dose consequences (e.g., see Shellfish and Fish results)

The presence of cesium-137 in a fish caught in the "mixing zone" within the Niantic Bay – as identified as a plant-related contamination in the 1997

<sup>39</sup> See discussion at page 8 supra.

<sup>40</sup> See 1997 Annual Radiological Environmental Monitoring Program Report.

Millstone effluent report – suggests widespread bioaccumulation of that carcinogenic radioisotope within the environment, requiring a “re-examination pursuant to GEIS standards.

The “radiological impacts of normal operations” should be analyzed as a site-specific Category 2 issue.

#### **4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period**

The SEIS considers the economic contribution to the community through payment of Dominion’s workforce; however, the SEIS does not separate out the economic investment made in maintaining a workforce to monitor Unit 1, a nuclear power plant undergoing decommissioning, and its repository of spent nuclear fuel. Nor does the SEIS consider the prospect of a continuing workforce required to maintain Units 2 and 3 in the event each or both units is/are decommissioned or prematurely shut down before or during the renewal period.

The SEIS does not consider the enormous health care costs associated with the community’s long-term exposure to low-level ionizing radiation, nor worker illnesses related to their exposures. We are aware of a recent surgery, upon a patient whose cancer is fairly linked to Millstone radiological and toxic chemical emissions, which cost in excess of \$2.5 million. This does not include follow-up or lifelong care.

The SEIS is incomplete and inaccurate in its assessment of socioeconomic impacts.

#### **4.4.6 Environmental Justice**

The SEIS does not address the environmental justice issues involved in the transportation and storage of nuclear waste generate by the Millstone Nuclear Power Station, either during its 35 years of operations or in the future. Transportation through poor urban areas and storage of Millstone’s nuclear waste in poor rural communities both implicate environmental justice concerns; neither aspect was addressed in the SEIS.

#### **4.7 Evaluation of Potential New and Significant Information on Impacts of Operations During the Renewal Term**

The Connecticut Coalition Against Millstone and others have provided the SEIS staff with “new and significant information” which, once considered, dictates site-specific review as Category 2 issues or, in the alternative, rejection of the SEIS *in toto*.

The “new and significant” information may be summarized as follows:

### **Millstone causes cancer and Millstone is responsible for an increased cancer incidence in the surrounding community.**

The SEIS states that “commentators” have provided “no evidence to support a causal relationship between increased cancer incidence and Millstone operations.”

The NRC’s SEIS staff concluded that the information provided during the scoping process was not new and significant with respect to the findings of the GEIS on the health effects to the public from radiological effluent releases due to the Millstone operations.”

To the contrary: the Coalition and others have presented overwhelming and un rebutted evidence of a causal relationship between increased cancer incidence and Millstone operations.

**While these facts are “significant,” they are not “new.”**

Since practically the onset of Millstone nuclear operations, Millstone’s radiological emissions have been linked to heightened cancer incidences.<sup>41</sup>

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<sup>41</sup> See footnote 4 supra.

**This is hardly surprising.**

**Since the onset of its operations, Millstone's owners and operators have submitted reports to the NRC and the DEP detailing their radiological<sup>42</sup> and chemical<sup>43</sup> effluent emissions to the air and water.**

**Millstone routinely releases to the air and water the following radioactive materials:**

Ag  
Be-7  
Ce-144  
Co-57  
Co-58  
Co-60  
Cr-51  
Cs-134  
Cs-137  
Fe-55  
Fe-59  
I-131  
I-133  
Kr-85  
Kr-88  
La-140  
Mn-54  
Mo-99  
Na-24  
Nb-95  
Nb-97  
Ru-105  
Sb-122  
Sb-124  
Sb-125

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<sup>42</sup> See the list of radionuclides listed at pages 34-35.

<sup>43</sup> See the list of chemical effluent emissions listed at pages 36-40.

Sn-113  
Sr-89  
Sr-90  
Sr-92  
TC-99M  
TC-101  
TC-104  
Tritium  
Xe-133  
Xe-135  
Zn-69M  
Zr-95  
Zr-97<sup>44</sup>

This list is not exhaustive.

**All radionuclides released by Millstone cause cancer.<sup>45</sup>**

**According to the U.S. Environmental Protection Agency,**

**Radioactive materials that decay spontaneously produce ionizing radiation. Any living tissue in the human body can be damaged by ionizing radiation. Cancer is considered by most people the primary health effect from radiation exposure. Simply put, cancer is the uncontrolled growth of cells. Ordinarily, natural processes control the rate at which cells grow and replace themselves. They also control the body's processes for repairing and replacing damaged tissue. Damage occurring at the cellular or molecular level can disrupt the control processes, permitting the uncontrolled growth of cells – cancer. This is why ionizing radiation's ability to break chemical bonds in atoms and molecules makes it such a potent carcinogen. . . . There is no firm basis for setting a "safe" level of exposure above background for stochastic effects [those**

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<sup>44</sup> Fission and Activation Products – Millstone Unit 2 Liquid Effluents – Batch Sampling – 1997 as reported in 1997 Radiological Environmental Monitoring Program.

<sup>45</sup> See selected bibliography prepared by Nuclear Information Resource Service, attached.

resulting from long-term, low-level exposure to radiation]. . . . Other than cancer, the most prominent long-term health effects [from radiation exposure] are teratogenic [those that result from the exposure of fetuses or unborn children to radiation] and genetic [those that can be passed from parent to child] mutations.<sup>46</sup>

According to the U.S. Nuclear Regulatory Commission, genetic effects and the development of cancer are the primary health concerns attributed to radiation exposure.<sup>47</sup>

Many chemicals discharged by Millstone are known carcinogens, such as hydrazine, hexavalent chromium, cadmium, lead and benzene and many others.

Millstone routinely discharges into the nuclear/chemical "mixing zone" which extends 8,000 feet toward the Niantic and Waterford shorelines, the following chemicals and others:<sup>48</sup>

**Chemicals & Metals "Known or Suspected Present" in Discharge**

Aluminum  
Antimony  
Ammonia  
Ammonium Hydroxide  
Arsenic  
Barium  
Beryllium  
Boric Acid  
Boron  
Bromide  
Bulab 6002

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<sup>46</sup> U.S. Environmental Protection Agency website, "Understanding Radiation: Health Effects" (3/16/05)

<sup>47</sup> U.S. Nuclear Regulatory Commission website, "Fact Sheet: Biological Effects of Radiation." (3/26/05)

<sup>48</sup> Millstone 1997 Radiological Environmental Monitoring Program Report and documents filed with Connecticut DEP.

Cadmium  
Carbohydrazide  
Chlorine  
Chromium  
Cobalt  
Conquor 3585 (methoxypropylamine and diethylhydroxylamine)  
Copper  
Cyanide  
Diethylhydroxylamine  
Epichlorohydrin  
Ethanolomine  
Fluoride  
Freon  
Hexavalent Chromium  
Hydrazine  
Hydrogen Peroxide  
Iron  
Methoxypropylamine  
Molybdate  
Molybdenum  
Nalcolyte  
Nickel  
Nitrogen  
Oil & Grease  
Phosphorus  
Selenium  
Silver  
Styrene  
Sulfate  
Sulfide  
Sulfite  
Surfactants  
Thallium  
Tin  
Titanium  
Tolyltriazole  
Xylene  
Zinc  
Zirconium

Volatiles

Acrolein  
Acrylonitrile  
Benzene  
Bromoform  
Carbon Tetrachloride  
Chlorobenzene  
Chlorodibromomethane  
Chloroethane  
2-Chloroethylvinyl Ether  
Chloroform  
Dichlorobromomethane  
1, 1-Dichloroethane  
1, 2-Dichloroethane  
1, 1-Dichloroethylene  
1, 2-Dichloropropane  
1, 3-Dichloropropylene  
Ethylbenzene  
Methylbromide  
Methylchloride  
Methylene Chloride  
1, 1, 2, 2, -Tetrachloroethane  
Tetrachloroethylene  
Toluene  
1, 2-Trans-Dichloroethylene  
1, 1, 1-Trichloroethane  
1, 1, 2-Trichloroethane  
Trichloroethylene  
Vinyl Chloride

GC/MS Fraction Acid Compounds

2-Chlorophenol  
2, 4-Dichlorophenol  
2, 4-Dimethylphenol  
4, 6-Dinitro-O-Cresol  
2, 4-Dinitrophenol  
2-Nitrophenol  
4-Nitrophenol

P-Chloro-M-Cresol  
Pentachlorophenol  
Phenol  
2, 4, 6-Trichlorophenol

Base Neutral Compounds

Acenaothylene  
Benzidine  
Benzo(a)anthracene  
Benzo(a)pyrene  
Benzo(ghi)perylene  
Benzo(k)fluoranthene  
Bis(2-Chloroethyl) Ether  
Bis(2-Ethylhexyl)phthalate  
Chrysene  
Dibenzo(ah)anthracene  
1,2-Dichlorobenzene  
1,3-Dichlorobenzene  
1,4-Dichlorobenzene  
3,3-Dichlorobenzidines  
Diethyl phthalate  
Dimethyl phthalate  
Di-n-butyl phthalate  
2,4-Dinitrotoulene  
1,2-Diphenylhydrazine  
Fluoranthene  
Fluorene  
Hexachlorobenzene  
Hexachlorocyclopentadiene  
Hexachloroethane  
Indenol1,2,3-ed)pyrene  
Isophorone  
Nurobenzene  
N-Nitrosodimethylamine  
N-Nitrosodiphenylamine  
Phenanthrene  
Pyrene

Pesticides

Aldrin  
Chlordane  
DDT  
DDE  
Dieldrin  
Endosulfan(alpha)  
Endosulfan (beta)  
Endosulfan Sulfae  
Endrin  
Endrin Aldehyde  
Heptachlor  
Heptachlor epoxide  
Arochlor 1016(PCB)  
Arochlor 1232(PCB)  
Arochlor 1242(PCB)  
Arochlor 1248 (PCB)  
Arochlor 1254 (PCB)  
Arochlor 1260 (PCB)  
Toxaphene

Other Substances

Ammonia  
Benzo(b)fluoranthene  
Chlorine  
Hexachlorocyclohexane (Alpha)  
Hexachlorocyclohexane (Beta)  
Hexachlorocyclohexane (Gamma)  
2,3,7,8-TCDD

**The interaction of radionuclides and chemicals has been established to create a synergy, multiplying the harmful effects of each.<sup>49</sup>**

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<sup>49</sup> See Memorandum of Ernest J. Sternglass, Ph.D. dated March 8, 2005 ("Synergistic Interaction of radiation, Air Pollution and Chemicals") and references therein (copy attached). And see "Health Effects of selected Industrial Chemicals and Radionuclides" (STAND Technical Report 2003-2) at page 5 (copy attached).

**Millstone discharges these radionuclides and chemicals – and more – into the air and into the nuclear/chemical “mixing zone” known as Niantic Bay, Pleasure Beach and Jordan Cove, defined as an area within 8,000 feet of the Millstone discharge point.**

**Some of the radionuclides, such as cesium-137, have been found in fish swimming in Niantic Bay.<sup>50</sup>**

**Some of the radionuclides, such as cobalt-60, have been found in the sediment of Jordan Cove where they enter the food chain when they are ingested by worms.<sup>51</sup>**

**Some of the radionuclides and toxic chemicals very likely entered Zachary M. Hartley’s mother while she was swimming in the nuclear/chemical “mixing zone” popularly known as Hole-in-the-Wall Beach during critical months of her pregnancy with Zachary, according to an expert on the health effects of low-level ionizing radiation, Dr. Helen Caldicott.<sup>52</sup> Four pathways are possible: breathing, swallowing, skin contact and eating a radioactive fish. Zachary was born with a rare cancer in his jawbone requiring lifesaving surgery.**

In SEIS section 4.7, beginning on page 4-53, the NRC states, “During scoping, some commentators suggested that operation of Millstone resulted in excess cancers in populations around the plant site,” and “other support of these positions at the May 2004 public meeting or thereafter commentators suggested there is no relationship between cancer incidence and nuclear power plants.”

Millstone’s cumulative dose to the environment and humans, based on annual Millstone reports filed with the NRC since 1970, totals over 6.5 curies. As reported in the response to section 2.2.7, releases of tritium into Long Island Sound since Millstone’s restart in 1998 are at all time highs in its operating history.

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<sup>50</sup> See 1997 Annual Radiological Environmental Operating Report at page 4-5.

<sup>51</sup> See [citation to follow]

<sup>52</sup> See footnote 14 supra.

Current annual plant reports indicate that Millstone Units 2 and 3, as in the years since 1970, have been releasing radionuclides such as strontium-90, cesium-137, iodine-131, -133 and -135, cobalt -58 and -60, krypton-85, xenon-131, -133 and -135, and other such radioactive chemicals, all known to be carcinogenic.

The NRC's denial of a causal relationship between Millstone's 35 years of radioactive releases and elevated cancer rates in nearby towns, and in New London County as a whole, does not hold up to scrutiny.

The most glaring example of the NRC's denial in the Millstone SEIS is its complete omission of consideration of the August 17, 2004 declaration of Dr. Ernest J. Sternglass. The Millstone SEIS lists, on page C-9, Dr. Sternglass' declaration as received on August 17, 2004. This is the only mention of it in the SEIS.

Consequently, the declaration was omitted from the NRC's evaluation of potential new and significant information in section 4.7.

In his declaration, Dr. Sternglass presents his credentials as an expert in the field of radiation and human health. He has written and published numerous studies in this field in peer reviewed scientific journals and testified to Congress and other government agencies on this subject. The NRC knows full well who Dr. Sternglass is. He first brought up the problem of radioactive releases in relation to increasing cancer rates around nuclear plants, and in towns near Millstone in particular, to the public eye in the 1970s. He has conducted and published studies informing the public of this continuing problem ever since.

In his declaration, Dr. Sternglass methodically outlines the "causal relationship between abnormally high doses of strontium-90 in milk produced near Millstone and the pattern of cancer changes at various distances from the Millstone plant.

Dr. Sternglass also states in his declaration, "It is my professional opinion that the radioactive releases from the Millstone Nuclear Power Station since its startup have caused and will continue to cause [emphasis added] excess infant mortality, low birthweight, leukemia and cancer as well as increased rates of both chronic and infectious diseases in the towns around Millstone as well

as in New London County and Connecticut as a whole."

For the NRC to exclude Dr. Sternglass' declaration from section 4.7 is a glaring major error in that in and of itself invalidates the NRC's conclusion that "information provided during the scoping process was not new and significant with respect to the findings of the GEIS on the health effects to the public from radiological effluent releases due to the Millstone operations."

This statement rather is indicative of the NRC's determination to support the nuclear industry's—and in this case Dominion's—rush to relicense old unsafe nuclear plants, to the detriment of the public's health and safety.

This bias is repeated in statements and omission throughout section 4.7, as the following will demonstrate.

For example, in dealing with the Connecticut Tumor Registry's report, "Cancer Incidence in Connecticut Counties 1995-99," the NRC does report that New London County "had the highest incidence rate of all invasive tumors for females," but omits that this rate was second highest for males, as was reported at the May 2004 public meeting.

Furthermore, the NRC characterizes information in the report indicating that New London County had the highest rate for 12 specific kinds of cancers as "several forms," a choice of words that seeks to minimize a major health crisis.

The NRC also fails to mention information from the report, which was testified to at the May 2004 public meeting, that New London County had the second highest rate for six more kinds of cancer, third highest for five additional ones, and fourth highest for seven more, totally 30 out of 39 kinds of cancers in which New London County was counted separately.

All of the above reveals a deliberate and systematic attempt to exclude the most important "new and significant" information about Millstone radioactive releases and its effects on human health.

Similarly, in dealing with a 2003 study by Joseph Mangano et al, presented at the May 2004 public meeting, "Elevated Childhood Cancer Incidence Proximate to U.S. Nuclear Power Plants," the SEIS selectively

focuses on information from the study that indicates there may not be a causal relationship between Millstone's radioactive releases and health problems. So the NRC states the study "reported no significant difference in childhood cancer mortality rates between counties surrounding the nuclear plants and the U.S. population."

This would be fine and fair if the agency did not also exclude the major finding of the study, which is that "cancer incidence for children less than 10 years of age, who live within 30 miles of each of 14 plants [one of which is Millstone] in the eastern U.S. (49 counties with a population of more than 16 million) exceeds the national average. The excess 12.4% suggests that 1 in 9 cancers among children who reside near nuclear reactors is linked to radioactive emissions."

Once again, this omission is deliberate and systematic, serving the nuclear industry's interests to the detriment of the public's health and safety.

The NRC also failed to mention numerous other studies listed in the bibliography of study that have linked radioactive releases from nuclear facilities to elevated cancers.

Another example of this exclusion of new and significant information is the NRC's treatment of the 1990 National Cancer Institute study of cancer in counties near nuclear power plants.

That study found that the risk for leukemia in children under 10 in New London County was over 3 times higher than for same aged children in "control counties" used for comparison. The NRC focused on NRC information that sought to downplay of that finding.

However, the NRC excluded other NCI information cited by Joseph Mangano in his report, also presented and testified to at the May 2004 public meeting, entitled "2500 Excess Cancer Cases in New London County Since 1970; Radioactive Emissions From Millstone May Be Cause." In that report Mangano stated, "in Millstone's first 14 years, leukemia cases for New London County children under 10 were **55% higher** than the state, and leukemia deaths **45% higher**. All scientists agree that children are most sensitive to low-level radiation's effects."

Once again, the NRC's failure to give equal weight to critical evidence invalidates its analysis and makes its conclusions false, as well as disqualifying itself as a just arbiter.

Another example is its treatment of another Connecticut Tumor Registry report, which examines cancer incidence in Connecticut towns 1995-99, rather than by county.

First of all, this report was not brought in by the public during the scoping process. The NRC decided to do so on its own as part of its response to information presented at the May 2004 public meeting and thereafter. Why? The NRC reported on the results of the study for only one town, Waterford, site of Millstone. The NRC reported "The town of Waterford does not have the highest ratio of observed cancers to expected cancers for any form of cancer analyzed."

As the NRC well knows, there is no barrier to prevent Millstone radioactive emissions from traveling beyond the boundaries of the town of Waterford. A more comprehensive such analysis would have included other towns near Millstone. But the NRC didn't do that, once again excluding critical information.

However, investigative journalist and author Michael Steinberg of Niantic, CT, did perform such an analysis, including the towns of Waterford, East Lyme, Old Lyme, New London and Groton together. Steinberg's analysis, included herein, found higher than expected incidence of cancer in these towns together for: all female cancers, lung cancer for females, colorectal cancers for females, prostate cancer for males, breast cancer for females, melanoma for both males and females, and cervical cancer for females.<sup>53</sup>

These findings are consistent with findings presented from the Connecticut Tumor Registry's study of Connecticut Counties 1995-99, as well as information presented in Mangano's 1998 study "2500 Excess Cancer Cases...", Sternglass' declaration, and a new study by Mangano presented at the January 11, 2005 meeting.

<sup>53</sup> See "Cancer Incidences in Connecticut Towns 1995-1999," as compiled by Michael Steinberg, attached.

Finally, the NRC reports in section 4.7 that a 2000 study by the Connecticut Academy of Science and Engineering (CASE) found that "The town of Waterford was not in the highest ratio category for any cancer except thyroid cancer, and at least three other town had higher ratios for thyroid cancer. At least 30 town had higher ratios for pediatric leukemia (ages 0 to 14) than Waterford."

First of all, this analysis, as reported above, is defective by limiting it to Waterford. Secondly, the CASE study focused on the Connecticut Yankee Nuclear Plant, and Millstone is never mentioned in it. Therefore radioactive emissions from Millstone are not considered in its analysis. Furthermore, information for cancer is not reported statistically by town, other than in maps where towns are not identified specifically but are marked by varying shades of white to black.

Nevertheless, the maps do indicate elevated cancers in towns around Millstone for all the specific kinds of cancers studied: thyroid cancer is elevated not only in Waterford, but also in Groton, Old Lyme and Stonington. Multiple myeloma is elevated for Waterford. And acute adult leukemia is elevated for Groton and Ledyard, both downwind of Millstone. However, while the CASE study uses information from the Connecticut Tumor Registry for 1976-95, it does not look for trends over those years (e.g. by comparing cancer rate increases or decreases over 5 year periods, as was done in studies by Sternglass and Mangano).

The CASE study was initiated in 1997. At that time, all three Millstone reactors had been shut down for two years because of gross mismanagement and harassment of whistleblowers. At that time Northeast Utilities owned and operated Millstone, and still owned the permanently shut down Connecticut Yankee Nuclear Plant. CASE reports that Northeast Utilities was one of its top financial supporters at that time, and its website still shows NU at the top of its list of financial supporters.<sup>54</sup>

Thus NU in effect was a major funder of the CASE study, which means CASE had a major conflict of interest, one that put pressure on it to come

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<sup>54</sup> We attach a study critical of the CASE report, entitled "Epidemiological Evaluation of the CASE Report Entitled 'Study of Radiation Exposure from the Connecticut Yankee Nuclear Power Plant'" (Suzanne Gutter and Edwin van Wijngarden) (February 21, 2001)

up with results that would please the hand that feeds it.

All the above points to the failure of the NRC to conduct a fair and unbiased analysis of the critical information given as public testimony at the May 2004 public meeting in Waterford, Connecticut, and in documents presented there and thereafter to the NRC.

As a result the NRC's conclusion that there is not new and significant information is fatally flawed. The agency excluded and downplayed the critical information that was presented, information that establishes a strong and clear relationship between Millstone's 35 years of radioactive emissions and the concurrent rise of cancers and other diseases in towns around Millstone and in New London County, as well as across Connecticut and into Rhode Island.

While the Connecticut Tumor Registry is a source of much information about the heightened incidence of cancer and related diseases in the area surrounding Millstone, it is not a completely reliable source of information.

Zachary M. Hartley is not the only victim of Millstone's radiological and toxic chemical releases. In any individual cancer case, a 100 per cent positive correlation with a suspected causative agent cannot be made. That is why we rely on all available information obtained formally – such as the Connecticut Tumor Registry and epidemiological research – as well as informally, through reports of victims themselves or their family members to understand the scope of this public health emergency.

Although Zachary was born in Connecticut with a life-threatening cancer in his jaw and although a tumor the size of an orange was removed from his face when he was 14 months of age, the Connecticut Tumor Registry does not list Zachary's cancer. The Registry's explanation is that a portion of Zachary's tumor was benign and therefore it does not qualify for listing in the Connecticut Tumor Registry.

The NRC SEIS staff relies on a report of the National Cancer Institute (NCI 1990), which in turn relies on data of the Connecticut Tumor Registry. According to the Connecticut Tumor Registry website, it obtains its funding from the National Cancer Institute.<sup>55</sup> The NCI report is fifteen (15) years old. The NCI report was released four (4) years after Millstone Unit 3

commenced generating nuclear energy and long before many cancers associated with its dangerous emissions might be detected. It does not reflect the extremely high concentrations of strontium-90, a carcinogen, found in goat milk sampled within five miles of Millstone in 2001. It does not report the case of Zachary M. Hartley. It does not report the case of Rachel Heaton, who developed a rare form of thyroid cancer years after swimming in the Niantic shoreline "mixing zone" because she moved from the area. Nor does it report the brain tumor of Charles D. Douton, Jr., one of three former Millstone site maintenance workers who developed brain tumors and were dismissed from their jobs at Millstone by Northeast Utilities, as identified by Cynthia M. Besade in her August 5, 2004 affidavit. The NCI report does not include any of the seven (7) cancer cases recently identified to the NRC SEIS staff among residents or former residents of a single road - Seabreeze Drive - in Waterford two miles downwind from Millstone. The Connecticut Coalition Against Millstone is actively investigating to determine to what extent the Connecticut Tumor Registry fails to maintain records of other Millstone victims.

The Connecticut Coalition Against Millstone is also actively investigating information it has received of rare cancers – including a fatal skin cancer confined to the feet of a woman who frequently waded for long periods in the nuclear/chemical "mixing zone" to the east of the Millstone discharge point – in the community surrounding Millstone. The information under review includes dozens of cases of early childhood death and disease.

The Coalition attaches a selected Bibliography compiled by the Nuclear Information Resource Service ("NIRS") linking nuclear power plant radiological emissions with cancers in their communities. For example, NIRS reports a 400 per cent increase in leukemia incidence in the population living downwind from the Pilgrim (MA) Nuclear Power Plant during the first five years after nuclear fuel was known to have leaked excess radioactivity. A necessary review of Millstone records will reveal the occurrence of leaking fuel at Unit 2 after Dominion assumed ownership.

The Coalition notes that the European Committee on Radiation Risk ("ECRR") has reported that radiation dose models employed by the NRC and other governmental agencies are probably 100 to 1,000 times too high

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<sup>55</sup> See [www.dph.state.ct.us/OPPE/hptumor.htm](http://www.dph.state.ct.us/OPPE/hptumor.htm)

to be accurate.<sup>56</sup>

The NRC SEIS staff had to be reminded at the NRC's January 11, 2005 public meeting on the SEIS that the Coalition and others had previously submitted documentation to the NRC establishing a causative link between Millstone radiological and toxic effluent emissions and the heightened cancer rates in the area surrounding Millstone.

The NRC SEIS staff did not adhere to the NRC's Principles of Good Regulation, which require in part:

Independence: Nothing but the highest possible standards of ethical performance and professionalism should influence regulation. However, independence does not imply isolation. All available facts and opinions must be sought openly from licensees and other interested members of the public. The many and possibly conflicting public interests involved must be considered.

The SEIS states that the NRC staff

and its contractors discussed Millstone's history of radiological effluent and environmental monitoring with officials from CTDEP's Division of Radiation. The reports cited above by CTDPH, CASE and the national Cancer Institute were also discussed. CTDEP conducts its own radiological environmental monitoring program around Millstone. STDEP had also reviewed the reports by CTDPH, CASE and the National Cancer Institute. CTDEP concluded that Millstone's radiological effluent and environmental monitoring data were accurate. CTDEP also concluded that the reports cited above by CTDPH, CASE and the National Cancer Institute reports showed no evidence of a causal link between public exposure to Millstone's radiological effluents and cancer in Connecticut towns."

The Connecticut Coalition Against Millstone has sent correspondence to Dr. Edward C. Wilds, Director of the DEP Radiation Bureau, to determine what conversations occurred with the SEIS staff, whether the DEP staff agrees with the characterizations of its conduct and input in the

<sup>56</sup> See "ECRR Report Challenges Entrenches Radiation Assumptions" (MIRS, February 21, 2003)

SEIS. Finally, the Coalition asked Dr. Wilds if he agreed with the SEIS statement that "CTDEP concluded that Millstone's radiological effluent and environmental monitoring data were accurate," and if so, to specify what radiological effluent and environmental monitoring data were referenced and, further, if so, how such statement could be reconciled with Northeast Utilities' plea of guilty in 1999 in the U.S. District Court to committing environmental felonies, including falsifying environmental monitoring records.

To date, Dr. Wilds has failed to respond to the Coalition's request.

#### 4.8.3. Cumulative Radiological Impacts

The GEIS did not perform a meaningful analysis of cumulative radiological impacts because its data base was limited to Millstone effluent discharges from 1985-1987.

The GEIS further states:

In addition, the radiological environmental monitoring program conducted by Dominion in the vicinity of Millstone measures radiation and radioactive material from all sources, including Millstone; therefore, the monitoring program measures cumulative radiological impacts.

The Health Physics Society defines cumulative dose as follows:

The total dose resulting from repeated exposures of ionizing radiation to the same portion of the body, or to the whole body, over a period of time.

Correspondingly, the SEIS failed to conduct the analysis required by virtue of GEIS 4.6.1.1, which provides:

To determine whether the added period of operation following license renewal would, by virtue of buildup, result in significant (double) added dose, the ratios of buildup factors for midlives of 30 to midlives of 20 years were evaluated. These ratios amount to a 35 per cent increase for Cesium-137 and a

6 per cent increase for cobalt-60. This added increase due to buildup will not significantly change the total dose to members of the public.

In certain cases, the bioaccumulation factors may require reexamination. These principally involve fish (in the human food chain) that are bottom feeders. Bottom feeders may ingest worms and other biota that may remobilize radioactive materials accumulated in the sediments.

Accumulation of radioactive materials in the environment is of concern not only to license renewal but also to operation under present licenses.

Accordingly, the SEIS is substantially flawed on the issue of cumulative radiological impacts.

### Conclusion

It has been demonstrated herein that the adverse environmental impacts of Millstone license renewal are so great that preserving the option of license renewal for energy

planning decisionmakers would be unreasonable. The NRC should reach such a conclusion in its final Environmental Impact Statement.

In the alternative, the NRC should recognize that its staff has failed to consider the full scope of the environmental impacts of present or future Millstone operations, and similarly, the licensee has failed to fully apprise the NRC of all pertinent facts and circumstances sufficient to enable the NRC to undertake meaningful review; in the absence of such complete evaluation the NRC must deny relicensing.

**CONNECTICUT COALITION  
AGAINST MILLSTONE**

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## U.S. Nuclear Regulatory Commission

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## Our Values

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### Principles of Good Regulation

The NRC adheres to the following Principles of Good Regulation:

- Independence:** Nothing but the highest possible standards of ethical performance and professionalism should influence regulation. However, independence does not imply isolation. All available facts and opinions must be sought openly from licensees and other interested members of the public. The many and possibly conflicting public interests involved must be considered. Final decisions must be based on objective, unbiased assessments of all information, and must be documented with reasons explicitly stated.
- Openness:** Nuclear regulation is the public's business, and it must be transacted publicly and candidly. The public must be informed about and have the opportunity to participate in the regulatory processes as required by law. Open channels of communication must be maintained with Congress, other government agencies, licensees, and the public, as well as with the international nuclear community.
- Efficiency:** The American taxpayer, the rate-paying consumer, and licensees are all entitled to the best possible management and administration of regulatory activities. The highest technical and managerial competence is required, and must be a constant agency goal. NRC must establish means to evaluate and continually upgrade its regulatory capabilities. Regulatory activities should be consistent with the degree of risk reduction they achieve. Where several effective alternatives are available, the option which minimizes the use of resources should be adopted. Regulatory decisions should be made without undue delay.
- Clarity:** Regulations should be coherent, logical, and practical. There should be a clear nexus between regulations and agency goals and objectives whether explicitly or implicitly stated. Agency positions should be readily understood and easily applied.
- Reliability:** Regulations should be based on the best available knowledge from research and operational experience. Systems

interactions, technological uncertainties, and the diversity of licensees and regulatory activities must all be taken into account so that risks are maintained at an acceptably low level. Once established, regulation should be perceived to be reliable and not unjustifiably in a state of transition. Regulatory actions should always be fully consistent with written regulations and should be promptly, fairly, and decisively administered so as to lend stability to the nuclear operational and planning processes.

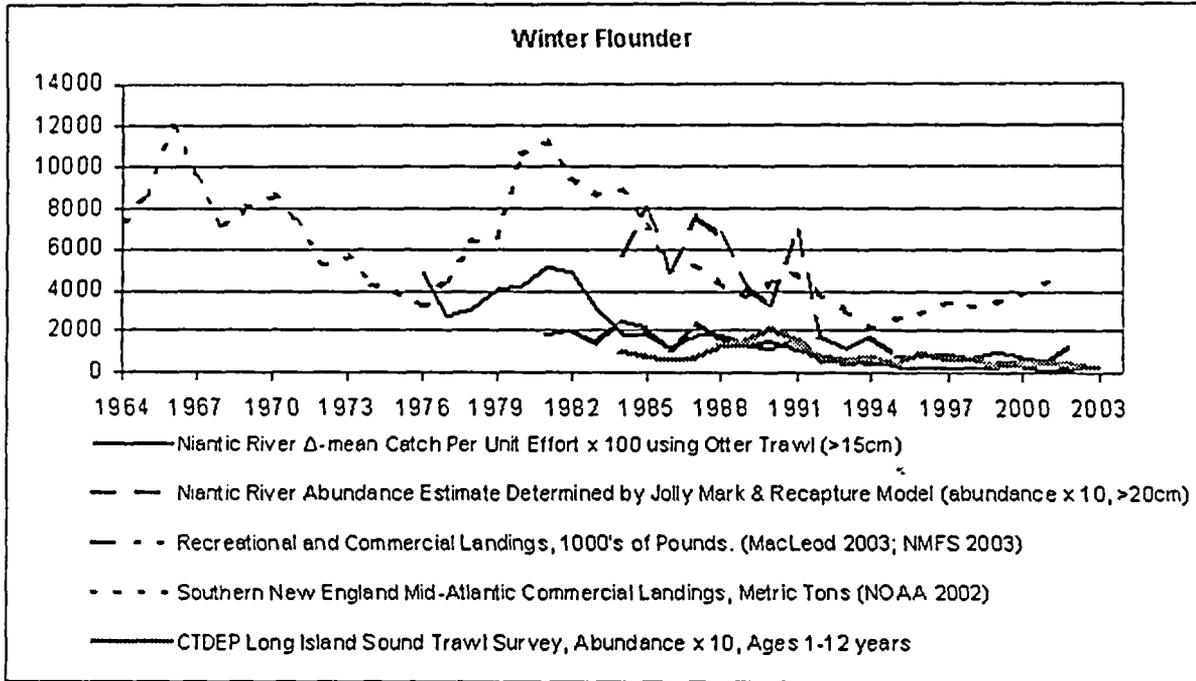
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## NRC Organizational Values

Integrity	... in our working relationships, practices and decisions.
Excellence	... both in our individual and collective actions.
Service	... to the public, and others who are affected by our work
Respect	... for individuals' roles, diversity, and viewpoints.
Cooperation	... in the planning, management, and work of the agency.
Commitment	... to protecting the public health and safety.
Openness	... in communications and decision making

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*Last revised Monday, June 14, 2004*



1           **Figure 2-6. Comparison of Winter Flounder Population Trends in Niantic River and Long**  
 2           **Island Sound**

3  
 4           According to NOAA, "The continuing low level of landings, catch per unit effort indices, and  
 5           survey indices suggest that winter flounder abundance in the Gulf of Maine has been reduced  
 6           substantially. Future improvements in the condition of the stock will depend on decreases in  
 7           exploitation in both the recreational and commercial fisheries, and on improved recruitment.  
 8           The stock is at a low biomass level and is considered to be exploited" (NOAA 1998). It is  
 9           possible that a variety of environmental factors may be responsible for decreasing flounder  
 10          abundances in the Niantic River in addition to fishing mortality, including entrainment of larvae  
 11          by Millstone, increasing water temperatures in the region, and habitat degradation associated  
 12          with the Niantic River estuary associated with contaminant or nutrient inputs. Because winter  
 13          flounder exhibit high fidelity to their natal stream, localized impacts to this species during  
 14          spawning and larval growth can dramatically influence population dynamics. At present, it is not  
 15          possible to quantify the importance of the various environmental stresses or evaluate their true  
 16          influence on winter flounder survival associated with the Niantic River.  
 17

September 28, 1999

## Owner of Connecticut Nuclear Plant Accepts a Record Fine

By MIKE ALLEN

**H**ARTFORD -- The owner of the Millstone Nuclear Power Station in eastern Connecticut admitted Monday that it had falsified environmental records and deliberately promoted unqualified plant operators. The owner, Northeast Nuclear Energy Company, pleaded guilty to 23 Federal felonies and agreed to pay \$10 million in fines, the largest penalty ever for a nuclear plant in this country.

The violations took place from 1994 to 1996.

In entering the guilty plea in United States District Court here, Northeast admitted that hydrazine, a toxic chemical used to reduce corrosion of pipes, had gushed into Long Island Sound at a rate of one gallon an hour during 1996 and that testers at the company had diluted their samples with ocean water to hide the problem from Federal regulators.

Federal prosecutors said Monday that they were unable to prove environmental harm from the hydrazine.

The company also admitted that after it submitted fraudulent information to the Nuclear Regulatory Commission, 12 control-room operators received Federal licenses. Problems with the training program at Millstone came to light in 1996 when six of seven candidates for control-room operator licenses failed Federal exams, prosecutors said.

In presenting the evidence in court Monday, the prosecutors said the corner-cutting could have put the plant in the hands of workers unable to prevent a crisis.

The investigation, previously secret, came to light in court Monday when the company waived indictment and pleaded guilty. As part of the plea agreement, the company was put on three years' probation, which allows prosecutors to monitor operations more closely.

The Millstone case is just the second time that a nuclear power plant owner had been found guilty of felonies. Fifteen years ago, after the 1979 accident at the Three Mile Island plant near Harrisburg, Pa., which began the industry's plunge from public acceptance, Metropolitan Edison pleaded guilty to falsifying records at the plant.

Officials at Millstone said they hoped Monday's pleas would end the long period in which the plant has been considered a national symbol of mismanagement in the nuclear power industry. In 1997, Millstone was assessed a civil fine of \$2.1 million by the Nuclear Regulatory Commission. In 1996, a Time magazine cover story treated the plant as an egregious example of lax enforcement of Federal regulations.

The three reactors in Waterford, Conn., were shut down under orders from the Nuclear Regulatory Commission because of problems with design, safety and paperwork. One of the three reactors is being decommissioned, while the other two have been restarted and are producing energy.

Since 1996, the utility has hired new executives and taken steps that it says would prevent violations in the future. Federal prosecutors, while describing the old offenses in harsh terms, said in Monday's proceedings that they had confidence in the new managers.

After the large number of Millstone candidates flunked their licensing tests, investigators discovered that they had not put in the required number of training hours nor mastered the maneuvers that Millstone had falsely claimed, the Government charged. Some of the candidates have since been retrained and are now on the job, the company said.

Federal prosecutors said economic pressure brought on by deregulation of the nuclear industry had contributed to the violations. "Rather than treat the problem," said Joseph C. Hutchison, an assistant United States Attorney, "the shortcut was taken so there was some economic saving."

Hutchison said complaints by community groups and workers at the plants had led to the three-year Federal investigation.

Stephen C. Robinson, the United States Attorney for Connecticut, said of the agreement, "No matter who you are, no matter how big or how powerful, if you endanger our citizens, if you violate the law, if you lie to regulators and choose profits over the public, we will come after you."

Michael G. Morris, the chairman and chief executive of Northeast Utilities, the parent of Northeast Nuclear, did not dispute

a statement that the violations were deliberate, but said the public had never been in danger. As he left the courthouse Monday, Morris attributed the violations to "inattention to detail" and "inadvertence," not deregulation. "The whole notion that you react differently in a competitive marketplace is true, but it doesn't cause this kind of behavior," he said. He said the lesson for plant owners was "it's better to operate within all of the laws and the requirements because these kind of fines, these kinds of embarrassments, will come your way if you don't."

Morris was hired in 1997, after the offenses took place. Nevertheless, Judge Robert N. Chatigny called him to the front of the court this morning and told him sternly he hoped the plea reflected a commitment by the company "to be a better citizen in the future than it was in the past."

Judge Chatigny added that despite the efforts of those who work in the public interest, "Ultimately, the public has to depend on the good faith, honesty and integrity of the people who manage our large companies."

A spokeswoman for Northeast Utilities, Mary Jo Keating, said the plea agreement should help with the plans to sell the plant, as required by state legislation deregulating the industry. "The worst thing in the market is any kind of uncertainty," she said from the company headquarters in Berlin, Conn.

David M. Pittinos of the Toxics Action Center, an environmental group in West Hartford, said today's plea vindicated residents who had been worried about mismanagement and safety at the plant. The admissions were especially damning, he said, because "these companies typically offer to do just about anything to weasel out of criminal charges and reach some out-of-court settlement."

In addition to the 23 counts involving the **nuclear** plant, another subsidiary, Northeast Utilities Service Company, pleaded guilty to two felonies resulting from the use of a fire hose to dilute water samples taken at Devon Station, a coal-fired power plant in Milford. Prosecutors said that their case against the service company was complete, but that their investigation was continuing and that individuals might be prosecuted.

As part of the \$10 million in fines, Northeast Utilities agreed to donate \$1 million to endow a business ethics chair at the University of Connecticut in Storrs, and \$650,000 for an environmental clinic at its School of Engineering; \$1 million to help local towns buy riverfront land for conversion into public parks, and \$650,000 to Riverfront Recapture, a Hartford group, for its leadership camp for disadvantaged city youth.

The agreement specified that the gifts were not tax deductible. The company said it did not intend to pass the costs on to consumers.

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STATE OF CONNECTICUT  
DEPARTMENT OF ENVIRONMENTAL PROTECTION



Exhibit A  
EMERGENCY AUTHORIZATION

- I. Pursuant to Connecticut General Statutes (C.G.S.) 22a-6k, an Emergency Authorization is hereby issued to:

Northeast Nuclear Energy Company (NNECO)  
Post Office Box 128  
Waterford, CT 06385-0128

to initiate, create, originate or maintain a discharge to the waters of the state (Long Island Sound) at:

Niantic Bay via Discharges Permitted Under NPDES Permit No. CT0003263, and  
Other Locations Authorized Herein Associated with Cooling Water Intakes, Fire Protection Systems and  
Plant Maintenance Systems at  
Millstone Nuclear Power Station Units 1, 2 and 3  
Rope Ferry Road  
Waterford, CT 06385-0128

- II. This Emergency Authorization ("Authorization") specifically allows NNECO to:

- (1) Discharge Unit 2 and 3 chlorinated and non-chlorinated pump lubrication water and pump leak off water to existing cooling water intake structures and existing discharge locations;
- (2) Discharge Unit 2 and 3 service water and circulating water strainer backwash wastewater and screenwash wastewater;
- (3) Increase the total maximum daily flow for Millstone Unit 3 from 1,313,200,000 gallons per day (gpd) to 1,410,600,000 gpd (as specified in Table 1 on page 6 of correspondence D12024 referenced in section V. of this Authorization) dated February 6, 1993 to David Cherico from F.C. Rothen;
- (4) Discharge incidental concentrations of ethanolamine (ETA) resulting from the previously authorized additions of ETA to Unit 3 feedwater and condensate systems. These incidental discharges (as described in Letter D12413) of ETA shall be authorized to DSN 001C via DSNs 001C-2, 001C-3, 001C-4, 001C-6(b), and 001C-9 of NPDES Permit CT0003263, issued December 14, 1992;
- (5) In the event of automatic plant shutdown, or other emergency situation, discharge condenser hotwell wastewater on a continuous basis via DSN 001C-3 of NPDES Permit CT0003263. NNECO shall notify the Commissioner, in writing, within 24 hours after such discharge commences;
- (6) Discharge incidental non-radioactive wastewaters from numerous intermittent sources from Units 2 and 3 (as described in Letter D12938) to DSN 006 of NPDES Permit CT0003263, issued December 14, 1992;
- (7) Discharge incidental concentrations of ethanolamine (ETA) and hydrazine resulting from the previously authorized additions of ETA and hydrazine within secondary units at Units 2 and 3. These incidental discharges (as described in Letter D12938) of ETA and hydrazine shall be authorized to DSN 006 of NPDES Permit CT0003263;
- (8) In the event of automatic plant shutdown, or other emergency situation, discharge Unit 3

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condensate surge tank wastewater to DSN 006 of NPDES Permit CT0003263. NNECO shall notify the Commissioner, in writing, within 24 hours after such discharge commences;

- (9) Discharge wastewater treated for hydrazine removal through air sparging and/or hydrogen peroxide addition from the Unit 2 Condensate Polishing Unit (DSN 001B-6). Such wastewaters may also contain residual concentrations of ammonia, hydrogen peroxide and ETA;
- (10) Discharge wastewater containing hydrazine resulting from previously authorized additions of hydrazine to Unit 2 feedwater systems via DSN 001B-1 during start-up, hot stand-by and shutdown conditions;
- (11) Discharge Unit 1 service water sump backwash to DSN 002 of NPDES Permit number CT0003263;
- (12) Discharge chlorinated and non-chlorinated intake pump seal water from Unit 1 service water, circulating water, and screenwash pumps to the existing cooling water intake structure and existing discharge locations;
- (13) Discharge fire water system wastewaters (as documented in Letter D1329), including:
  - (a) Fire pump (P-32) gland run off water to DSN 009 of CT0003263 or to the ground;
  - (b) Pressure relief valve discharge from fire pump (M7-3) to a trap rock dispersion area;
  - (c) Fire pump (M7-3) gland run off to DSN 009 of CT0003263;
  - (d) Diesel powered fire pump (M7-7) cooling water and relief valve discharges to DSN 009 of CT0003263;
  - (e) Fire pump (M7-7) gland run off water to pump house floor drains;
- (14) Redirect the discharge of Unit 1 and Unit 2 chemistry laboratory wastewaters (as documented in Letter D13453) from DSN 001A-2 to DSN 001B-2.
- (15) Increase the maximum daily flow from DSN 001B of NPDES Permit No. CT0003263 to 341,550,000 gallons per day;
- (16) Increase the maximum daily flow from DSN 001B-5 of NPDES Permit No. CT0003263 to 51,340,000 gallons per day;
- (17) Convert the primary source of Unit 2 circulating water pump lubrication water from chlorinated domestic water to plant service water. Chlorinated domestic water may remain available to use as a backup source of water supply;
- (18) Discharge incidental concentrations of ethanolamine (ETA) and hydrazine from Units 1 and 2 resulting from the previously authorized additions of ETA and hydrazine within secondary units at Units 2 and 3. These incidental discharges (as described in Letter D13034) of ETA and hydrazine shall be authorized to DSN 001 of NPDES Permit CT0003263.

III This Emergency Authorization shall become effective on the date it is issued, and shall expire upon a final determination on NNECO's application for reissuance of NPDES Permit No. CT0003263 or upon the Commissioner's determination that the requirements of Section 22a-6k of the Connecticut General Statutes are no longer applicable to the activities authorized herein, whichever is sooner. NNECO shall update the

documented need for this Emergency Authorization as requested. Upon issuance of this Authorization, Emergency Authorizations EA0100123S issued on December 28, 1999, EA0100133RS issued on May 12, 2000, EA0100142R issued on October 29, 1999 and EA0100143R issued on October 3, 1999 shall expire and no longer be in effect.

IV The fee of \$500.00 has been submitted for issuance of this Authorization.

V This Authorization has been issued based on information contained in various submittals, including but not limited to the following:

1. Letter D11343 from D. Amerine to J. Grier received December 22, 1997;
2. Letter D00362 from S. Scace to J. Grier dated August 11, 1997;
3. Letter D11523 from S. Scace to M. Harder dated September 24, 1997;
4. Letter from M. Harder to S. Scace dated October 1, 1997;
5. Letter D11631 from D.B. Amerine to M. Harder Dated November 3, 1997;
6. Letter D12024 from F.C. Rothen to David Cherico dated February 6, 1998;
7. Letter dated August 13, 1997 from M. Harder to S. Scace;
8. Letter D10304, dated October 4, 1996 from S. Scace to M. DiNoia;
9. Letter D12418 request for Emergency Authorization Millstone Unit 3 from Dennis Welch to James Grier received April 29, 1998.
10. Numerous correspondences from Northeast Nuclear Energy Company to DEP as referenced in Letter (D13038) from Paul M. Jacobson to James Grier dated September 1, 1998 and all documents referenced therein;
11. Correspondence D13275 dated September 13, 1998 from P. Jacobson to M. Harder and all documents referenced therein;
12. Correspondences D13239 and D13164 from Paul M. Jacobson to James Grier dated September 22, 1998 and August 26, 1998 respectively, and all documents referenced therein;
13. Correspondence D15453 from Paul Jacobson to James Grier dated February 3, 2000 and all documents referenced therein.
14. Millstone Nuclear Power Station Technical Specification Manuals for Units 1, 2, and 3.
15. Correspondence D16432 dated October 2, 2000 from Paul M. Jacobson to James Grier and all documents referenced therein.

VI 1. DEFINITIONS

The definitions of terms used in this Authorization shall be the same as the definitions contained in C.G.S. section 22a-423, and section 22a-430-3(a) of the Regulations of Connecticut State Agencies.

Any person who, or municipality which initiates, creates, originates, or maintains a discharge for which an authorization is issued must comply with that authorization. If the source or activity generating the discharge for which an authorization is issued is owned by one person or municipality but is leased or in some other way the legal responsibility of another person or municipality (the discharger), the discharger is responsible for compliance with any authorization issued by the Commissioner.

VI. EFFLUENT LIMITATIONS & SPECIAL CONDITIONS:

(1) The following discharge limits shall not be exceeded at any time:

- (a) The flow of the Units 2 and 3 service water strainer backwashes shall not exceed 2600 gallons per minute.
- (b) The discharge of Units 2 and 3 pump lubrication and leak off wastewater shall be maintained only when such discharges are necessary for plant operation.
- (c) The pH of the Units 2 and 3 service water strainer backwash discharges shall not be less than 6.0 or greater than 9.0 standard units at any time.

(2) The following special conditions shall be complied with at all times:

- (a) The Units 2 and 3 service water strainer backwash discharges shall not exceed the limitations specified in section VII. (1) above of this Authorization. The treatment system(s) shall be maintained as necessary to ensure that all limitations are met.
- (b) Best management practices shall be implemented to ensure that no liner, debris, building materials or similar materials are discharged to the waters of the state.
- (c) Operational practices as outlined on page four, section 3) A. 1 and 2 of the December 22, 1997 correspondence D11348 from Northeast Utilities to James Grier (Ref: Attachment 1) shall be implemented at all times.
- (d) The management practices referenced as a) through d) on pages 3 and 4 of Letter D12413 (Ref: Attachment 2) shall be followed during all periods of discharge.
- (e) The management practices referenced as e) on page 4 of Letter D12413 (Ref: Attachment 2) shall be followed upon commencement of discharge at DSN 001C-9.
- (f) No discharge shall cause a violation of any condition or effluent limit as set forth in NPDES Permit CT0003263, except as authorized herein.
- (g) The total mass of ETA discharged from Millstone Unit 3 during any day shall not exceed 636 kilograms.
- (h) During discharge of 001C-8 pursuant to section II.(3) of this Authorization, the maximum daily flow of 001C-8 may exceed 100,000 gallons per day provided the total daily flow from Millstone Unit 3 during that day does not exceed 1,410,600,000 gallons.
- (i) Units 2 and 3 service water chlorine injection points may be used as specified in submittals from NNECO referenced herein. At all times chlorine injection shall be regulated to maintain the minimum

concentration needed to inhibit or eliminate biological activity.

- (j) The concentration of hydrazine at DSN 006 shall not exceed either 50 ppb monthly average or 300 ppb daily maximum.
- (k) During periods when auxiliary feedwater is used in the Unit 2 steam generators, the total daily combined mass of hydrazine discharged via DSN 001B-1 and DSN 001B-1(a) shall not exceed 33.12 kg/day at a hydrazine concentration of no more than 125 ppm.
- (l) With respect to hydrazine treatment at DSN 001B-6 (Unit 2 Condensate Polishing Facility), treatment practices as set forth in section 2 (pages 4-6) of correspondence (D13038) from NNECO to J. Gner dated September 1, 1998 (Ref: Attachment 3) shall be implemented.
- (m) During all periods of discharge, measures to mitigate the impact of ETA on the receiving water shall be implemented as specified in Letter D12413 referenced in section V. (9) of this Authorization.

#### VIII MONITORING REQUIREMENTS:

- (a) Unless otherwise specified in this Authorization, all samples collected to verify compliance with the limits in this Authorization shall be grab samples. All samples shall be collected at points specified in this Authorization.
- (b) On a semi-annual basis (June and December) sampling for chlorine (free, and total residual) shall be conducted between the wash racks and traveling screens at Units 2 and 3. These samples shall be collected from the intake bays of active circulation pumps.
- (c) On a semi-annual basis (June and December) sampling for chlorine (free, and total residual) shall be conducted at Units 1, 2 and 3 for discharges from:
  - (1) The circulating water pump lubrication strainer backwash or source water for the circulating water pump lubrication strainer for Units 2 and 3.
  - (2) The service water strainer backwash for Units 1, 2 and 3.
  - (3) Flow estimates and field pH measurements of these discharges shall be recorded during every sampling event.
- (d) On a monthly basis daily composite sampling for ethanolamine (ETA) and hydrazine shall be conducted at the DSN 006 sampling station; flow monitoring and the range of pH measurements shall be recorded for each sampling event.
- (e) During periods when auxiliary feedwater is used in the Unit 2 steam generators, weekly grab sampling for hydrazine shall be conducted at DSN001B-1; total daily flow and pH measurements shall be recorded during each sampling event.
- (f) On a quarterly basis (March, June, September and December) sampling for ETA shall be conducted at DSNs 001C-2, 001C-3, 001C-4, 001-6(b), and 001C-9 of NPDES Permit No. CT0003263.
- (g) In the event of an emergency condenser hotwell discharge as authorized in section II.(5) of this Authorization, DSN 001C-3 shall be monitored weekly for ETA and all associated pollutant parameters required pursuant to NPDES Permit No. CT0003263.
- (h) On a quarterly basis (March, June, September and December) submit a summary of activities relative to the discharge of fire water system discharges as authorized in section II. (13) of this Authorization.

- (i) On a quarterly basis (March, June, September, and December) sampling for ETA and hydrazine shall be conducted at DSNs 001A-2, 001B-2, and 001B-3. Estimated total daily flow shall be recorded for every sampling event.
- (j) On a weekly basis sampling for hydrazine, ammonia nitrogen, and, when used, hydrogen peroxide shall be conducted at the Unit 2 Condensate Polishing Facility (DSN 001B-6). Estimated total daily flow, estimated instantaneous flow, and estimated number of discharge hours per day shall be recorded for each sampling event.
- (k) All sample analyses which are required by this Authorization shall be performed using methods approved in accordance with 40CFR Part 136 or as approved in writing by the Commissioner, or as pending before the Commissioner in correspondence D10304 dated October 4, 1996.

IX. REPORTING REQUIREMENTS:

- (a) Unless otherwise stated in this Authorization, NNECO shall submit the results of all monitoring as required in section VIII. of this Authorization on a quarterly basis, no later than 30 days following the last month of each quarter (March, June, September, and December). A monthly summary of any violations of any of the limitations, terms or conditions of this Authorization, cause of any violation(s), and corrective action(s) undertaken and/or planned shall be submitted within 30 days of the beginning of the following month. NNECO shall comply with all reporting and notification requirements as specified in Sections 22a-430-3 and 4 of the Regulations of Connecticut State Agencies and as required in this Authorization. All monitoring reports and notifications specified herein shall be submitted to DEP at the address noted in section IX. (c) of this Authorization.
- (b) All reports shall be submitted in a reporting format prescribed by the Commissioner, as attached to this Authorization, or as later revised by the Commissioner.
- (c) If a violation of any of the discharge limits specified in this Authorization occurs, the Commissioner shall be notified within 2 hours of becoming aware of the circumstances, or the next business day if NNECO becomes aware of such circumstances outside of normal business hours. Written notification must be submitted to the DEP within 48 hours at the following address:

Mr. James Grier  
 Department of Environmental Protection  
 Water Management Bureau  
 Bureau of Water Management  
 79 Elm Street  
 Hartford, CT 06106-5127.

- (d) NNECO shall notify the DEP in writing of the date of final discontinuance of any discharge authorized herein.

X. OTHER REQUIREMENTS:

- 1) NNECO shall comply with all applicable Regulations of Connecticut State Agencies, including, without limitation,

Section 22a-430-3  
 Subsection (b) General - subparagraph (1)(D) and subdivisions (2),  
 (3), (4) and (5)

Subsection (c) Inspection and entry  
 Subsection (d) Effect of a Permit - subdivisions (1) and (4)  
 Subsection (e) Duty to Comply  
 Subsection (f) Proper Operation and Maintenance  
 Subsection (g) Sludge Disposal  
 Subsection (h) Duty to Mitigate  
 Subsection (i) Facility Modifications, Notification - subdivisions  
 (1) and (4)  
 Subsection (j) Monitoring Records and Reporting Requirements - subdivisions  
 (1), (6), (7), (8), (9), and (11) (except subparagraphs (9)(A)(2), and (9)(C))  
 Subsection (k) Bypass  
 Subsection (m) Effluent Limitations Violations  
 Subsection (n) Enforcement  
 Subsection (o) Resource Conservation  
 Subsection (p) Spill Prevention and Control  
 Subsection (q) Instrumentation, Alarms, Flow Recorders  
 Subsection (r) Equalization

Section 22a-430-4

Subsection (t) Prohibitions  
 Subsection (p) Revocation, Denial, Modification, Appendices

- b) The following additional terms and conditions shall be complied with:
1. This Authorization is for the discharge of (A) pollutants in quantities and concentrations as specified in this Authorization and in correspondence submitted by NNECO, as set forth in section II. of this Authorization; and (B) any substances resulting from the processes or activities described in this Authorization and correspondence by NNECO, as set forth in sections I. and II. of this Authorization in concentrations and quantities which the Commissioner determines cannot reasonably be expected to cause pollution. However, the Commissioner may seek an injunction or issue an order to prevent or abate pollution, and may seek criminal penalties against a person who willfully or with criminal negligence causes or threatens pollution.
  2. Discharge of any substance which is not from the processes or activities described in this Authorization in correspondence submitted by NNECO, as set forth in sections I. and II. of this Authorization, shall be considered a violation of this Authorization unless it is authorized by an individual permit issued under Section 22a-430 of the General Statutes or a general permit issued under section 22a-430b of the General Statutes.
  - 3) Within fifteen days after the date NNECO becomes aware of a change in any information submitted to the Commissioner under any registration of this Authorization, or that any such information was inaccurate or misleading or that any relevant information was omitted, NNECO shall submit the correct or omitted information in writing to the Commissioner.
  - 4) Nothing in this Authorization shall relieve NNECO of other obligations under applicable federal, state and local law.
  - 5) Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under this Authorization by NNECO shall be signed

by NNECO and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows: "I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense".

- 6) Any false statement in any information submitted pursuant to this Authorization may be punishable as a criminal offense under Section 22a-438 of the General Statutes or, in accordance with Section 22a-6, under Section 53a-157 of the General Statutes.
- 7) The Commissioner reserves the right to make appropriate revisions to this Emergency Authorization in order to establish any appropriate effluent limitations, schedules of compliance, or other provisions which may be necessary to adequately protect human health and the environment.
- 8) The Commissioner may order summary suspension of this Authorization in accordance with Section 4-182 of the Connecticut General Statutes.

I find that this Authorization is necessary to prevent, abate or mitigate an imminent threat to human health and the environment, and such Authorization is not inconsistent with the Clean Water Act.

Entered as an Emergency Authorization of the Commissioner of Environmental Protection.

10/13/00  
Date

  
Arthur J. Rocque, Jr.  
Commissioner

Facility ID. 152-003  
Application No. 2000-10EA  
Authorization No. EA0100176

2/212/21 1/10 1/100 5005

Question 1: NRC documents, with titles, authors and dates, of all studies of health effects of exposure to radionuclides and chemicals present at Millstone upon persons who have worked at Millstone, either as employees or contractors or in any other capacity, since 1970.

Response: We have no such documents.

Question 2: NRC documents, with titles, authors and dates of all studies of health effects observed, catalogued or studied in any way in the population of individuals identified in section (1) above after they have left service at Millstone and until their deaths.

Response: We have no such documents.

Question 3: NRC documents, with titles, authors and dates of all studies of health effects of exposure to radionuclides and chemicals present at Millstone on persons who have worked at Millstone, either as employees or contractors or in any other capacity, since 1970, based on postmortem evaluation.

Response: We have no such documents.

Question 4: NRC documents, with titles, authors and dates of all studies of health effects of exposure to radionuclides and chemicals, present at Millstone as well as discharged from Millstone, upon members of the public.

Response: We have no such documents.

Question 5: Please provide citations to the statutes, regulations and other legal requirements which identify what information a nuclear licensee such as the Millstone Nuclear Power Station is required to provide to the NRC with regard to the following:

- (1) Reporting data of worker exposure to radiation;
- (2) Reporting data of health effects of worker exposure to radiation and chemicals during their terms of employment or assignment;
- (3) Reporting data of health effects of worker exposure to radiation and chemicals, both among employees and contract workers, following their departure from the licensee;
- (4) Reporting data of cancer incidences among present and former workers;
- (5) Reporting data of cause of death among former workers.

Response: 10 CFR 20.2206 requires licensees to submit information annually about the results of individual dose monitoring. However, according to 10 CFR 20.2106, this information is protected from public disclosure because of its personal privacy nature. In addition, the Millstone Technical Specifications, which are part of the operating license, require an annual

report to the NRC of total plant occupational radiation exposure. There is no NRC requirement to report data about the health of workers.

Question 6: Please identify by title and date all information provided to the NRC by the owners and operators of the Millstone Nuclear Power Station since 1970 responsive to item (5) above.

Response: All reports to the NRC regarding occupational dose that are available to the public are in the PDR. NUREG-0713, Volume 25, "Occupational Radiation Exposure at Commercial Power Reactors and Other Facilities 2003," summarizes the occupational exposure for each power plant including Millstone. It also has historical data for many years.

Question 7: Please provide the titles of all records reviewed by you and your staff with regard to the draft EIS of the phenomenon of the incidences of brain tumors among workers in the former "site maintenance" department at Millstone c. 1994 as well as the incidence of cancer and other diseases among contract workers fulfilling the job requirements of the former "site maintenance" department after the "site maintenance" department was eliminated c. 1994

Response: We have no such documents.

Question 8: Please provide the titles of all records reviewed by you and your staff with regard to the draft EIS of the phenomenon of the incidences of cancer and disease among persons who have worked as pipefitters at Millstone.

Response: We have no such documents.

Question 9: Please provide the titles and dates of all records reviewed by you and your staff with regard to the draft EIS of the phenomenon of the incidences of cancer and disease among non-workers within 5-mile, 10-mile and 50-mile radii of the Millstone Nuclear Power Station.

Response:

10/12/03 3/3/18 4/12/00 1/10/18 1/15/00 3/16/00 1/2/00 1/10/00 1/18/00 3/3/00 1/10/00  
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Handwritten text, likely bleed-through from the reverse side of the page, containing various numbers and symbols.

Question 10: Please provide the dates and titles of all documents reviewed by you and your staff regarding radiological and chemical effluents discharged by the Millstone Nuclear Power Station since 1970.

Response: Section 2.1.4 of the Millstone DSEIS lists the documents that we reviewed regarding radiological effluent releases from Millstone. Section 2.2.3 that we reviewed the National Pollutant Discharge Elimination Permit (NPDES) regarding chemical effluent releases. During the environmental site audit, we met with Ken Major, Margaret Welch, Charles Nezianya, and Lee Dunbar of the Connecticut Department of Environmental Protection to discuss Millstone's compliance with the NPDES. Lee Dunbar was the expert on chemical toxicity issues.

Question 11: Please provide a list of the chemicals used and discharged at Millstone since 1970, as reviewed by yourself and your staff, and please provide the analysis applied in the draft EIS of how the environment would be affected if the Millstone Nuclear Power Station were to convert from an open to a closed cooling system, particularly as to how such conversion would reduce or eliminate the need for use and discharge of toxic chemicals to the environment.

Response: The NPDES permit issued by the Connecticut Department of Environmental Protection was reviewed as indicated in Section 2.2.3 of the Millstone DSEIS. No additional list of chemicals released from Millstone was obtained. No analysis was done by the staff of possible reductions in chemical effluents that could be achieved by converting to a closed cooling system.

Question 12: At pages 4-55 – 4-56 of the draft EIS, the following statements appear:

"CTDEP [Connecticut Department of Environmental Protection] conducts its own radiological environmental monitoring program around Millstone. . . . CTDEP concluded that Millstone's radiological effluent and environmental monitoring data were accurate."

With regard to such statements, please identify the names of all CTDEP individuals who provided such statements to you and your staff, the date(s) such statements were made, whether such statements were in writing or verbal (if in writing please provide a copy), and the dates, times, methods of analysis and monitoring referred to and the results of such monitoring as provided to you and your staff.

Response: On April 24, 2004, Brian Colby of Los Alamos National Laboratory and I talked by

telephone with Dr. Edward Wilds, Director of the Division of Radiation, and Michael Firsick, Supervising Radiation Control Physicist, of the Connecticut Department of Environmental Protection. I talked with Dr. Wilds at the public meetings on February 17, 2004 and January 11, 2005. I also talked with Mr. Firsick by telephone in the Fall of 2004 to confirm that nothing had changed since the April telephone call. I received no written statements from these individuals.

Question 13: Please identify and explain the methodology you and your staff applied in reconciling the CTDEP statements (see (12) above) with Northeast Nuclear Energy's Company's plea of guilty to committing environmental felonies during a period of time (c.1990s) while CTDEP conducted onsite monitoring of Millstone effluent releases.

Response: As we indicated in the Millstone DSEIS, we reviewed the last few years of effluent and environmental monitoring reports for Millstone. We concluded that the radiological data in these reports serve as a valid indicator of the radiological effluents that can be expected at Millstone during the renewal period.

Question 14: At page 4-56 of the draft EIS, the following statement appears:

"CTDEP also concluded that the reports cited above by CTDPH, CASE and the National Cancer Institute reports showed no evidence of a causal link between public exposure to Millstone's radiological effluents and cancer in Connecticut towns."

With regard to such statements, please identify the names of all CTDEP individuals who provided such statements to you and your staff, the date(s) such statements were made, and whether such statements were in writing or verbal (if in writing please provide a copy).

Further with regard to such statements, please state whether you and your staff requested such CTDEP personnel to review other documents asserting such a causal link as submitted to the NRC by the Connecticut Coalition Against Millstone, including affidavits of Dr. Ernest Sternglass, Joseph Mangano, Michael Steinberg and Cynthia Besade and, if not, please explain.

Response: The statements regarding conclusions by CTDEP were based on the communications with Dr. Wilds and Mr. Firsick discussed in the response to Question 12. They indicated that they had not reviewed the claims by Dr. Mangano and Dr. Sternglass; we did not ask them to review those claims.

# **CONNECTICUT COALITION AGAINST MILLSTONE**

[www.mothballmillstone.org](http://www.mothballmillstone.org)

March 14, 2005

Public Health Committee  
Connecticut General Assembly  
Legislative Office Building  
Hartford CT 06106

Environment Committee  
Connecticut General Assembly  
Legislative Office Building  
Hartford CT 06106

Dear Public Health Committee and Environment Committee:

The Connecticut Coalition Against Millstone requests your immediate attention.

The Coalition is an organization of statewide safe-energy groups, families and Millstone whistleblowers devoted to serving as a watchdog over the operations of the Millstone Nuclear Power Station in Waterford.

It has come to our attention that a little boy, Zachary M. Hartley, whose mother swam regularly at a beach in Niantic (East Lyme) which is vulnerable to Millstone waterborne contamination, was born in 1997 with a rare cancer in his jawbone. The jawbone and a tumor the size of an orange were removed during a life-saving 23-hour surgery when Zachary was 14 months of age. Doctors were unable to remove the entire tumor because of the high risk of death. Zachary is now 7 years old and is under constant medical surveillance. He is about to undergo major facial reconstructive surgery.

Zachary's parents recently contacted the Coalition for help in determining the cause of Zachary's medical condition.

The Coalition researched the records of Millstone's reported radiological and chemical releases to the environment during 1997. We learned that

Northeast Utilities, the then-owner of Millstone, reported it had caught a fish that year contaminated with the deadly radionuclide cesium-137 in Niantic Bay halfway between the Millstone discharge point and Hole-in-the-Wall Beach, where Zachary's mother swam during critical months of her pregnancy.

The Coalition learned that the Connecticut Department of Environmental Protection permits Millstone to discharge incredibly toxic materials at heightened levels of concentration within a "mixing zone" which has a radius of 8,000 feet from the discharge point. The beach in Niantic where Zachary's mother swam is within this radiological and chemical "mixing zone" – hardly a safe place for an expectant mother to be. Satellite photographs in our possession track the path of Millstone's thermal plume flushing these deadly contaminants toward the Niantic beaches twice a day, every day, as well as the Waterford beaches to the east.

At a press conference on March 10, 2005, Dr. Helen Caldicott, world-renowned pediatrician and expert on the health effects of low-level ionizing radiation, having examined Zachary's medical records, stated that the cancerous tumor may have resulted from embryonic exposure to cesium-137, as cesium-137 is medically linked to bone cancer. Zachary's mother might have ingested cesium-137 – or any one of dozens of radionuclides and toxic, volatile and carcinogenic chemicals Millstone routinely flushes into the Niantic Bay – by any of four pathways: ingestion, breathing, skin contact or by eating a radioactively contaminated fish.

Neither the Hole-in-the-Wall Beach nor any other beach in East Lyme to the west of the Millstone discharge point, nor Pleasure Beach directly to the east of the Millstone discharge point, is posted with warning signs that swimming in these waters will expose unborn children to risk of birth defects and cancer. Zachary's mother was utterly unaware that she was swimming in a radiologically and chemically-contaminated "mixing zone" when she was pregnant with Zachary. Had the beach been properly posted, she would have avoided it like the plague.

The Coalition is aware of numerous other medical cases which strongly suggest a link to exposure to waterborne radiological and chemical effluents discharged by Millstone. These include a woman who recently died of skin cancer – confined to her feet – who frequently waded in the "mixing zone" waters, a rare thyroid cancer which developed in a young

woman exposed to effluent at Crescent Beach in East Lyme, and even a pet Labrador retriever, which succumbed recently to a rare spinal osteosarcoma at one-and-a-half years of age. The dog frolicked frequently along the shoreline of Niantic Bay.

The Coalition is investigating these and other cases as well.

Considering the information now known about Zachary and his medical condition, and the daily, routine discharges from the Millstone Nuclear Power Station to the "mixing zone," we declare to you that swimming at the East Lyme and Waterford beaches is a hazard to health and to unborn children.

We urgently request the Public Health Committee and the Environment Committee to convene a joint hearing to investigate the Millstone radiological and chemical discharges and their relation to public health.

Zachary and his parents request that they be permitted to testify at the outset of the hearing.

Given the information available to date, prudence dictates that the shoreline beaches of East Lyme and Waterford be closed to the public until it may be established with certainty that human contact with the radiological and toxic waste products flushed out of Millstone in the mixing zone is not harmful to children and other living things.

We recognize that your full consideration of this issue may require you to enact legislation which will close the Millstone Nuclear Power Station. Please be advised that Northeast Utilities acknowledged to the DEP in a 1993 report that it could continue producing electricity and virtually eliminate the radiological and toxic chemical discharges to the Niantic Bay area by converting from the present "once-through" cooling system to a "closed" cooling system which would recycle waste onsite rather than release it to the environment. Connecticut's DEP never pursued this alternative. It is sobering to consider that Zachary M. Hartley might have been born without life-threatening jawbone cancer if the DEP had ordered Millstone to convert from once-through to a closed cooling system in 1993.

On behalf of the Hartleys and the Coalition, we thank you for your urgent attention to this matter.

For your further information, we attach news articles which appeared on March 11, 2005 in the Hartford Courant, Norwich Bulletin and The New London Day.

Sincerely,

Nancy Burton

Please respond to:  
Nancy Burton  
147 Cross Highway  
Redding Ridge CT 06876  
Tel. 203-938-3952

## **Boy's Cancer Blamed On Millstone**

### **Mom's Exposure To Chemicals Alleged**

By THOMAS D. WILLIAMS  
Courant Staff Writer

March 11 2005

NIANTIC -- Seven-year-old Zachery M. Hartley has a rare, disfiguring cancer of the jaw. His parents and an internationally known physician blame the Millstone nuclear power plant.

Dr. Helen Caldicott, a co-founder of Physicians for Social Responsibility, said Thursday that it is likely the rare disorder afflicted Zachery because his mother swam in the ocean near the nuclear plant during her pregnancy.

At a bayside press conference, Caldicott said Tonia Hartley came in contact with radiological compounds discharged from the plant into Niantic bay.

Michael and Tonia Hartley and a state anti-nuclear group are demanding that Millstone be shut down and that swimming in the bay be prohibited.

Although Millstone was closed at the time in 1997 when Tonia Hartley went swimming, Caldicott said, the plant was "washing out with volatiles [chemicals] and that had a synergistic effect" making the water emissions extremely hazardous. She said anyone swimming in the bay then could have been exposed to the chemicals by swallowing or breathing them, absorbing them through the skin or eating contaminated fish from the bay.

But, Peter Hyde, spokesman for Dominion Nuclear Connecticut Inc., the plant's operator, said: "We've looked at this and we empathize a great deal with this boy and his family. But we don't agree that there is any evidence that

Millstone caused this boy's cancer. We live here. We swim in this water. We would never do anything consciously to cause harm to our families or neighbors."

Hyde said Caldicott did not say she could definitively link the cancer to the plant's emissions.

Invited to the press conference by the Connecticut Coalition Against Millstone, Caldicott said 17 to 19 similar occurrences of rare cancers have been reported among people living in the vicinity of Brookhaven National Laboratory on Long Island, N.Y.

Brookhaven, begun in 1947 as a nuclear-science research center, conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national security for the U.S. Department of Energy.

The Hartleys did not fully link Tonia Hartley's swimming to her son's cancer until January while viewing a public television broadcast of the coalition opposing Millstone's pending re-licensing application, said Nancy Burton, a coalition leader.

Tonia Hartley, who swam regularly for seven months while she was pregnant, was in Boston Thursday readying for Zachery's next major operation, but sent a tape recording of her comments to the conference.

"Connecticut is not looking out for its children," she said. "There were no signs posted on the beach by the state, the town or the federal government that swimming in the water could be hazardous to my unborn child.

"I'm sharing our story as a mother looking out for the community so the community can make an educated decision knowing the price we paid for being unaware. This has been a nightmare for my family for seven years and it is continuing to be a nightmare for the rest of Zachery's life," she said.

As his son stood by, Michael Hartley said he and his wife decided to go public because "no one in town has said anything about this, and if they know they are not talking. I want the public to vote on it," he said.

An advocate of citizen action to remedy the nuclear and environmental crises, Caldicott, 66, has spent the past 35 years on an international campaign to educate the public about the medical hazards of the nuclear industry.  
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Friday, March 11, 2005

Troubled waters?: Group: Plant pollution may have sickened boy

By JENNY BONE MILLER  
Norwich Bulletin

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Photos by Tali Greener/Norwich Bulletin

Zachary Hartley, 7, and his dad, Michael, both of Canterbury walk along Hole-in-the-Wall Beach Thursday in Niantic. Zachary Hartley, 7, and his dad, Michael, both of Canterbury, sit at the Morton House Thursday in Niantic. Zachary has been diagnosed with a rare facial cancer believed to have been the result of chemical and radiological discharges from water around the Millstone Nuclear Power Station. Caldicott  
THE CALDICOTT FILE WHAT IS RHABDOMYOMA?

Name:Dr. Helen Caldicott.

Fame:Activist for anti-nuclear and environmental causes for 30 years.

Background:Was instructor in pediatrics at Harvard Medical School, specializing in cystic fibrosis, and on staff at Children's Hospital Medical Center, Boston, until 1980. Founded Cystic Fibrosis Clinic at the Adelaide Children's Hospital in 1975. Founded Physicians for Social Responsibility, an organization of doctors against nuclear arms and power.

Honors: 19 honorary degrees, nominated for Nobel Peace Prize, author of five books, subject of several documentary films, including *Eight Minutes to Midnight*, nominated for an Academy Award in 1982, and "If You Love This Planet," Academy Award winner for best documentary in 1983.

Today: Divides her time between Australia and the United States. President of The Nuclear Policy Research Institute ([www.nuclearpolicy.org](http://www.nuclearpolicy.org)) based in California.

Rhabdomyoma is a rare tumor that develops in muscle tissue. It is diagnosed most often in men ages 25-40.

Fetal rhabdomyoma, however, chiefly affects boys between birth and 3 years old.

EAST LYME -- A Canterbury first-grader will have painful surgery on his face for the fourth time because of a tumor his mother said was preventable.

Tonia Hartley, 24, who lived on State Street in Niantic, swam every day in the Niantic Bay during the summer of 1997, when she was pregnant with Zachary, who is 7 now.

She and Zachary's father, Michael Hartley, 26, said Thursday at a press conference organized by the Connecticut Coalition Against Millstone, that cesium-137 and other chemicals emitted into the water from the nearby Millstone Nuclear Plant caused a rare benign tumor the size of an orange in Zachary's mouth. That tumor contained another, cancerous tumor.

When Zachary was 14 months old, doctors removed part of his jaw and the fetal rhabdomyoma, which had a fetal rhabdomyosarcoma inside it, in a surgery that took 23 hours. Before that he had three biopsies.

Zachary, an active boy who takes karate lessons and likes monster trucks, will have facial reconstructive surgery this summer. Doctors will break his leg to take some bone to build a new jaw for him. Despite the pain, his mother said, he is anxious to have the surgery to end the constant teasing he has endured from his peers. When asked if he was afraid of the surgery Thursday, he quickly said no.

"It hurts me more than anything to know that if I hadn't lived there, if I didn't swim there, he would be OK," Tonia Hartley said in a taped message that was played at the news conference. She was in Boston arranging for Zachary's next surgery and left the tape to be played on her behalf.

In 1997, a fish contaminated with cesium-137 was found in the bay. The family suspected the chemicals in the water might have caused Zachary's problems when they were diagnosed, but their fears were dismissed as paranoia, Michael Hartley said.

Shortly after Zachary's birth, they moved to Canterbury, where Tonia had a second, healthy son, who is 3 years old.

In January, the family saw that the Northeast Nuclear Energy Co., which owned Millstone in the 1990s, had admitted falsifying environmental records and dumping hundreds of gallons of hydrazine, a toxic chemical used to reduce the corrosion of pipes, into Long Island Sound.

In February, they contacted the coalition and said the Hartleys wanted to tell the public their story.

"Millstone has been dumping chemicals into the water for years, and they say it's no big deal," Michael Hartley said. He and Zachary visited the Hole-in-the-Wall beach where Tonia swam so many years ago for the news conference. Red and white striped Millstone towers were visible on the horizon as Zachary walked along the shore.

"I'm here to say it's not safe," Michael Hartley said.

Dr. Helen Caldicott, well-known former Harvard instructor in pediatrics and anti-nuclear activist, supported the family's claims at the news conference. She said although there is no way to know with 100 percent certainty what causes any cancer, more than 17 rhabdomyomas were diagnosed in the immediate area around the nuclear power plant in Brookhaven, N.Y.

"As a good physician, you'd have to suspect," she said. "Cesium 137 causes tumors like this boy has."

The family has not filed papers for a lawsuit. Michael Hartley said they want the power plant closed, but at the very least the bay should be closed to swimming. He said they would consider filing a lawsuit in the future if that's what it takes to close the plant, but they have not hired a lawyer yet.

"I would like the state to do some real studies on this. What they have now are based on the state tumor registry, and those can't be accurate because Zachary's tumor wasn't registered," he said. "It wasn't 100 percent cancer, even though there were cancer cells inside the tumor, so he wasn't counted."

Environmental factors have not been identified as causes of fetal rhabdomyoma, Richard V. Worrell, vice chairman emeritus of the department of orthopedics, University of New Mexico School of Medicine, wrote in an article at [www.emedicine.com](http://www.emedicine.com).

"We have a lot of empathy for the family, but we absolutely disagree with the correlation to Millstone Power Plant," Pete Hyde, spokesman for Millstone, said. "We emit only a fraction of the radiation we are allowed by federal guidelines. They make the claim that one fish was found with cesium-137. Did they say how much? They have no scientific background and they make the case that because one child had a tumor it must be Millstone's fault."

He said Millstone employees raise their families near the plant and swim in the water. The Nuclear Regulatory Commission gave Millstone a glowing report this month, he said.

In the 1990s, the plant was owned by Northeast Utilities, and there were some problems with environmental reports then. But in 2001, it was bought by Dominion and has a clean record.

Hyde acknowledged the plant emits trace amounts of chemicals.

"By trace amounts, we're talking parts per million or parts per billion, with a B," Hyde said. "The coalition has one agenda, and that's to shut down Millstone Power Plant. We just don't agree with their conclusions."

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Originally published March 11, 2005

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Featured in Health

Group Says Boy's Cancer Was Caused By Millstone Emissions  
Coalition Urging EL To Close Town Beaches

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Dr. Helen Caldicott, right, a renowned pediatrician and authority on the health effects of low-level ionization radiation, speaks on a possible link between a rare jawbone cancer in Zachary M. Hartley, 7, of Canterbury. Mike Hartley, Zachary's father, is at left during a news conference at the Morton House. Zachary's photo is above him.

By JUDY BENSON  
Health/Science/Environment Reporter  
Published on 3/11/2005

East Lyme — An organization seeking the shutdown of the Millstone Nuclear Power Station is urging closure of town-owned beaches on Niantic Bay and is linking a 7-year-old boy's rare facial tumor to radiation and carcinogenic chemical emissions from the plant, located about 1.5 miles across the bay in Waterford.

The boy's mother, Tanya Hartley, is a former East Lyme resident and swam regularly at the town's Hole-in-the-Wall beach during her pregnancy, according to her husband, Michael, who took part in a news conference called by the Connecticut Coalition Against Millstone on Thursday. The family currently lives in Canterbury. The news conference was held in the lobby of the Morton House apartment building on Main Street, across the street from the bay.

First Selectman Wayne Fraser said he had no response to the group's request and that he had not previously been informed about the boy's tumor, which required extensive surgery to remove it. Michael Hartley said part of the tumor was cancerous and part was benign, and that his son will undergo facial reconstruction surgery this summer in Boston.

Fraser said he would seriously consider any health concerns raised by the state Department of Public Health or other officials, but none have been raised in conjunction with Millstone. The town has no plans to close its beaches or post safety warnings, as the coalition requested in a March 9 letter.

"We react to proper methods and officials," he said. "East Lyme strongly supports a safe Millstone for families and a safe working environment for employees."

The news conference included remarks by Dr. Helen Caldicott, a pediatrician, author and nuclear disarmament activist who is also against nuclear power and the health risks she believes it carries for those who live near plants. Caldicott came at the invitation of Nancy Burton of Redding Ridge, coalition leader.

Caldicott said that from her review of the boy's medical records, she believes there is a strong possibility his tumor was caused by his mother's exposure to the plant emissions in the air and water. The plant releases chemicals that are "very carcinogenic," she said.

"I wouldn't want to live here," she said. "These plants must be shut down for the health of the people in this area."

Peter Hyde, spokesman for Millstone, said the plant is closely monitored by the federal Nuclear Regulatory Commission and is within acceptable limits for radiation and other emissions.

"We empathize with the mother and her child, but to make the leap between Millstone operations and this poor child's illness is not supportable," he said.

The NRC has not been contacted with safety concerns about Millstone related to the boy's illness, according to NRC Spokesman Neil Sheehan. Members of the public can petition the NRC about safety issues, he said, but that has not been done in this case.

Concerns about cancer rates around the plant were raised during recent public hearings about plant re-licensing, he said, and results of several studies were reviewed as part of that process, he said. The NRC concluded there is no evidence linking cancer rates to the plant.

"It's certainly difficult to make some cause-and-effect relationship between swimming and cancer," Sheehan said.

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**Dominion Resources, Inc.**  
A PUBLIC CITIZEN CORPORATE PROFILE



OCTOBER 2004

# Public Citizen Corporate Profile: Dominion Resources, Inc.

*A special report by Public Citizen's Critical Mass Energy and Environment Program*

October 2004

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Public Citizen, founded in 1971, is a non-profit research, lobbying, and litigation organization based in Washington, D.C. Public Citizen advocates for consumer protection and for government and corporate accountability, and is supported by over 150,000 members throughout the United States.

## Introduction

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As a vast, diversified, and aggressive energy company, Dominion Resources, Inc. encompasses virtually every aspect of the energy industry, and it is one of the country's largest public utility holding companies. From oil and gas drilling and storage, to electricity generation, transmission, and distribution, Dominion does it all.

It is a company that has achieved a remarkable degree of vertical integration, and thus power: an insatiable thirst for expansion has compelled Dominion to buy up electricity-generating plants while expanding the market for its power by working towards joining the country's largest electricity interconnection, PJM. The company is even taking steps towards building new nuclear power reactors, something that would have been unthinkable just a few years ago.

Not surprisingly, Dominion has not always operated lawfully. The energy giant has been subject to a slew of lawsuits and government violations. In its quest to perpetually increase profits, the effect of this corporate behemoth's operations on the health and welfare of the public is not always taken into consideration. For example, Dominion skimmed on costly pollution-control equipment at one of its fossil-fuel power plants—a violation of federal clean air laws—and ultimately agreed on a billion-dollar settlement with the federal government over the infraction.

But the ability of regulators to keep Dominion in check is not absolute; indeed, the integrity of state officials has, in many instances, been compromised by the power of Dominion and other large energy companies. The company is even trumping its government regulators in the state of Virginia by pushing through legislation that the regulators themselves say is bad for consumers of electricity.

It is therefore essential that the public is aware of the broad reach and tremendous influence of this massive energy company.

## Corporate Overview<sup>1</sup>

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Dominion Resources, Inc. describes itself as a “diversified, fully integrated electric and gas holding company” and “one of the nation's leading energy companies.”<sup>2</sup> Indeed, Dominion is a major publicly-traded corporate player in the domestic energy industry, having broad holdings in various sectors of the energy industry.

The company is based in Richmond, Virginia, and has operations in twenty states and Canada, comprising the full range of the energy industry—from fossil fuels exploration to production, electric generation and transmission. Touting the breadth of its industry dominance, the aptly-named Dominion boasts in its 2003 annual report that it “has the capability to discover and produce gas, store it, sell it or use it to generate power; it can generate electricity to sell to customers in its retail markets or in wholesale transactions,” giving the company the ability to “produce and sell energy in whatever form it finds most useful and economic.”<sup>3</sup>

The mammoth Dominion—with assets of \$44.2 billion, an annual operating revenue of \$12.1 billion, and more than 400,000 shareholders—is divided into four separate business divisions, each comprised of a host of companies:

- **Dominion Generation** is the electric power generation division of Dominion, operating facilities in Virginia (where the majority of its customers reside), West Virginia, North Carolina, Connecticut, Illinois, Indiana, Pennsylvania, and Ohio. Dominion is also seeking to purchase a nuclear plant in Wisconsin and fossil-fuel plants in Rhode Island and Massachusetts. The company operates coal, nuclear, natural gas, and hydro plants. Collectively, Dominion's generating stations have the capacity to produce between 24,000 and 26,000 megawatts of electricity.
- **Dominion Energy** is the company's electric and natural gas transmission operation, with 7,900 miles of interstate gas distribution pipelines in Midwest, Mid-Atlantic, and Northeast states; and 6,000 miles of electric transmission lines, principally in Virginia and North Carolina. This division also encompasses Dominion's multi-state underground natural gas storage system—with 760 billion cubic feet of storage capacity in Pennsylvania, West Virginia, and New York—as well as the country's second-largest liquefied natural gas (LNG) storage facility (Cove Point) on the Chesapeake Bay near Baltimore, Maryland. Dominion's energy trading, marketing, and arbitraging<sup>4</sup> activities—conducted by Dominion Energy Clearinghouse—also fall under this division.
- **Dominion Delivery** comprises the capillaries to Dominion Energy's arteries. This division operates electric and gas distribution systems that draw from transmission lines to provide energy services to millions of customers in Northeast and Mid-Atlantic states. Dominion Delivery also manages 200 billion cubic feet of natural gas storage in Ohio and Pennsylvania. Combined with the company's other storage facilities, Dominion runs the nation's largest gas storage system, with a capacity of 960 billion cubic feet. Dominion's customer service operations also fall under this category.
- **Dominion Exploration & Production** is the gas and oil exploration, production, and development division of Dominion, with onshore and offshore operations in Canada, the Gulf Coast, the Gulf of Mexico, and the continental United States. Dominion owns 6.4 trillion cubic feet of proven natural gas and oil reserves, and it produces more than a billion cubic feet of gas and oil daily. The company drilled 922 wells in 2003 alone.

Dominion's telecommunications business has been discontinued, and its financial services subsidiary is being divested according to the terms of an order from the U.S. Securities and Exchange Commission (SEC).<sup>5</sup>

The various companies held by parent Dominion Resources include Dominion Virginia Power (also known as Virginia Electric and Power Company, or VEPCO) and Dominion North Carolina Power, electric utilities (or "distribution companies," in industry parlance) in Virginia and North Carolina, respectively; Dominion Peoples, a gas distribution company in Pennsylvania; Dominion Cove Point LNG, LP, in Maryland; and Dominion Technical Solutions, Inc., an engineering and construction services company for operators of electric transmission lines, substations, and distribution facilities.

## Money and Politics

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When it comes to politics, Dominion knows how to play the game. Through lobbying, campaign contributions, and favors to legislators, Dominion has been able to exert a considerable influence over government officials, most notably in pushing through Virginia's electric deregulation law in 1999—a highly sought prize for the company. Whether on the federal or state level, Dominion knows that money equals access.

Dominion has been a prodigious funder of the campaigns of candidates for federal elective office. The company has emerged as the fourth-largest federal campaign contributor in the energy sector, giving even more than ExxonMobil: since 1999, Dominion has given over \$3 million to presidential candidates and prospective members of Congress; about two-thirds of that total went to Republican candidates.<sup>6</sup> In that same period, Dominion spent more than \$2.4 million lobbying Congress.<sup>7</sup>

Dominion's access to government regulators extends beyond mere campaign contributions. Dominion's president and chief operating officer, Thomas F. Farrell, was part of the new Bush administration's transition team for the U.S. Department of Energy (DOE), just as Dominion was facing litigation from the federal government for alleged violations of the Clean Air Act.<sup>8</sup> Since 2003, Susan B. Warner, the wife of U.S. Sen. George Allen (R-Va.), has had a seat on Dominion's board of directors, a position for which she earns approximately \$54,000 per year, despite virtually no experience in corporate governance or the electric utility business. The *Virginian-Pilot and The Ledger-Star* of Norfolk called the appointment "influence-buying, pure and simple."<sup>9</sup> Sen. Allen has said that he will continue to vote on legislation that might affect Dominion,<sup>10</sup> and he has accepted \$39,900 in campaign contributions from Dominion, his third-largest contributor, since 1999.<sup>11</sup>

Neither has Dominion ignored the Republican senators from Ohio—home of the company's "East Ohio" natural gas distribution subsidiary. During the Republican Party's 2004 national convention in New York City, Dominion hosted a luncheon in honor of Sens. Mike DeWine and George V. Voinovich. According to a Dominion official, such a gathering provided "an effective way to get all the officeholders together in one location and introduce ourselves or reintroduce ourselves."<sup>12</sup> Both senators have supported comprehensive energy legislation (derived from the infamous energy "task force" lead by Vice President Richard Cheney) favored by Dominion. Dominion has been a top campaign contributor to Sen. Voinovich, shelling out \$26,353 to the Ohio politician since 1999.<sup>13</sup>

Dominion has also been an aggressive lobbyist on the state level in Virginia, where it has won passage of electric restructuring legislation that is opposed by the state's own utility regulator, the Virginia State Corporation Commission.<sup>14</sup> During the 2003-2004 legislative session, Dominion spent more money lobbying Virginia government officials than any other entity, shelling out \$459,990 to fund its small army of lobbyists.<sup>15</sup> Moreover, in apparent attempts to seek favor from state officials, Dominion treated seven Virginia legislators to a Washington Redskins football game at a cost of \$3,154, and the company spent \$1,899 on a hunting outing in Georgia for state Sens. William C. Wampler Jr. (R-Bristol) and Martin E. Williams, (R-Newport News).<sup>16</sup>

## **Exorbitant Executive Compensation**

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Dominion treats its executives well—perhaps too well. In 2003, Dominion’s chairman and chief executive officer, Thomas E. Capps, received \$7.22 million in total compensation, up from \$2.79 million for his work in the previous year. Chief Operating Officer Thomas F. Farrell took home \$3.7 million in 2003—almost three times his earnings the previous year—and Thomas N. Chewning, the executive vice president and chief financial officer, received \$2.85 million in compensation last year.<sup>17</sup> Dominion’s rank-and-file has not failed to notice the remarkable disparity between their compensation and that of Dominion’s elite. The Utility Workers Union of America (UWUA), which represents approximately 3,000 Dominion employees,<sup>18</sup> has pointed out that in 2003, compensation for Dominion’s top five executives increased by 174 percent to \$17.7 million, more than 5 percent of Dominion’s net income, compared to their 2002 earnings of \$6.5 million or half a percent of Dominion’s net income. Dominion executives experienced this extraordinary windfall in a year when the financial performance of the company was less than stellar: net income in 2003 dropped 77 percent from the previous year.<sup>19</sup>

In an attempt to curb excessive executive pay, a coalition of Dominion shareholders called the “Reform Dominion Now Coalition,” led by the UWUA, proposed a resolution to shareholders to require their approval of executive compensation exceeding the limits established by the U.S. Internal Revenue Code for deductibility of employee remuneration—generally \$1 million. Despite an attempt by Dominion management to get the U.S. Securities and Exchange Commission to squash the proposal,<sup>20</sup> the coalition succeeded in getting a vote on the measure at the annual Dominion Resources, Inc. shareholder meeting on April 23, 2004, in Cleveland, where the resolution ultimately failed.<sup>21</sup>

Shareholders had previously sued Dominion and its corporate leadership in 1994, alleging securities fraud and mismanagement. The case was ultimately dismissed.<sup>22</sup>

## **III Corporate Citizenship**

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While Dominion treats its executives as royalty and strives incessantly to win the favor of public officials, the company does not appear to hold the public itself in such high esteem. Dominion doesn’t seem eager to contribute much to the commonwealth, as it has proved remarkably adept at exploiting favorable tax provisions to avoid paying taxes: according to the public interest groups Citizens for Tax Justice and the Institute on Taxation and Economic Policy, Dominion avoided 82 percent of its federal income taxes between 2001 and 2003, paying a mere 3.1 percent rate on its almost \$4.5 billion in profits during that period—a far cry from the statutory corporate tax rate of 35 percent and the sixth-lowest rate among energy companies.<sup>23</sup>

But Dominion’s operation of nuclear reactors has proved especially troubling for its neighbors.

### *Millstone*

Dominion Nuclear Connecticut—a Dominion subsidiary and the operator of the Millstone nuclear power station—is party to a lawsuit against the town of Waterford, Connecticut, alleging that the town's appraisal of Millstone, at \$1.2 billion, was too high (Dominion values the plant at about \$1 billion). The difference is significant: if Dominion wins the case, the town could lose up to \$24 million in tax revenue in 2004 alone. According to *The Day* newspaper of New London, Conn., Waterford city officials accused Dominion of refusing to provide the town with information regarding the methodology the company employed in valuating its plant—until a judge ultimately ordered disclosure of this information.<sup>24</sup>

Other Millstone neighbors have had a disharmonious relationship with Dominion and the plant it operates. On two separate occasions, local fishermen have pursued legal action against the operator of Millstone, most recently in 2002, seeking to recover damages for “intentional interference with fishermen’s livelihood.”<sup>25</sup> The fishermen claimed that discharges of hot water from the Millstone plant—due to its “once-through” cooling system<sup>26</sup>—had depleted the winter flounder stock in the Niantic Bay of Long Island Sound, adversely affecting their business. (In both cases, the court directed the fishermen to pursue their complaint through state regulatory agencies.)

The Millstone nuclear plant may also contribute to public health problems: according to a recent report by the Connecticut Department of Public Health, New London County—where Millstone is located—has the highest age-adjusted cancer incidence rate for women and the second-highest rate for men in the state.<sup>27</sup>

Should an accident or attack occur at Millstone, the safety of nearby residents may not be Dominion’s highest priority. Under a commission from the state of New York, James Lee Witt Associates—a consulting firm headed by its namesake, the former director of the Federal Emergency Management Agency—issued a scathing report on the adequacy of emergency plans for Millstone and the Indian Point nuclear power station near New York City. Nevertheless, Dominion did not compel Connecticut’s Office of Emergency Management to make the recommended changes to an emergency response booklet distributed to residents near Millstone.<sup>28</sup>

### *North Anna*

Dominion’s North Anna nuclear station has also not always been welcome by its neighbors in Virginia. In 1971, displaced landowners brought legal action against Virginia Electric and Power Company (VEPCO), a subsidiary of Dominion, to protest the license it had been granted by the Virginia State Corporation Commission to construct a dam to create a reservoir—which became Lake Anna—for use to cool components of the power station.<sup>29</sup> Another lawsuit was brought against VEPCO by environmental groups in the 1970s alleging an unjust and unnecessary seizure of land for five electric transmission projects, one of which connected the new North Anna power station to the grid.<sup>30</sup> Both lawsuits were ultimately unsuccessful.

### *Property Trespass*

In 2002, landowners again sued VEPCO and its subsidiary Dominion Telecom, Inc., alleging that the company had illegally used easements on their property for a commercial fiber optic network, constituting a “continuing trespass.”<sup>31</sup> The parties eventually agreed to a class action settlement in which Dominion was required to pay about \$7 million to the plaintiffs.<sup>32</sup>

### **Market Malfeasance**

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Dominion’s aggressive business tactics have not only adversely affected the public, but have also crossed the line of legality, violating federal rules governing sensitive market information.

On August 2, 2004, Dominion agreed to a legal settlement with the U.S. Federal Energy Regulatory Commission (FERC) for violations of regulations regarding the sharing of natural gas market information. Over a period of three years, Dominion Transmission, Inc. had shared sensitive, non-public information regarding natural gas inventory levels with its affiliate, Dominion Energy Clearinghouse—Dominion’s energy trading and marketing operation—which, in turn, shared that data with other industry participants before the information became public. This special knowledge gave Dominion, which has the country’s largest underground natural gas storage system, a distinct and unfair advantage in the volatile natural gas market.

By the terms of the settlement, Dominion agreed to pay a \$500,000 civil penalty and offer a refund of \$4.5 million to its natural gas storage customers, as well as institute reforms to prevent future transgressions of this kind.<sup>33</sup>

### **Clean Air Act Violations**

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Misusing market data is a serious infraction, but it is not the only time that Dominion has crossed the federal regulators.

In April 2003, Dominion’s VEPCO agreed to a \$1.2 billion enforcement settlement with the U.S. Department of Justice (DOJ) and the U.S. Environmental Protection Agency (EPA) for violations of the Clean Air Act. The settlement stemmed from violations cited by the EPA for VEPCO’s failure to comply with the New Source Review (NSR) requirements of the Clean Air Act.<sup>34</sup>

The EPA charged VEPCO with failing to obtain the requisite NSR permits for significant modifications it made to its coal-fired Mount Storm Power Plant in West Virginia that resulted in increased power-generating capacity. The Clean Air Act requires that such modifications be accompanied by the installation of pollution-control equipment to mitigate environmental contamination. But VEPCO neglected to install such equipment, which, according to the EPA, resulted in the release of “massive amounts” of sulfur dioxide (SO<sub>2</sub>), nitrogen oxide (NO<sub>x</sub>), and particulate matter.<sup>35</sup>

The Commonwealth of Virginia and the states of New York, New Jersey, Connecticut, and West Virginia joined the suit against VEPCO and ultimately agreed to the consent decree,<sup>36</sup> in which VEPCO agreed to pay the sum of \$1.2 billion for pollution control installations to eliminate thousands of tons of SO<sub>2</sub> and NO<sub>x</sub> emissions by 2013.<sup>37</sup>

The terms of the settlement also include a requirement that VEPCO install emissions-control equipment at eight of its coal-fired electricity-generating plants. VEPCO must also pay a \$5.3 million civil penalty and \$13.9 million for environmental and public health projects.<sup>38</sup> Two of the plants that VEPCO agreed to upgrade are among the biggest polluters in the country. The Mount Storm station was the second-highest plant in mercury emissions in 2001, emitting 1,400 pounds of mercury. Dominion's coal-fired Chesterfield station was also among the top thirty mercury polluters that year, and it was among the top thirty SO<sub>2</sub> polluters in 2003.<sup>39</sup>

### *Other Violations*

Dominion's natural gas pipeline operator, Dominion Transmission, Inc., has also been under fire from the federal government for wrongdoing. In 2001, the U.S. Department of Transportation (DOT) issued the company a fine for mismanaging its pipeline infrastructure in the state of New York.<sup>40</sup> In 2003, the DOT issued the company a corrective action order following a pipeline rupture and subsequent fire in Pennsylvania.<sup>41</sup>

## **Reactor Operation Malfeasance**

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In addition to violating federal regulations for fossil fuel plants, Dominion has frequently violated U.S. Nuclear Regulatory Commission (NRC) operating regulations for nuclear power stations. Violations and other management lapses cited in just the past several years include:

### *Surry Power Station (near Newport News, Va.); operated by Dominion subsidiary VEPCO*

- A January 2004 NRC inspection revealed a ventilation system problem that could impair emergency reactor shutdown. That inspection also revealed that Surry's operators' "fire response procedures were not effective in assuring a safe shutdown of the Unit 1 reactor."<sup>42</sup> That same month, inspectors reported that VEPCO operators had failed to properly monitor the moisture containment barriers of the reactor's concrete containment unit, an oversight that could leave potentially serious corrosion unnoticed.<sup>43</sup>
- An April 2003 NRC inspection revealed the improper storage of flammable materials near "safety-related equipment."<sup>44</sup>
- In December 2001, the NRC cited VEPCO with a violation for improper maintenance of its emergency diesel generators, which power critical safety operations in the event of a loss of offsite power.<sup>45</sup>
- In December 1997, VEPCO was charged by the NRC with a regulatory violation for failing "to provide adequate fire protection features for structures, systems and components important to safe shutdown," compromising essential safety features of the plant.<sup>46</sup>
- In August 1997, VEPCO was issued a notice of violation and slapped with a penalty of \$55,000, for what the NRC regarded as a "serious failure" to adequately monitor its

maintenance activities to ensure that critical operations are functioning properly. The NRC predicted that because the nature of the problem was “corporate,” “similar deficiencies likely exist at the North Anna facility.”<sup>47</sup>

Surry was also the site of a terrible accident in 1986, when a pipe burst due to corrosion and erosion, spewing boiling water on eight nearby workers, four of whom subsequently died from their injuries.<sup>48</sup>

*Millstone Power Station (near New London, Conn.); operated by Dominion subsidiary Dominion Nuclear Connecticut, Inc.*

- Dominion’s Millstone station, which it acquired in 2001, was the site of one of the country’s most startling lapses in radioactive waste management: two irradiated fuel rods—the most radioactive form of nuclear waste—were found missing, and they have never been recovered. The Northeast Nuclear Energy Company, from which Dominion acquired Millstone, initially reported the missing fuel rods at Millstone in 2000. Although Dominion was not operating the plant at the time, it was sanctioned by the NRC for the violation and served with a \$288,000 civil penalty for the unprecedented mismanagement of nuclear fuel. Investigations into the incident revealed that the fuel rods were probably mistaken for other reactor components, “cut up,” and sent to a low-level radioactive waste facility, probably in South Carolina.<sup>49</sup>
- A recent study of the Millstone site ordered by the state of Connecticut revealed nineteen areas of oil or metal alloy contamination in the ground requiring cleanup.<sup>50</sup>

*North Anna Power Station (near Richmond, Va.); operated by VEPCO*

- A September 2003 inspection by the NRC revealed that VEPCO had failed to report the “unplanned release of a toxic gas which could affect safety of station personnel.”<sup>51</sup>

While recent operation of the North Anna nuclear station has been relatively smooth, the licensing of the plant, as well as its early years of operation, were wrought with serious misrepresentations and violations of government regulations by VEPCO, including:

- In September 1975, the Atomic Safety and Licensing Board (ASLB), the judicial arm of the NRC, cited VEPCO for making “material false statements” in its application to construct the North Anna station. VEPCO said there was no geologic fault at the site, but it was ultimately uncovered that a fault does exist at the site. As a result, a penalty of \$60,000—the legal maximum—was levied against VEPCO, its third such fine. This was the largest fine ever assessed against the nuclear industry up to that time<sup>52</sup>; however, the NRC later reduced the amount to \$32,500.<sup>53</sup> High-level NRC officials were later investigated by the Department of Justice for their role in the cover-up.<sup>54</sup>
- In September 1976, the U.S. Occupational Safety and Health Administration (OSHA) cited VEPCO for 59 safety violations at the North Anna construction site, after four fatalities on the site.<sup>55</sup> The NRC later ordered VEPCO to pay \$31,900 in fines for safety violations at the site.<sup>56</sup>

- In September 1979, radioactive gas was discharged into the air after a series of malfunctions triggered a shutdown of North Anna's Unit 1 reactor.<sup>57</sup>
- In May 1980, Unit 1 malfunctioned again and was shut down when operators were unable to close an essential water valve. A second malfunction a couple of hours later caused the activation of the emergency cooling system.<sup>58</sup>
- In June 1987, tubing ruptured inside one of Unit 1's steam generators, resulting in the release of radioactive gas into the atmosphere for over an hour and forcing the shutdown of the reactor.<sup>59</sup>
- In January 1994, the NRC issued a notice of violation and proposed a \$15,000 civil penalty against VEPCO for violating safety regulations at North Anna. Under testing, the emergency backup system for pumping cooling water into one of the reactors had failed twice.<sup>60</sup>

## Plans for Nuclear Expansion

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Despite this rough history of nuclear plant operation, Dominion's plans for nuclear expansion are evident from its recent designs to acquire licenses for at least one new nuclear reactor at its North Anna site, as well as efforts to buy another nuclear plant and extend the licenses of the reactors it currently operates.

### *New Reactors*

On September 25, 2003, Dominion submitted an application to the NRC for an Early Site Permit (ESP) for a potential reactor location at its North Anna nuclear station in central Virginia. If the NRC grants Dominion an ESP, it will then be able to seek a combined Construction and Operating License (COL) at any time in the next ten to twenty years (with the opportunity for a ten- to twenty-year renewal) for one or two reactors at the North Anna site without having to revisit site-specific licensing criteria. Under the DOE's *Nuclear Power 2010* program—a plan to expedite the licensing and construction of new nuclear power plants—taxpayers will pay up to half the cost of Dominion's ESP application as part of a “public-private partnership.”<sup>61</sup> The DOE expects to spend up to \$15 million<sup>62</sup> of taxpayers' money on three ESPs, of which Dominion's is one. Public Citizen, the Blue Ridge Environmental Defense League (BREDL), and the Nuclear Information and Resource Service (NIRS) are engaged in a legal intervention in the licensing hearing for Dominion's ESP.

The primary concern of the intervenors is the potential impact of one or two more reactors on Lake Anna, the man-made lake created for cooling purposes at the North Anna nuclear station. Initially, Dominion proposed to build two very large reactors with once-through cooling systems, but the company has since revised its application, instead planning to build one reactor with a dry cooling tower. Yet even one additional reactor would have a detrimental effect on aquatic life in the lake and on public recreation. The Virginia Department of Environmental Quality (VDEQ) stated in a letter to Dominion that the water drawdown required to serve additional generation capacity would “adversely affect lake access, and local economic conditions in the process.”<sup>63</sup> The VDEQ is also concerned that another reactor would degrade conditions for aquatic life downstream because of the voluminous water intake required for such an operation.<sup>64</sup> While the NRC's Atomic Safety and Licensing Board affirmed the role of the citizens' groups in

the licensing proceedings, it rejected all contentions brought against Dominion's plan except for the challenge that a new reactor would harm Lake Anna's population of striped bass, a popular sport fish.<sup>65</sup>

Dominion has supplemented this application by leading an industry consortium that applied to the DOE on March 17, 2004 for taxpayer funds to pay for up to half of the consortium's COL application expenses.<sup>66</sup> The funding is also through the DOE's *Nuclear Power 2010* program. The consortium—which includes the engineering firms Hitachi America, Bechtel Corp., and Atomic Energy of Canada, Ltd—referenced the North Anna station as a model in studying the feasibility of building a new reactor.<sup>67</sup> The predicted cost of the COL permitting process is \$500 million, of which the federal government will pay up to \$250 million and Dominion would pay roughly \$61 million.<sup>68</sup>

### *License Renewals, New Acquisitions, and Waste Storage Expansion*

Dominion operates three nuclear power stations: North Anna, with two reactors; Surry, with two reactors; and Millstone, acquired in 2001, with two operating reactors and one decommissioned reactor. In March 2003, the operating licenses for the reactors at North Anna and Surry were renewed by the NRC, extending their legal period of operation beyond 2030.

The license renewal application for the Millstone station is currently under review. A citizens' group, the Connecticut Coalition Against Millstone, petitioned to intervene in the license renewal proceeding for operation of the plant, but the NRC licensing board assigned to the project ultimately denied the petition.<sup>69</sup>

Despite an apparent conflict of interest, Dominion has hired Connecticut state Sen. Melodie Peters to work as a public relations consultant for the Millstone license renewal. Sen. Peters, whose term will end this year, is the co-chairperson of the Senate's Energy and Technology Committee, and she was a major proponent of Connecticut's 1998 energy deregulation law, which paved the way for Dominion to acquire the Millstone nuclear power station.<sup>70</sup>

Dominion's recent public relations efforts—possibly to promote Millstone's license renewal—have included hosting a tour at the plant for a group of children from the 2004 Tunza International Children's Conference on the Environment, a United Nations event initiated by the 1992 Rio Earth Summit. Dominion put up \$10,000 to cosponsor the event, which was held in Connecticut.<sup>71</sup>

Dominion is also seeking to expand its nuclear generating capacity. The company intends to purchase the Kewaunee nuclear power plant near Green Bay, Wisconsin, and the NRC recently approved the transfer of the Kewaunee operating license to Dominion.<sup>72</sup> According to Wisconsin's Nuclear WatchDog—a project of the Madison branch of the public health organization Physicians for Social Responsibility—the sale of Kewaunee to Dominion would deny the people of Wisconsin their ability to effectively regulate and ensure the safe operation of the plant by eviscerating the oversight powers of the Wisconsin Public Service Commission (PSC).<sup>73</sup> The Citizens' Utility Board of Wisconsin also opposes sale of the facility, arguing that ceding the plant to Dominion would not be in the best interests of Wisconsin ratepayers.<sup>74</sup> Dominion has objected to a condition of the sale that would maintain state jurisdiction over the

plant, currently owned by the Wisconsin Public Service Corporation and Wisconsin Power and Light Co., a subsidiary of Alliant Energy.<sup>75</sup>

The legacy of deadly irradiated nuclear fuel haunts the nuclear industry, with no acceptable solution, as it continues to pile up at nuclear sites around the country. Dominion has discovered no magical solution to the problem: the company is planning to expand the storage facility for irradiated (or “spent”) fuel at its Surry station, which would allow Dominion to store its exhausted uranium fuel rods through the year 2019.<sup>76</sup> Moreover, a Connecticut government agency recently granted Dominion a permit to construct a two-acre “dry cask” storage facility at Millstone to accommodate the glut of nuclear waste that is overflowing the plant’s existing capacity.<sup>77</sup> Meanwhile, the company is party to a lawsuit against the DOE for its failure to construct a nuclear waste repository to store nuclear plant operators’ irradiated fuel, a project for which ratepayers have been paying millions of dollars in fees to the Nuclear Waste Fund.<sup>78</sup>

Dominion is planning to expand not only its nuclear holdings, but its possessions in other energy sectors as well. For example, the company is seeking a permit to build a 600-megawatt coal-fired power plant in Conneaut, Ohio,<sup>79</sup> and it has reached a preliminary deal to buy three fossil fuel-burning plants—with a total generating capacity of 2,839 megawatts—in New England.<sup>80</sup> The company has also recently announced plans to buy a 310-megawatt gas-fired power plant, an 80-megawatt wood-burning plant, and a 138-megawatt coal-fired plant, all in the state of Virginia. Dominion’s acquisition of these plants is designed to lower the collective cost of its long-term power purchase contracts in an attempt to improve its competitive position—and hence make more money—in the forthcoming deregulated energy market in Virginia.<sup>81</sup> With regard to asset acquisition, the company assures its investors that “Dominion investigates any opportunity that may increase shareholder value...with an objective to enter into transactions that would be immediately accretive to earnings per share.”<sup>82</sup>

## **Expanding Dominion’s Domain: Electric Utility Restructuring in Virginia**

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Beyond Dominion’s new plants and acquisitions, the company’s aggressive promotion of Virginia’s electric utility deregulation demonstrates its ceaseless drive to expand its domain—and thus its profits. Deregulation—fiercely sought by public utility holding companies and touted as a way to lower electric rates through competition—has not developed as predicted by its promoters. The low rates never materialized, and market-manipulation scandals have plagued freshly-deregulated markets, most spectacularly in the Enron-orchestrated California energy crisis of 2000. Deregulation has gone so badly, in fact, that most states that were considering it have abandoned their plans in recent years: 32 states have either repealed, delayed, suspended, or ceased considering electric restructuring legislation.<sup>83</sup> Nevertheless, Dominion has obstinately advocated deregulation in Virginia, against all evidence that it will not benefit consumers and even protest from Virginia’s utility regulators.

### ***Dominion Pushes for Deregulation and Rate Caps***

Dominion has been recognized as “one of the driving forces”<sup>84</sup> behind the passage of the 1999 Virginia Electric Utility Restructuring Act, and it remains a vehement proponent of the law, despite warnings from state officials about the extreme harm that could befall consumers if the

law is fully implemented. (Virginia is in the midst of a period of transition period to a deregulated electric market, the end of which is set by the Act at mid-2007.) The restructuring law is designed to introduce competitive retail markets for electricity in Virginia instead of the current system of regulated monopolies. Deregulation would free Dominion from the yoke of Virginia state regulators, allowing it to generate and sell electricity to whomever it wants at whatever price the market will bear. The profit incentive under deregulated markets has compelled companies to engage in wanton manipulation of electricity supply; such practice would be well within Dominion's power in a retail market, since it has such broad control over electricity generation, transmission, distribution, and trading.

Virginia's own State Corporation Commission (SCC), in its 2003 annual report to the governor and state legislature on the state of electric utility restructuring in Virginia, recommended a suspension of the 1999 Virginia Electric Utility Restructuring Act, calling such a move necessary in order to "preserve Virginia's authority."<sup>85</sup> The SCC expressed its strong skepticism at the consumer benefits of electric deregulation, suggesting that its research has left it with "substantial doubt as to the ability of retail electric competition to provide...lower prices for Virginians than would have been charged under the traditional regulation of the industry."<sup>86</sup> As evidence, the SCC cites the lack of consumer benefits realized in other deregulated markets,<sup>87</sup> and asserts further that "[i]t is in the public interest to avoid ceding jurisdiction over transmission, generation, reliability, and, ultimately, the cost of power, to federal regulators and regional entities."<sup>88</sup> Even Dominion has admitted the "sluggish pace"<sup>89</sup> at which its imagined competitive electric supply market has developed; the company was forced to abandon an electric retail choice pilot program in February 2004 for lack of alternative electricity suppliers willing to participate.<sup>90</sup>

Yet Dominion has remained steadfast in its support for electric deregulation. In remarks before the Virginia Commission on Electric Utility Restructuring—a body of the Virginia General Assembly—Thomas F. Farrell, Dominion's president and chief operating officer, said that Dominion strongly opposes "any and all efforts to suspend the [Virginia Electric Utility Restructuring] Act," calling such proposals "purely and simply anti-consumer legislation."<sup>91</sup>

But Dominion has proven remarkably adept at purposely confusing its personal and shareholder interest with that of the consumer. For example, Dominion has touted the consumer benefits of capping electricity rates at the onset of Virginia's electric retail market, suggesting that this will compel utilities to reduce costs and become more efficient.<sup>92</sup> At the same time, however, a Wall Street investment firm, Morgan Stanley, has reported that the legislation mandating rate caps until 2011 is good news for Dominion investors, predicting that the cap will result in a \$1.50 per share increase of Dominion's value, since Dominion's electric transmission division will be able to purchase power from its generation division at a set rate in a virtual monopoly while potentially having access to cheaper power generated by Midwestern plants under deregulation.<sup>93</sup> Dominion calls operating under capped rates a "competitive advantage because savings from productivity gains go to the bottom line."<sup>94</sup>

Moreover, Dominion has convinced the Virginia legislature that it is entitled to recover the "stranded costs" incurred from the transition from a regulated electricity distribution system to a deregulated electricity market. Dominion claims that it has made capital investments under state

regulation that will be uneconomical in a deregulated environment, leaving it “stranded” in the new electricity market with costs it would not have incurred were it not for erstwhile directives from the state.<sup>95</sup> Despite the fact that Dominion lobbied for Virginia’s electric deregulation legislation, its shareholders will not be liable for any “competitive transition” costs. Thanks to Dominion’s friends in the Virginia General Assembly, this will instead befall Dominion’s ratepayers, even though the company has considerable funds available for the “recovery” of these stranded costs and the retail competition that was supposed to curb Dominion’s profits has not yet materialized.<sup>96</sup> Even those who have chosen to switch to another electricity provider will be saddled with “wires charges” for using Dominion’s transmission lines to get their power.<sup>97</sup> Despite this huge windfall, Dominion’s COO Thomas Farrell disingenuously told Virginia legislators that the electric restructuring act has “shifted the financial burden from the customer to our shareholders,” leaving the company with the responsibility to meet its obligations “without asking for more money from their customers.”<sup>98</sup>

### *Dominion Applies to Join the PJM Electric Interconnection*

In the spring of 2004, Dominion’s electric utility subsidiary, VEPCO, applied to the FERC to join the PJM Interconnection, L.L.C., a “Regional Transmission Organization” (RTO) that operates an enormous competitive wholesale electricity market in the Northeast and parts of the Midwest, including Delaware, Illinois, Maryland, New Jersey, Ohio, Pennsylvania, Virginia, West Virginia and the District of Columbia.<sup>99</sup> Per the requirements of Virginia’s electric restructuring law, Dominion had previously filed an application with the Virginia SCC in June 2003 to join PJM.<sup>100</sup> At the time that Dominion and PJM reached an agreement on the merger, in 2002, then president and chief executive officer Edgar M. Roach, Jr. said that the “established wholesale electricity markets covered by the PJM Interconnection will provide access to a larger competitive market...”<sup>101</sup> This statement—combined with recent power plant acquisitions and the quest to attain preliminary licenses for new nuclear reactors—indicates that Dominion is thirsty for an export market for the electricity it generates, despite whatever consequences such generation might have for local authorities who want to maintain some measure of control over the utilities producing power in their districts. By joining PJM, Virginia will very likely become an exporter of power through Dominion, since the state’s electricity rates are cheaper than the PJM average. Virginia’s retail electric rates are 5.5 percent lower than the PJM average (6.3 cents per kilowatt/hour versus 6.7 cents per Kwh).<sup>102</sup> Indeed, Virginia’s SCC has expressed wariness over the prospect of Virginia customers losing priority transmission service, which the FERC considers undue discrimination in a deregulated market.<sup>103</sup> This situation has prompted the *Richmond Times-Dispatch* to question, “If, as the [FERC] suggests, states can pull no strings to protect their native load, then can PJM brown-out rate-paying Virginians to avert a blackout elsewhere?”<sup>104</sup>

In its report to Virginia government officials, the SCC specifically recommended a suspension of the portion of the 1999 Virginia Electric Utility Restructuring Act that requires electric utilities to join or create RTOs such as PJM.<sup>105</sup> The SCC called such a suspension necessary as a “means to best preserve Virginia’s jurisdiction.”<sup>106</sup>

### *Legislative Discipline*

The critical SCC has recently been reprimanded by Virginia lawmakers, who eviscerated the Commission’s authority to perform independent environmental reviews before issuing operating

licenses to companies proposing new electric generating plants. Legislators also barred the SCC from issuing licenses to new power plants in certain polluted areas that are contingent upon environmental reviews.<sup>107</sup> The Chief Patron of this legislation was state Sen. Thomas K. Norment, a Republican from the third district who had recently been treated to two hunting trips—one all the way to the Arctic Circle—by Dominion, which picked up the nearly \$5,000 tab.<sup>108</sup> Norment was also Chief Patron of the Virginia Electric Utility Restructuring Act, which he is credited with authoring, although it appears that he is merely a vessel for Dominion-crafted legislation.<sup>109</sup>

## **The Eminent Domain of Dominion**

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When it comes to exercising dominance in the domain of the energy industry, Dominion is an eminent player. The company has demonstrated a remarkable ability to exert influence over lawmakers and public officials, and its aggressive asset acquisition and expansion of market territory are the marks of a company bent on maximizing profit, regardless of the effects on its ratepayers or the public.

The company is positioning itself to develop new nuclear generating capacity at time when the enormous waste and security problems of this technology are far from resolved. Meanwhile, the company is buying up fossil-fuel power plants giving scant attention to renewable energy, with a mere seven percent of its electric-generation capacity coming from renewable sources, almost all of which are hydro.<sup>110</sup>

Government regulators have not been completely blind to Dominion's misdeeds, but, unfortunately, the company's incredible influence over public officials has thwarted government efforts to protect consumers from the abuses of companies like Dominion.

Dominion does not shy from playing the game, so to speak, in the infamously ruthless energy industry. The result may make the company's shareholders happy, but ratepayers and the general public may suffer the brunt of the effects stemming from the behavior of this market-hungry company.

## Endnotes

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<sup>1</sup> Most of the information in this section is drawn from Dominion's 2003 Annual Report, its 2003 annual "Form 10-K" filing with the U.S. Securities Exchange Commission (much of which is identical to the annual report), and a fact sheet produced by Dominion called "Facts About Dominion, 2004 Edition: Based on Data as of December 31, 2003," as well as general information available on the Web site of Dominion, <<http://www.dom.com>>.

<sup>2</sup> Annual Report 2003, Dominion Resources, Inc., 25.

<sup>3</sup> *Ibid.*, 25.

<sup>4</sup> Arbitraders exploit price discrepancies in different markets to profit from virtually simultaneous purchase and sale of securities or currency.

<sup>5</sup> Dominion Resources, Inc., Form 10-K, U.S. Securities and Exchange Commission, 2003, 22.

<sup>6</sup> *Opensecrets.org – Money in politics data*, Center for Responsive Politics, 26 Sept. 2004 <<http://www.opensecrets.org/>>.

<sup>7</sup> Dominion's aggregate lobbying expenditures are listed in the biannual lobbying report it is required to file, per the Lobbying Disclosure Act of 1995. The reports may be viewed on the Web site of the United States Senate Office of Public Records, <<http://sopr.senate.gov/>>. Dominion's lobbying expenditures through 2000 are also posted on *Opensecrets.org – Money in politics data*, the Web site of the Center for Responsive Politics, <<http://www.opensecrets.org/lobbyists/index.asp>>.

<sup>8</sup> *Opensecrets.org – Money in politics data*, Center for Responsive Politics, 2 Jan. 2001, <<http://www.opensecrets.org/2000elect/other/bush/transitioncmtes2.asp>>.

<sup>9</sup> "Va.'s New Power Couple: George and Susan Allen," *The Virginian-Pilot and The Ledger-Star* [Norfolk, Va.] 11 April 2003: B8.

<sup>10</sup> Tyler Whitley, "Allen Defends Wife's Role; Predicts 'Outstanding' Job in Dominion Role," *The Richmond Times-Dispatch*, 16 April 2003: B3.

<sup>11</sup> *Opensecrets.org – Money in politics data*, Center for Responsive Politics, <<http://www.opensecrets.org>>.

<sup>12</sup> Stephen Koff and Mark Naymik, "Republicans face challenges in New York," *The Plain Dealer*, 29 Aug. 2004: A1.

<sup>13</sup> *Opensecrets.org – Money in politics data*, Center for Responsive Politics, <<http://www.opensecrets.org>>.

<sup>14</sup> Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003).

<sup>15</sup> Lobbyist Registration Database of the Virginia Secretary of the Commonwealth, Anita Rimler, 25 July 2004, <<http://www.commonwealth.virginia.gov/Lobbyist/database.cfm>>.

<sup>16</sup> Tyler Whitley, "Lobbying Costs Top \$13 Million," *The Richmond Times-Dispatch*, 24 July 2004: B7.

<sup>17</sup> Greg Edwards, "Executives of Richmond, Va.-Based Dominion Resources Receive Hefty Raises," *Richmond Times-Dispatch*, 16 March 2003.

<sup>18</sup> Telephone conversation with Brian McCarthy, deregulation coordinator for the Utility Workers Union of America, 30 Sept. 2004.

<sup>19</sup> "Open Letter to Institutional Investors at Dominion Resources," Letter from the Utility Workers Union of America to investors, 1 April 2004.

<sup>20</sup> Greg Edwards, "Union seeks oversight on Dominion pay," *Richmond Times-Dispatch*, 24 March 2004: C1.

<sup>21</sup> Greg Edwards, "Dominion Resources investors reject shareholder approval of pay," *Richmond Times-Dispatch*, 24 April 2004.

<sup>22</sup> Isobel Weill, et al., Plaintiffs, v. Dominion Resources, Inc., et al., Defendants, U.S. District Ct., E.D. Virginia, Richmond Division, 875 F.Supp. 331, 1994.

<sup>23</sup> Robert S. McIntyre and T.D. Co Nguyen, "Corporate Income Taxes in the Bush Years," Citizens for Tax Justice and the Institute on Taxation and Economic Policy, September 2004: 3, 27, 29, 51.

<sup>24</sup> Patricia Daddona, "Waterford OKs Spending More On Legal Battle In Its Tax Case Dominion," *The Day* [New London, Conn.] 15 July 2004; the pending case is Dominion Nuclear, et al. v. Town of Waterford, 2004 WL 944759 (Conn.Super.), Super. Ct. of Conn., Judicial District of New London, 2004.

<sup>25</sup> James Engelmann et al. v. Dominion Nuclear Connecticut, Inc. et al., Super. Ct. of Conn., 2002 WL 491715 (Conn.Super.), 2002.

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<sup>26</sup> The alternative to the once-through cooling system is the use of cooling towers, which employ outside air to cool water heated by the reactor. In contrast, once-through systems use water for quenching, consuming and release vast quantities of river or lake water.

<sup>27</sup> State of Connecticut, Dept. of Public Health, Connecticut Tumor Registry, *Cancer Incidence in Connecticut Counties, 1995-1999* (Hartford, Conn.: State of Connecticut, Jan. 2004) 6.

<sup>28</sup> Diane Scarponi, "Millstone Booklet Unchanged After Critical Report," *The Day* [New London, Conn.] 11 June 2004.

<sup>29</sup> *J. B. Vaughan et al. v. Virginia Electric and Power Company*, Supreme Ct. of Appeals of Va., 211 Va. 500, 178 S.E.2d 682, 1971.

<sup>30</sup> *Rappahannock League for Environmental Protection, Inc., et al. v. Virginia Electric and Power Company et al.*, Supreme Ct. of Va., 216 Va. 774, 222 S.E.2d 802, 1976.

<sup>31</sup> *Wiley Vick Fisher, Jr., et al., for themselves and on behalf of all others similarly situated, Plaintiffs, v. Virginia Electric and Power Company and Dominion telecom, Inc., Defendants*, U.S. District Ct., E.D. Virginia, Richmond Division, 217 F.R.D. 201, Docket No. 3:02cv431, 2004.

<sup>32</sup> "Dominion Agrees to Settlement," [Press Release] Dominion Resources, Inc., 5 May 2004.

<sup>33</sup> U.S. Federal Energy Regulatory Commission, "Order Approving Stipulation and Consent Agreements: Dominion Resources, Inc.; Dominion Transmission, Inc.; Dominion Energy Clearinghouse; Northern Illinois Gas Company; and Columbia Gas Transmission Corporation," Docket No. IN04-2-000, 2 Aug. 2004; "Commission Accepts \$8.1 Million to Resolve Improper Sharing of Gas Storage Inventory Information," U.S. Federal Energy Regulatory Commission [News Release] 2 Aug. 2004.

<sup>34</sup> "U.S. Announces Largest Clean Air Act Settlement with Utility – VEPCO Agrees To Spend \$1.2 Billion To Clean Up Power Plants," [Media Advisory] U.S. Department of Justice and U.S. Environmental Protection Agency, 21 April 2003. Relevant Clean Air Act statutes are at 42 U.S.C. §§ 7470-7492. This settlement came even as the EPA was moving to revise its NSR rules in a way that may introduce loopholes allowing electricity-generating facilities to avoid enforcement actions for NSR violations. The NSR violation notice to VEPCO was issued under the Clinton administration.

<sup>35</sup> "Notice of Violation III-00-003-WV Issued to Mount Storm Electric Generating Station Plant Identification # 54-023-00003," U.S. Environmental Protection Agency, Region III, 24 April 2000.

<sup>36</sup> *United States of America, et al. v. Virginia Electric and Power Company* [Consent Decree] U.S. Dist. Ct., Eastern District of Virginia, 2003.

<sup>37</sup> Kenneth W. Betz, "U.S. announces big Clean Air settlements amid controversy," *Energy User News*, 28.6, 1 June 2003: 1.

<sup>38</sup> *United States of America, et al. v. Virginia Electric and Power Company* [Consent Decree] U.S. Dist. Ct., Eastern District of Virginia, 2003.

<sup>39</sup> "America's Dirtiest Power Plants: Plugged into the Bush Administration," *Environmental Integrity Project and Public Citizen's Congress Watch*, May 2004; data from the Environmental Protection Agency's Emissions Tracking System (ETS) and Toxics Release Inventory (TRI) program.

<sup>40</sup> U.S. Dept. of Transportation, Research and Special Programs Administration, Office of Pipeline Safety, [Notice of Violation and Imposition of Civil Penalty] CPF No. 1-2001-1001.

<sup>41</sup> U.S. Dept. of Transportation, Research and Special Programs Administration, [Corrective Action Order] CPF No. 1-2003-1007 H, 20 Oct. 2003.

<sup>42</sup> *Surry Power Station - NRC Inspection Report 05000280/2003008 and 05000281/2003008; Preliminary White Finding, EA -04-005*, 2 Feb. 2004.

<sup>43</sup> *Surry Power Station – NRC Integrated Inspection Report Nos. 05000280/2003005 and 05000281/2003005*, 26 Jan. 2004.

<sup>44</sup> *Surry Power Station - NRC Integrated Inspection Report Nos. 50-280/03-02 and 50-281/03-02*, 25 April 2003.

<sup>45</sup> *Final Significance Determination for a White Finding and Notice of Violation (NRC Special Inspection Report Nos. 50-280/01-06 and 50-281/01-06, Surry Power Station) EA-01-235*, 21 Dec. 2001.

<sup>46</sup> *Notice of Violation, Virginia Electric and Power Company, Surry Power Station (NRC Integrated Inspection Report 50-280/97-09, 50-281/97-09)* 24 Dec. 1997.

<sup>47</sup> *Notice of Violation and Proposed Imposition of Civil Penalty - \$55,000 (NRC Inspection Report 50-280/97-01 and 50-281/97-01) EA 97-055*, 29 Aug. 1997; Sandra L. Figueroa, a secretary at the NRC, confirmed in an October 1, 2004 telephone conversation that VEPCO paid this fine on September 15, 1997.

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- <sup>48</sup> See U.S. Nuclear Regulatory Commission, Office of Inspection and Enforcement, Information Notice No. 86-106: FEEDWATER LINE BREAK, 16 Dec. 1986; see also Licensee Event Report, Accession # 8704130361, Docket No. 05000281, Surry Power Station, Unit 2, "Rx Trip and Main Feedwater Pipe Failure," 31 March 1987.
- <sup>49</sup> Notice of Violation and Proposed Imposition of Civil Penalty - \$288,000 (NRC Special Inspection Report No. 50-245/01-013), EA-02-014, 25 June 2002.
- <sup>50</sup> Patricia Daddona, "Chemicals In Ground At Millstone," *The Day* [New London, Conn.] 15 July 2004.
- <sup>51</sup> North Anna Power Station - NRC Integrated Inspection Report No. 05000338/2003004 and No. 05000339/2003004, 27 Oct. 2003.
- <sup>52</sup> Hal Willard, "Veeco Fined \$60,000 for A-Plant Fault," *Washington Post*, 12 Sept. 1975: A1.
- <sup>53</sup> Hal Willard, "Nuclear Agency Fines Veeco," *Washington Post*, 13 Nov. 1976: D4.
- <sup>54</sup> Joanne Omang, "U.S. Cover-Up Seen on Fault at Veeco Site," *Washington Post*, 1 Oct. 1977: A1.
- <sup>55</sup> "59 Violations Found at Veeco's A-Plant," *Washington Post*, 28 Sept. 1976: C5.
- <sup>56</sup> Athelia Knight, "Veeco Asks NRC to Drop \$31,900 Construction Fine," *Washington Post*, 30 Dec. 1976: B4; "Agency Orders Veeco to Pay \$31,900 Fine," *Washington Post*, 9 Feb. 1977: C6.
- <sup>57</sup> Stephen J. Lynton and Thomas Grubisich, "Radioactive Gas Emitted By Va. Plant," *Washington Post*, 26 Sept. 1979: C1.
- <sup>58</sup> Stephen J. Lynton, "Troubled Veeco Plant Shut Again; Valve Malfunction Leads to Closing of N. Anna Unit," *Washington Post*, 24 May, 1980: B1.
- <sup>59</sup> Sandra Evans and Lynda Richardson, "Va. Reactor Shut Down After Leak; Tube at North Anna Recently Inspected," *Washington Post*, 16 July 1987:A1
- <sup>60</sup> Michael Martz, "NRC Hits North Anna on Safety Flaw," *Richmond Times-Dispatch*, 11 Jan. 1994: C1.
- <sup>61</sup> "Energy Secretary Abraham Announces Private-Public Partnership to Evaluate Sites for New Nuclear Plants in the United States; Energy Department Awards Funds to Dominion Resources, Entergy and Exelon to Demonstrate Early Site Permitting Process," U.S. Department of Energy [Press Release] 24 June 2002.
- <sup>62</sup> U.S. Dept. of Energy, Office of Nuclear Energy, Science and Technology and its Nuclear Energy Research Advisory Committee, Subcommittee on Generation IV Technology Planning, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010*, Vol. II, Main Report, Appendix J: "Near Term Deployment Roadmap Resource Needs," (Washington: U.S. Dept. of Energy, 31 Oct. 2001) J-1.
- <sup>63</sup> Virginia Department of Environmental Quality, letter to Dominion Resources, Inc., 10 Feb. 2004, 11.
- <sup>64</sup> Virginia Department of Environmental Quality, memo to Ellie Irons, Program Manager, Environmental Impact Review, 15 Jan. 2004, 5.
- <sup>65</sup> "In the Matter of Dominion Nuclear North Anna, LLC (Early Site Permit for North Anna ESP Site," United States Nuclear Regulatory Commission, Atomic Safety and Licensing Board [Memorandum and Order: Ruling on Standing and Contentions] Docket No. 52-008-ESP, ASLBP No. 04-822-02-ESP, LBP-04-18, 6 Aug. 2004.
- <sup>66</sup> Greg Edwards, "Funds Sought for Nuclear Reactor at North Anna, Va., Plant," *Richmond Times-Dispatch*, 1 April 2004.
- <sup>67</sup> "Focus On The Groups Hoping To Build The Next US N-Plant," *NucNet: The World's Nuclear News Agency*, 21 May 2004. <<http://www.worldnuclear.org>>.
- <sup>68</sup> Greg Edwards, "North Anna funds sought; Request is related to licenses for possible third nuclear reactor," *Richmond Times-Dispatch*, 1 April 2004: C1.
- <sup>69</sup> "In the Matter of Dominion Nuclear Connecticut, Inc. (Millstone Nuclear Power Station, Units 2 and 3)," U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, [Memorandum and Order: Ruling on Standing and Contentions] Docket Nos. 50-336 and 50-423-LR, ASLBP No. 04-824-01-LR, LBP-04-15, 28 July 2004.
- <sup>70</sup> "Sen. Melodie Peters to work for nuclear plant operator," *Associated Press Newswires*, 2 July 2004; Patricia Daddona, "Dominion Hires Peters To Help With Millstone License Renewal," *The Day* [New London, Conn.] 2 July 2004.
- <sup>71</sup> Carole Bass, "Kids Go Nuclear," *New Haven Advocate*, 22 July 2004.
- <sup>72</sup> "NRC Staff Approves Transfer of Operating License for Kewaunee," NRC News, U.S. Nuclear Regulatory Commission, Office of Public Affairs, 10 June 2004.
- <sup>73</sup> "Kewaunee Nuclear Power Plant," Wisconsin's Nuclear WatchDog, July 2004, <<http://www.wnwd.org/power/kewaunee.php>>.
- <sup>74</sup> "In the Matter of the Application for All Approvals Necessary for the Transfer of the Ownership and Operational Control of the Kewaunee Nuclear Power Plant From Wisconsin Public Service Corporation and Wisconsin Power and Light Company to Dominion Energy Kewaunee, Inc.," Initial Brief of the Citizens Utility Board in Opposition

---

to the Proposed Sale of the Kewaunee Nuclear Power Plant, before the Public Service Commission of Wisconsin, Docket No. 05-E1-136, 26 July 2004.

<sup>75</sup> Thomas Content, "Dominion Resources objects to Wisconsin restrictions on nuclear power plant," *Milwaukee Journal Sentinel*, 26 June 2004.

<sup>76</sup> Patrick Lynch, "Dominion Needs to Expand Nuclear Storage Facility in Surry, Va.," *Daily Press* [Newport News, Va.] 6 Feb. 2004.

<sup>77</sup> Patricia Daddona, "Dominion Gets Permit for 49 Storage Units at Millstone," *The Day* [New London, Conn.] 28 May 2004.

<sup>78</sup> Patricia Daddona, "Millstone Owner Sues Energy Department Over Lack Of A Federal Spent Fuel Waste Site," *The Day* [New London, Conn.] 15 July 2004.

<sup>79</sup> Diana Lewis, "County officials updated on proposed Conneaut site project," *The News-Herald* [Willoughby, Ohio] 14 July 2004.

<sup>80</sup> Tina Davis, "Dominion Marches On Northeast With Power Plant Deal," *The Energy Daily* [Washington, D.C.] 9 Sept. 2004: 1+.

<sup>81</sup> Michael Davis, "Dominion to Buy Power Plant; Utility Already Purchases Output from the Chesapeake Facility," *The Virginia-Pilot & The Ledger-Star*, [Norfolk, Va.] 7 July 2004: D1.

<sup>82</sup> Annual Report 2003, Dominion Resources, Inc., 48.

<sup>83</sup> For a good analysis of the current sorry state of electric power markets, see the "2004 Performance Review of Electric Power Markets" by Kenneth Rose, a senior fellow at Michigan State University's Institute of Public Utilities, included as Part I of Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (1 Sept. 2004).

<sup>84</sup> Greg Edwards, "Virginia Rate-Cap Extension Pays Off for Dominion Resources," *Richmond Times-Dispatch* [Knight Ridder/Tribune Business News] 2 April 2004.

<sup>85</sup> Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003) Part I, xii and Part III, 22. The SCC's 2004 report on restructuring, while refraining from calls to suspend implementation of the Act, remains deeply skeptical about the supposed consumer benefits of electric utility restructuring, saying on page iv of the "Executive Summary and Overview" that "the problems that are impeding the development of retail competition in Virginia and other regional markets continue unabated" and, regarding retail competition, "little, if anything, has changed since last year."

<sup>86</sup> Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003) Part I, v.

<sup>87</sup> Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003) Part I, xiii.

<sup>88</sup> *Ibid.*, xii.

<sup>89</sup> Comments of E. Paul Hilton, senior vice president of Dominion Virginia Power, to David R. Eichenlaub, assistant director in the Division of Economic and Finance, Virginia State Corporation Commission, 22 May 2003. Included in Part II, Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003).

<sup>90</sup> Greg Edwards, "Va. Power to Delay Programs; Pilots are to Supply a Choice between Electricity Providers," *The Richmond-Times-Dispatch*, 24 Feb. 2004: C6.

<sup>91</sup> Remarks of Thomas F. Farrell II for the Virginia Commission on Electric Utility Restructuring, 13 Jan. 2004. Comments may be viewed at Dominion's Web site, <<http://www.dom.com/about/speeches/011304.jsp>>.

<sup>92</sup> Comments of E. Paul Hilton, senior vice president of Dominion Virginia Power, to David R. Eichenlaub, assistant director in the Division of Economic and Finance, Virginia State Corporation Commission, 22 May 2003. Included in Part II, Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility

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Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003).

<sup>93</sup> Greg Edwards, "Virginia Rate-Cap Extension Pays Off for Dominion Resources," *Richmond Times-Dispatch* [Knight Ridder/Tribune Business News] 2 April 2004; Morgan Stanley also considers the rate cap "good news" for Dominion investors in a equity research report on Dominion, Scott Soler and John Kiani, "Is the Sum > Than the Parts?," Morgan Stanley, 2 June 2004, 17.

<sup>94</sup> Annual Report 2003, Dominion Resources, Inc., 11.

<sup>95</sup> *Ibid.*, 45.

<sup>96</sup> Between 1999 and 2002, Dominion had excess earnings of over \$886 million that could offset stranded costs, according to the Commonwealth of Virginia's State Corporation Commission in "Stranded Cost Report," Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly, Vol. I, 1 July 2003, page 29 and Attachment No. 6.

<sup>97</sup> See Code of Virginia, Title 56, Sections 583 and 584.

<sup>98</sup> Remarks of Thomas F. Farrell II for the Virginia Commission on Electric Utility Restructuring, 13 Jan. 2004. Comments may be viewed at Dominion's Web site, <<http://www.dom.com/about/speeches/011304.jsp>>.

<sup>99</sup> "Joint Application to Establish PJM South, PJM Interconnection, L.L.C. and Virginia Electric and Power Company," U.S. Federal Energy Regulatory Commission, Docket No. ER04-\_\_\_-000, 11 May 2004.

<sup>100</sup> "Application of Virginia Electric and Power Company," Ex parte, In re: Virginia Electric Power Company; Regional Transmission Entities, Commonwealth of Virginia, State Corporation Commission, Case No. PUE-2000-00551.

<sup>101</sup> "Dominion, PJM Announce Regional Transmission Agreement," Electric News Releases, Web site of Dominion Resources, Inc., 25 June 2002 <<http://www.dom.com/news/elec2002/pr0625.jsp>>.

<sup>102</sup> Energy Information Administration, 1 Oct. 2004 <<http://www.eia.doe.gov/>>.

<sup>103</sup> Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003) Part I, xi.

<sup>104</sup> "Native Load," editorial, *The Richmond Times-Dispatch*, 11 July 2004: E2.

<sup>105</sup> Title 56, Section 579 of the Code of Virginia states that "each incumbent electric utility owning, operating, controlling, or having an entitlement to transmission capacity shall join or establish a regional transmission entity." The statute further sets the application deadline for joining RTEs at July 1, 2003, and orders that "each incumbent electric utility shall...transfer management and control of its transmission assets to a regional transmission entity by January 1, 2005, subject to Commission approval..."

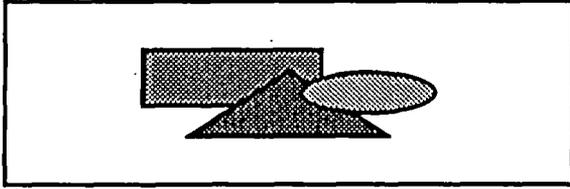
<sup>106</sup> Commonwealth of Virginia, State Corporation Commission, Report to the Commission on Electric Utility Restructuring of the Virginia General Assembly and the Governor of the Commonwealth of Virginia, *Status Report: The Development of a Competitive Retail Market for Electric Generation within the Commonwealth of Virginia* (2003) Part I, ii.

<sup>107</sup> The General Assembly of Virginia approved S. 554 on April 4, 2002, adding a section numbered 10.1-1186.2:1 and amending § 56-46.1 and § 56-580.

<sup>108</sup> Craig Timberg and Sarah Cohen, "Va.'s Feeding Frenzy; Lobbyists, Lawmakers Defend Gifts," *The Washington Post*, 22 Jan. 2001: A1.

<sup>109</sup> Warren Fiske, "Relying on Lobbyists," *The Virginian-Pilot and The Ledger-Star* [Norfolk, Va.] 18 Feb. 2001: A1.

<sup>110</sup> Fact sheet: "Dominion Generation," from the Web site of Dominion Resources, Inc., 17 Sept. 2004. <<http://www.dom.com/about/companies/generation/index.jsp>>.



## **Conservation group sues Brayton Point**

**The Conservation Law Foundation also suing the State of Massachusetts over the way it controls mercury emissions.**

**08:40 AM EST on Friday, March 11, 2005**

**BY ROB MARGETTA**

**Journal Staff Writer**

The Conservation Law Foundation announced yesterday that it plans to file a lawsuit against Dominion Energy, owner of the Brayton Point Power Station, over mercury pollution.

The foundation, a nonprofit environmental advocacy group with offices in most New England states, claims that Brayton Point's smokestacks discharge 240 pounds of toxic mercury each year.

That is enough to poison 120 million pounds of fish, according to the foundation. Eating mercury in fish and shellfish presents a danger to children and pregnant mothers, as it can harm developing nervous systems.

Seth Kaplan, the foundation's senior attorney, said the foundation is giving joint notice of its intention to sue Brayton Point and the Massachusetts Department of Environmental Protection, which issues the plant's air discharge permits.

The lawsuit's goal is to get the state to require the installation of the newest technology to combat mercury emissions from the plant, Kaplan said. This approach is known as the maximum available control technology standard.

If the state creates the standard, it could set a precedent that would force all similar plants nationwide to follow the same rules, he said.

But Jim Norvelle, a spokesman for Dominion, said the lawsuit is pointless -- Brayton Point already has to meet state requirements for reducing mercury emissions.

Those requirements will force the plant to bring its mercury emissions down 85 percent by 2008. By 2012, the plant's mercury emissions will have to be down 95 percent, Norvelle said.

Kaplan said reducing Brayton Point's mercury emissions is only half the point. The Conservation Law Foundation also wants the maximum technology standard because of its possible effect on other plants.

The lawsuit is based on "an obscure section of the Clean Air Act," Kaplan said. "As far as we can tell, no one has used this."

According to the EPA, until a 1990 amendment the Clean Air Act only listed eight hazardous air pollutants and established standards for only seven. The amendment directed the EPA to create maximum technology standards for 189 hazardous substances.

But, Kaplan said, the EPA only began working on those standards in 2000. The EPA was ready to pass a strong mercury rule in 2001, but the Bush administration interfered, he said.

The EPA plans to announce new mercury emissions rules next week, which lean toward the cap-and-trade system favored by the administration.

Unlike the maximum technology standard, which would require technological solutions to reduce pollution at plants, cap and trade would rely on long-term market forces. The system would allow plants that emit high levels of pollution to buy the rights to keep polluting from those that are better about controlling emissions.

Some environmentalists and congressional Democrats have attacked cap and trade.

The Conservation Law Foundation says the EPA is retreating from its responsibilities and claims its lawsuit would bypass the EPA by getting a court order declaring that state air regulators have to enforce the Clean Air Act.

This, Kaplan said, is where the "obscure section" of the Clean Air Act comes in. The act, he said, has a section stating that if there is no federal maximum technology standard for a dangerous substance, a plant-by-plant standard should be created.

The Clean Air Act does not specifically say what authority would set that standard, but Kaplan said the duty should fall on states.

And, if Massachusetts sets a maximum technology standard for Brayton Point, it could set a national precedent, he said.

Kaplan said there are many power plants similar to Brayton Point, a coal-burning plant which is one of Massachusetts' six oldest power producers.

The Conservation Law Foundation would like to see Brayton Point's mercury emissions reduced by at least 90 percent, Kaplan said.

The foundation is also pursuing similar legal action against the Merrimack Station Power Plant in Bow, N.H.

To contact Rob Margetta, phone (508) 674-8401 or e-mail [rmargett \[at\] projo.com](mailto:rmargett@projo.com).

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## Millstone Owner Turned Down Free Homeland Security Device

By **PATRICIA DADDONA**  
*Day Staff Writer, Waterford*  
Published on 3/9/2005

**Waterford** — The owner of Millstone Power Station refused free security equipment from the U.S. Department of Homeland Security two years ago because it wasn't needed, a company spokesman said Tuesday.

Homeland Security officials offered Dominion Nuclear Connecticut a barrier to protect its nuclear reactors' water intake structures from a possible terrorist attack, Pete Hyde, the spokesman, said.

The intake structures for Dominion's two operating reactors, Millstone 2 and Millstone 3, suck in a million gallons of water a minute from Long Island Sound. Seawater cools the steam from turbines and condenses it into clean water, which is then reheated and turned into steam again to generate electricity.

The intake system is dedicated to steam generation and is not part of the primary system used to cool the reactors, Hyde said.

"Protection of the intakes was not a nuclear-safety issue," he said. "An attack obviously is not something we would welcome; interruption would have an impact. We would have to shut the plant down, but it would not cause a meltdown of the plant."

Millstone also has high-pressure safety injection systems that would inject water from tanks into the reactor core, if needed, in a nuclear emergency, Hyde said. Seawater culled from the intake system is not used for that purpose, he said.

An engineering analysis done in 2003 showed that the security barrier "wasn't necessary for us to meet the Nuclear Regulatory Commission's post-9/11 security requirements," Hyde said.

Following the terrorist attacks of Sept. 11, 2001, the NRC has gradually adopted new requirements to enhance security at the nation's 103 nuclear reactors. The improvements include new guard towers, physical barriers and enhanced emergency equipment and communication.

U.S. Rep. Edward J. Markey, D-Mass., who sits on the House Homeland Security Committee, is writing to Homeland Security officials to find out why the federal agency bypassed the NRC on this matter, a spokeswoman for Markey said Tuesday.

Markey first released a letter Tuesday demanding answers from the NRC, but NRC spokesman Neil Sheehan told The Day the NRC was not the source of the offer.

Homeland Security press aides did not return a call seeking information. ■

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**THE CARCINOGENIC, MUTAGENIC,  
TERATOGENIC AND  
TRANSMUTATIONAL  
EFFECTS OF  
TRITIUM**

**CITIZENS AWARENESS NETWORK**

**WWW.NUKEBUSTERS.ORG**

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## CITIZENS AWARENESS NETWORK

### INTRODUCTION

During the past two decades, residents of the Deerfield River Valley in Massachusetts suffered alarming health problems: an increased cancer rate, miscarriages, multi birth-defected children, and a ten-fold increase in Down's Syndrome (a congenital disease characterized by mental retardation and bodily malformation). Local health authorities were unable or unwilling to account for the region's growing pattern of health anomalies.

Attention turned to the safety of the nearby Yankee Rowe nuclear power station, the nation's first 'experimental' commercial reactor, and the effectiveness of the standard nuclear safety guidelines of the Nuclear Regulatory Commission [NRC]. During a series of public meetings, area residents learned that the Yankee Rowe reactor had used the nearby Deerfield River as a radioactive waste dump over the past thirty years. The Nuclear Regulatory Commission, the agency that oversees the operation of commercial nuclear reactors in America, permitted this dumping of radioactive waste.

Concerned citizens, realizing that the river had been widely used for well water, crop irrigation, and recreational purposes, began to question whether the increases in disease were due to the reactor's regular releases of radioactive materials into the river.

It was at this point that the Citizens Awareness Network [CAN] was formed as a grassroots organization primarily concerned with the health and safety of its community.

The Citizens Awareness Network began to investigate effluent releases from the Yankee Rowe reactor into the Deerfield River, and compiled a 30-year history of such releases. CAN found that large quantities of tritium, a dangerous enviro-toxin, had been released into the river (given the river's size and the degree of contact the community routinely had with its water).

The Massachusetts Department of Public Health [MDPH] initially denied that there was cause for concern. After continuing pressure from CAN and the local community, MDPH agreed to a preliminary investigation of the diseases. After eight years the MDPH completed an initial investigation, which determined that there was statistical significance in cancers and children with Down's Syndrome. Investigations are ongoing with the Department of Environmental Protection (DEP).

With the professional assistance of epidemiologist Dr. Sidney Cobb, and the work of concerned citizens, CAN coordinated research into state health statistics, effluent reports and meteorological data. Dr. Cobb analyzed the raw data and concluded that an epidemic indeed existed in the Deerfield River Valley, and that a full-scale epidemiological study was warranted. A Health Committee of local residents formed, coordinated by CAN to access the professional help needed to document both the diseases in the Deerfield River Valley and the mechanism of contamination. Over the years CAN enlisted the help of Harvard School of Public Health, US Geological Services, and the Center for Disease Control (CDC).

An analysis of statewide statistics provided by MDPH confirmed a statistically significant increase in various types of cancer in the Deerfield River Valley.

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Moreover, deficiencies in MDPH's records for the incidence of Down's Syndrome prompted CAN, community leaders, and local legislators to advocate for a new statewide birth defects registry. Presently a birth defects registry is forming with the help of the CDC.

The Citizens Awareness Network has continued its investigation of the nuclear reactor, leading to our research on tritium, one of the nuclear isotopes regularly released into the Deerfield River. We present this research with the experience of successfully influencing legislators and health officials through information and awareness. We believe that ordinary citizens can - and must - understand the scientific and social issues related to the production of nuclear power.

CAN believes that the standard operation of a nuclear power station causes untold harm, sickness and death. The focus on nuclear accidents results in misleading and diversionary arguments over the safety and effectiveness of existing technology. We believe that Yankee Rowe has been one of the 'safest' reactors in the country, according to NRC guidelines. It is the NRC guidelines that need re-evaluation.

The epidemic of disease in the Deerfield River Valley did not become apparent until 25 to 30 years after operation began. We are now beginning to see the health effects of long-term exposure to low level radiation in our community, and communities throughout the world.

We have all participated in a terrible experiment. The data from the investigation of Yankee Rowe and other nuclear facilities will provide information to educate citizens about the effects of radiation on the health of their generation and future generations.

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### TRITIUM

Tritium is a radionuclide emitted as waste from pressurized water nuclear reactors, heavy water nuclear reactors and the new generation of nuclear reactors. It has been an integral part of the nuclear weapons industry: tritium was released into the atmosphere as part of weapons testing in the 1950's and 60's. It is a beta emitter and has a half-life of 12.5 years. It decays to an isotope of helium, releasing a neutrino and a beta particle (an electron). The electron is slow-moving and has a very short range.

Tritium was believed to be a relatively benign radionuclide because of the weakness of the beta radiation emitted when it decays. The beta electron is a small particle that passes readily through most barriers. The dangers of tritium come from inhalation, ingestion, and absorption.

Tritiated water (HTO) passes through the human body in 12 days. However, when the radionuclide unites with carbon in the human body, plants, or animals, it becomes organically bound (OBT) and can remain in the human body for 450 to 650 days. One study found traces of tritium in the body 10 years after exposure.(24)

As tritium makes its way up the food chain it may become more concentrated.(16) Pigs fed with tritiated food themselves became tritiated, as did their offspring. The blood, heart, and kidneys of the piglets were more tritiated than the mother .(23)

Tritium is carcinogenic, mutagenic, and teratogenic. (21) Human beings can receive chronic exposure to OBT through the ingestion of plants and animals exposed in the effluent pathway, in addition to direct uptake through inhalation, absorption and drinking contaminated water. Especially sensitive to the effects of tritium are rapidly growing cells such as fetal tissue, genetic materials and blood forming organs. (2,12,19, 21, 20)

Tritium is dense and has a short track length. It releases all its activity at one time. This makes it more potent and similar to soft x-rays, which are more effective than hard x-rays. (15) When and where it deposits its radioactivity, it creates at least one lesion in the cell. This lesion must be repaired within 24 hours or the cell will be carcinogenic when it eventually divides. (26, 30) There may be a threshold below which the repair mechanism is not activated in the body, (13,15,27, 32) therefore, low levels of chronic radiation exposure can accumulate in the body without the repair system being activated. (11, 25, 27,30,32, 36)

Tritium has a transmutational effect which is mutagenic. After the particle releases its radioactivity into the cell, a helium ion is formed. The helium springs away from the 9-particle and severs the bond with the compound to which the tritium had attached itself. The compound acquires a positive charge and becomes chemically active. (22)

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It then can attach itself to a ring of a protein precursor that will make up the chromosomal strands in the DNA. Depending on the ring it attaches to, it can affect the protein precursors and damage the DNA. This would create a mutational effect. (22)

Radiological research has found a correlation between tritium and cumulative genetic injury. (21) There was found in successive generations a reduction in relative brain weight, reduction in litter size, and increased reabsorption of embryos. Correlations have been found in epidemiological research between tritium and Down's Syndrome. Associations have also been found between low-level radiation and Down's Syndrome. (6,7,8,10,31)

### The Deerfield River Valley (DRV)

Nuclear power stations must dispose of waste to operate. For pressurized water reactors (such as Yankee Rowe), the main effluent release is into a body of water. Thus the Deerfield River Valley becomes a radiation waste dump for Yankee Rowe. When tritium is released into such an environment, plants, animals, and human beings in the vicinity can be contaminated. (17,24)

The Deerfield River is a small winding river in western Massachusetts. It has white water and is fast running. The valley through which the river runs is 800 feet on either side, creating a tunnel where inversions are held 34% of the time. Fog hangs in the valley for days at a time. Yankee Atomic Electric Co developed this meteorological data.

The river has been used for recreational purposes during the 31 year history of the Yankee Rowe reactor. Citizens swim, fish and boat in the river. Wells and cropland are adjacent to the river, and in times of drought, river water is used to irrigate crops. Each year 500,000 people use the river.

For 31 years the Deerfield River has been a dumping ground for low-level radioactive waste. During the 1960's and early 70's, Yankee Rowe had problems with faulty fuel rods and dumped large amounts of tritium into the river. Up to 1,800 curies a year were released, nominally within NRC guidelines.

The estimated concentrations of tritium were 10,000 times greater in the DRV than outside the valley. There were batch releases each month. People in the community were generally unaware that the river was radioactive, although it had been noted that since the reactor opened, the river never froze.

An analysis of the Deerfield River (done by a graduate student at John Hopkins University from US Geological Services studies) raised serious questions concerning the migration of contamination from the Deerfield River, the potential for wells in Ashfield, Deerfield, and Greenfield to share water supplies with the Deerfield, and the potential for recharging. Recommendations were made to study evaporation of tritium, measure pollutant contaminations, and ascertain information on the holding basins in the valley.

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This analysis and its recommendations were presented to MDPH, however, the department did not investigate these issues or refer the concerns to other agencies that could be of help. There is presently an ongoing investigation of wells and pathways of contamination by the Department of Environmental Protection (DEP) in Massachusetts.

### Epidemic of Disease in DRV

Increases in miscarriages, mental retardation, cancer and other health problems began to be noted in the 1980's through 1990's. There have been over 10 children born with Down's Syndrome since the 1980's, all to mothers under the age of forty. In fact, an additional three children with Down's Syndrome have been born in the 1990's. Most affected families live within a five-mile radius of each other in the effluent pathway, or have had extensive contact with the river during their pregnancies.

Down's Syndrome occurs, on average, in one of 700 to 1,000 live births. Of the approximately 2,000 live births within the valley in the last 20 years, the incidence of Down's Syndrome is closer to one in 100. There have been six chromosomally damaged children conceived during the same time period. Two of these children were born. One died at 6 months, the other child was five years old with Down's Syndrome features. Another of the chromosomally damaged fetuses was trisomic. The Massachusetts Department of Public Health initiated a preliminary investigation of the environs around Yankee Rowe, in the pristine rural environment of the DRV.

There is a 50% increase in five different cancers; a 40% increase in heart disease; and a 110% increase in infectious disease leading to mortality according to an analysis by Dr. Sidney Cobb of MDPH statistics. Cobb pressured the MDPH to study the valley and called for a large-scale health study to be undertaken by the state. Cobb had been instrumental in pressuring the state to engage in a health study of leukemia around the Pilgrim reactor in southeastern MA. That study found a 4-fold increase in leukemia in residents living within a 5-mile radius of that reactor.

After eight years the MDPH released a preliminary investigation riddled with misinformation. The state refused to study the Deerfield River Valley as a whole even though the population of the valley was smaller than a small city (under 10,000 residents; 35,000 including Greenfield and Deerfield)). MDPH included inaccurate

meteorological data that had wind patterns blowing away from the valley even though it had participated with CAN and the Deerfield River Valley Health Committee in a meteorological study done by Harvard School of Public Health. It refused to include certain children born or conceived in the valley with Down's Syndrome, lowering the statistical significance from a 10-fold increase in to a four-fold increase. MDPH refused to include multi birth-defected children, brain tumors, heart disease, immune deficiency disease, and to acknowledge the reality that a "cluster" of Down's Syndrome and other diseases existed.

It, however, acknowledged statistical significance in breast cancer, non-Hodgkin's Lymphoma, and Down's Syndrome. 11 cases of Multiple Myeloma were found in the valley. The state refused to acknowledge statistical significance in Multiple Myeloma because the cases were scattered among the 8 towns studied. Greenfield, MA, located between the Yankee Rowe and the Vermont Yankee reactor in

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Vernon, Vermont (which the state did not include in the study), had an additional 8 cases. Multiple Myeloma is a rare blood cancer; there are only 12,700 cases diagnosed each year in the US. The only known cause is ionizing radiation.

After MDPH refused to revise its study or proceed with a full-scale health study in the area, CAN obtained statistics from the MA Cancer Registry which found 27 cases of multiple Myeloma from 1982-1992 in the Valley and Greenfield. (14 in the 8 towns and 13 in Greenfield.) Additionally, we found 17 cases of brain tumors between 1982-92 in the valley and 18 brain tumors in Greenfield during the same period, bringing the combined total to 35 brain tumors. These are alarming statistics for a poor, rural community with limited medical services. It is a terrible reality for ordinary people faced with the burden of caring for sick and dying relatives and friends.

Citizens Awareness Network (CAN) and Nuclear Information Resource Service (NIRS) have demanded that NRC fund an independent epidemiological investigation of the DRV. This would entail an effluent pathway study of the river. We have also demanded that NRC reevaluate their inadequate and unfounded dosimetry standards for tritium.

To understand the effects of tritium exposure, the effects of organically bound tritium (OBT), and tritiated water (HTO) must be calculated. Since the effects of tritium are on a cellular level rather than an organ level, microdosimetry is required.

The issues raised in this report about the operation of the Yankee Rowe reactor were forwarded to the Inspector General of the Nuclear Regulatory Commission for investigation. The NRC subsequently acknowledged that over 10,000 curies of tritium were released into the Deerfield; it also stated that it was not within its regulations to authorize or organize a health study of the residents of the Deerfield River Valley.

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### Annotated bibliography of low-level radiation studies and tritium research

#### Down's Syndrome

I E. Alberman, J.A. Polani, Fraser Roberts, C.C. Spicer, M. Elliot, E. Armstrong, 'Parental Exposure to X-irradiation and Down's Syndrome.' London: Ann. Hum. Genet. 36 (1972): 195.

Effect of radiation on increase in Down's Syndrome was greatest in subgroup where X-rays were received more than ten years before conception. There was significant increase of 'ever' X-rayed mothers in Down's Syndrome group. The size or dose of X-ray was less important than the cumulative effect, as if damage was not followed by repair.

2. V. BEIR, 'Health Effects of Exposure to Low Levels of Ionizing Radiation.' National Academy Press. 1990.

Report stated that there was no threshold for the effects of radiation when the brain is in its most sensitive stage of development. This was especially true from 8-15 weeks through 22 weeks of gestation.

3. Susan Harlap, 'Down's Syndrome in West Jerusalem,' American Journal Epidemiol, 97, No. 4. pp. 225-232.

Research found that there were environmental factors involved in the etiology of Down's Syndrome. Harlap compared rates of Down's Syndrome in different groups in Israel. For mothers aged under 35, the age-adjusted risk of Down's Syndrome is increased eightfold in one group who used the ritual baths while for older mothers difference in risk is less than threefold.

4. N. Kochupillai, I.C. Verma, M.S. Grewal, V. Remalinggaswami, 'Down's Syndrome and related abnormalities in an area of high background radiation in coastal Kerala.' Nature, 262 (1976) 60-61.

Research compared high background population to control with low background radiation. The observed frequency was higher than in controls and significant. Higher frequency of cases of Down's Syndrome born to mothers aged 30-39. There was an association suggested between low dose radiation exposure of older maternal age, suggesting that the damaging event accelerates oocyte aging and causes primary trisomy rather than translocation trisomy.

5. CN Rasmey, Ellis, and Zeally, 'Down's Syndrome in the Lothian Region of Scotland 1978 to 1979.' Biomed & Pharmacother 45 (1991) : 267-272.

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### BIBLIOGRAPHY

Observable increases in Down's Syndrome were noted in Lothian Region of Scotland after the accident at Chernobyl. The highest rate of 27.12 in 1987 was significantly higher than average for the whole period. Increase in incidence peaked in late 1987 and subsequently returned to pre-1986 levels.

6. Sheehan, M. Patricia and B. Hillary Irene, 'An Unusual Cluster of Babies with Down's Syndrome

Born to Former Pupils of an Irish Boarding School.' British Jour. Med. 1 1 Dec. 1983 : 287.

Sheehan found a cluster of children born with Down's Syndrome (8) to mothers who attended a girls school as adolescents, during the Windscale fire at that reprocessing reactor. The school was in the effluent pathway and the radionuclide released was tritium. There were 30 birth abnormalities in all in this small population.

7 A.T. Sigler, et al 'Radiation exposure in parents with children with mongolism (Down's Syndrome).' Bulletin of John Hopkins Hospital, 2 (1968): 1045-1049.

Radiation exposure increased the risk of mongolism in parents. There was validation of the view concerning cumulative radiation damage to genetic material. Exposure was result of fluoroscopic and therapeutic radiation.

8 K. Sperlind, J. Pelz, RD. Wegner, I. Schulzke and E. Srruck, 'Frequency of Trisomy 21 in Germany before and after the Chernobyl accident.' *giomed&Pharmacother*45,(1991):255-262.

Increases in Down's Syndrome were observed in Germany after the Chernobyl accident. There was a peak in incidence in January 1987. This peak is highly significant.

9.- Uchida, Irene and Elizabeth and J. Curtis, 'A Possible Association Between Maternal Radiation and Mongolism.' *Lancet* (10/14/61):848-850.

There is a strong association between the incidence of mongolism and a history of maternal abdominal radiation. Radiation effect may be age-dependent.

10 T. Zuftan and W. Luxin, 'An Epidemiological investigation of Mutational Diseases in the High Background Radiation Area of Yangiang, China.' *1. Radiat. Res.* 27 (1986): 141-150.

There were increases in Down's Syndrome found in high background radiation area. Increases in cancer were not found. Average background dose was 330 mR/yr and 114 mR/yr in control group. There was a higher rate of cancer in control group, which had received a greater number of medical X-rays.

Tritium

1 1 D.F. Cahill and C.L. Yuile, 'Tritium Irradiation of Mammalian Fetus.' *Radiation Research* 44 (1970) : 727.

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### BIBLIOGRAPHY

Offspring conceived by parents subjected to low level lifetime exposure manifest effects at HTO activity levels 10-100 times lower than those required during exposure in utero only.

1 2 L.A. Carsten and S.L. Cumberford, 'Dominant Lethal Mutations in Mice Resulting from Chronic Tritiated Water Ingestion.' *Radiation Research* 66(1973):609.

Two successive generations of mice were exposed to continued ingestion of tritiated water. In second-generation females, there was a significant reduction in the number of viable embryos.

1 3 A.L. Carsten, et al, ' 1989 Summary Update of the Brookhaven Tritium Toxicity Program with

## Emphasis

on Recent Cytogenic and Lifetime-Shortening Studies in Proceedings of the Third Japan-US workshop on Tritium Radiobiology and Health Physics.' (Edited by S. Okada), Institute of Plasma Physics. Nagoya University, Nagoya, Japan. IPPJ-REV-3.

There may be an effect at very low doses where the radiation inhibits the repair mechanism. This may occur during tritium irradiation. Theory consistent with the track structure calculations of Goodhead using very weak X-rays. There was significant reduction in the number of viable embryos resulting from matings between animals maintained on tritium diet. There was no effect on breeding effectiveness.

14R.L. Dobson and M.E. Cooper, 'Tritium Toxicity - Effects of low-level <sup>3</sup>H<sub>2</sub>O Exposure in Developing Female Germ Cells in the Mouse,' Radiation Research 58. p. 91.

Adult female mice were maintained on tritium levels 8.5, 0.85 and 0.085 Ci/ml of body water from day of fertilization. In female offspring exposed to tritium from conception and sacrificed at 14 days, primary oocytes were decreased below control number by 90% at 8.5, and significantly at 0.085 level.

15 D.T. Goodhead and H. Nikjoo, "Current Status of Ultrasoft X-ray and Track Structure Analysis as Tools for Testing and Developing Biophysical Models of Radiation Action.' Radiat. Prot. Dos. 31, No. 1/4 (1990) 343-352.

Authors conclude that ultrasoft X-rays are more effective than equal doses of hard X-rays. Their RBEs increase with decreasing X-ray energy down to very small track lengths of 7 nm. Low energy electron track ends are a predominate cause of cell inactivation in all low LET radiations. (Ultrasoft X-rays are very similar in energies and track lengths to tritium  $\beta$ -radiation).

16 Kirchman, et al, '1973 Studies on the Food Chain Contamination by Tritium.' In Tritium, editors Moghissi and Cater, Messenger Graphics, Phoenix, AZ, US.

Tritiated grass eaten by cows has been shown to be effectively transferred to their milk. OBT levels in their milk were 10 times higher in cows fed on tritiated grass than cows fed on HTO.

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### BIBLIOGRAPHY

17 D. Macintosh, S. Lung, F. Tsai and J. Spengler, 'A Preliminary Assessment of the Potential Human Exposure to Tritium Emissions from the Yankee Atomic Electric Company Nuclear Power Facility Located Near Rowe, MA.' Harvard University School of Public Health, Dept. of Environmental Health 7(1993)

Graduate students, under the supervision of J. Spengler, conducted a preliminary assessment of potential exposures and doses to the Deerfield River Valley residents to tritium released from the Rowe nuclear power reactor. Concentrations of tritium were found to be 10,000 times greater in the valley than the surrounding area. Researchers suggested that an investigation be undertaken to study the effects of organically bound tritium, the effect of the river rapids and falls on HTO evaporation, and OBT aerosolization.

18 J.W. Laky, et al, 'Some Effects of Lifetime Parental Exposure to Low-Levels of Tritium on the F2 Generation." Radiation Research 56, (1973) :171.

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Research done on effects of low-level exposure to tritiated water. Continued exposure calculated as whole body dose rates 3 to 3,000 mrad/day produced a 30% reduction in adult F1 male testes, but no impairment in growth or reproductive ability. Statistically significant effects on F2 neonates were: reduction in relative brain weight, decreased body weight, decreased litter size and increased reabsorption. Brain and testes contained approximately 100% and 50% greater tritium activities than the average in other tissues.

19 J.W. Lasky, and S.J. Bursian, *Radiation Research* 67, (1976) : 314.

Rats were exposed to constant tritium activities of 10 uCi/ml of body water for 42 days beginning first day of pregnancy or birth. In males exposed from birth or first day, there was a significant reduction in the testes weight and sperm content. In females exposed there was a significant reduction in F2 litter size and an increase in the number of reabsorbed embryos. The group most sensitive to low-level exposure was the one exposed from first day of pregnancy.

20 D.J. Mewissen, 'Cumulative Genetic Effects from Exposure of Male Mice to Tritium for Ten Generations.' IAEA Symposium on Biological Implications of Radionuclides Released from Nuclear Industries, (1979).

Data established the existence of cumulative genetic injury and the existence of cumulative genetic injury at the 9th generation. Their F2 offspring (unexposed) exhibited a significant increase in dominant lethal mutations resulting in a decrease in litter size.

21 T. Straume, 'Health Risks from Exposure to Tritium.' UCRL-LR-105088, Lawrence Livermore Laboratory, Livermore, California, US 94550, (1991).

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### BIBLIOGRAPHY

Tritium is more hazardous to health than other types of low-level radiation. Tritium is about 1.5 times as carcinogenic, 2-5 times as mutagenic, and 2 times as teratogenic.

22 G. Tislajar-Lentulis, P. Hennenberg and L.E. Feinendegen, 'The Oxygen Enhancement Ratio for Single and Double Strand Breaks Induced by Tritium Incorporated in DNA of Cultured Human T1 Cells. Impact on the Transmutation Effect.' *Radiation Research* 94, (1983) : 41 -50.

Researchers found that a third of single strand DNA breaks caused by the decay of tritium in 6-thymidine were due to transmutation. This is over and above the radiational effect.

23 M. Van Hees, et al, 'Retention in Young Pigs of OBT Given During Pregnancy and Lactation.' *Radiat. Prot. dos.* 16, no 1-2, (1971) : 123-126.

Pigs fed with tritiated food themselves became tritiated. They passed on tritium to their offspring. The blood, heart, and kidneys of the young piglets were more tritiated than the tritiated foods fed their mother.

24 H. Wasserman, and K. Solomon, 'Killing Our Own,' N.Y. Dell. (1982) :190-193.

There is a long residency period in the body of very low concentrations of tritium. A 1981 study of former

American atomic workers showed a majority with tritium levels still ten times above normal. Study found that tritium can remain in the body for up to ten years.

#### Low-Level Radiation

25 K.F. Baverstock, D. Papworth, and J. Vennart, 'Risk of Radiation at Low Dose Rates.' *Lancet*, 1, (1981) 430-433.

Researchers studied workers involved in assemblage of instrument-dials made luminescent with radium. Significance found for breast cancer induced by gamma radiation. Exposure at rate of 0.1 rad per 8 hours, allowing adequate time for repair from exposure. Although the luminizer appears to be a high dose study, it demonstrates the inability of the body to adequately repair after exposure to low-level radiation.

26 M.A. Bender, 'Significance of Chromosome Abnormalities.' (1984) :281-289 in *Boice*.

Bender investigated the repair of chromosome breaks incurred through exposure to radiation. In discussing repair of chromosome breaks, he reports repair half-times which are 'typical of the order of 1 or 2 hours.'

27 L.W. Brackenbush, and L.A. Brady, 'Microdosimetric Basis for Exposure Limits.' *Health Physics* 55, (1988) : 251-255.

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#### BIBLIOGRAPHY

Researchers state that 'Since most cells repair radiation damage with a characteristic time ranging from a few minutes to a few hours, it is evident that irreparable or mispaired damage must dominate the low-LET radiation effect at low dose rates.'

28 I.D. Bross, et al, 'A Dosage Response Curve for the One Rad range: Adult Risk for Diagnostic Radiation.' *Amer. Jour. Pub. Health*, 69, no. 2, (1979).

Bross investigated the effects of diagnostic medical trunk X-rays on 220 men with non-lymphatic leukemia and 270 controls. Research suggests that most heart disease is 'prompted' by radiation exposure. The doubling dose of radiation for leukemia was determined to be 5 Rems.

29 Sidney Cobb, MD MPH., "Health in the Deerfield River Valley. Some Preliminary Looks," (9/29/1992).

Dr. Cobb analyzed raw health statistics in the Deerfield River Valley to determine whether a full epidemiological investigation should be undertaken. Cobb investigated available data for cancer incidence, Down Syndrome, and mortality. He found a 50% greater overall mortality, a 50% greater mortality from cancer (5), a 40% greater mortality in heart disease, a 70% greater mortality from 'other' causes in the Deerfield River Valley. There was suggestive evidence that there might be an excess in Down's Syndrome. His conclusions were that the health problems deserve immediate attention. These problems were consistent with radiation injury incurred between 1960 and 1972.

30 H.J. Evans, K.E. Buckton, G.E. Hamilton and A. Garothers, 'Radiation-induced chromosome aberrations in nuclear-dockyard workers.' *Nature*, 277, (Dec. 1979) : 531 -S34.

Researchers demonstrated a significant dose-dependent increase in chromosome aberrations in peripheral blood

leukocyte chromosomes in a population of monitored nuclear-dockyard workers, subject to occupational radiation exposure within maximum permissible limits 5 rem per year. The observed increase in dicentric aberrations is not large but is a direct expression of increased genetic damage caused by radiation exposure. It is possible to detect a biological effect at the chromosome level to ionizing radiation below the internationally agreed maximum permissible levels.

31 L.E. Feinendegen, et al, 'Biochemical and Cellular Mechanisms of Low-Dose Radiation Effects.' *International Journal of Radiation, Biology* 53, no. 1, (1988) : 23-27.

Researchers studied the ability of irradiated cells to repair themselves. Feinendegen states, 'Whereas the majority of single-strand breaks and base changes are very efficiently and quickly repaired with half-times less than 1 hour, the reconstitution of a double-strand break probably lasts much longer, perhaps up to several hours, and not all double-strand breaks are fully repaired.'

32 J. Gentry, et al, 'An Epidemiological Study of Congenital Malformations in New York State.' *Amer. Jour. Pub. Health*, 49, no. 4, (4/1959).

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Congenital malformation rates were studied in association with high and low background areas in New York State. The areas with the highest background radiation had the highest rates of malformations (17.5). For unlikely rural areas the rate was 12.5. There was a relationship between malformation rate and use of water from wells and springs as opposed to large surface areas (lakes and rivers). A doubling of the prevalence of severe mental retardation was found. There was also a sharp increase in the incidence of Down's Syndrome. AEC estimates that background radiation levels associated with igneous rock formations ranged from .07 to .11 Rems/yr.

33 D.T. Goodhead, 'Spatial and Temporal Distribution of Energy.' *Health Physics*, 55, (1988) : 231-240.

Goodhead studied the ability of cells to repair themselves after exposure to radiation. He suggests that the repair system may need a 'kick' to get started. He states: '...it is conceivable that the cell would repair relatively more efficiently if there were more damage to stimulate its repair process.'

34 A.J. Grosovsky, and J. Little, 'Evidence for linear response for the induction of mutations in the human cells by X-ray exposures below 10 rads.' *Proc. Natl. Acad. Sci., USA, Genetics* 82, (April 1985) 2092-2095.

The induction of thioguanine resistance was studied in continuous human lymphoblast cultures exposed to daily X-ray exposures of 1, 2.5, 5 or 10 rads for periods up to one month. The effects of small daily fractions were additive suggesting that doses as small as 1 rad are mutagenic in human lymphoblasts. A linear increase in mutation frequency was observed over this dose range with no apparent threshold. Results suggest that for human lymphoblasts, the mutagenic risk of low dose of X-rays can be accurately estimated by linear extrapolation from high dose effects.

35 M. Otake, and W. Schull, 'In utero exposure to A-bomb radiation and mental retardation; an assessment.' *British Jour. Radiol.*, 57, (May 1984) : 409-414.

Otake and Schull studied the incidence of mental retardation in Japanese A-bomb survivors. They found that the 8th through the 15th week of gestation was especially significant. Implication that 1 rad absorbed by the fetus during this period may double the rate of mental retardation.

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## CITIZENS AWARENESS NETWORK

### BIBLIOGRAPHY

36 A. Upton, "Prevention of Work-Related Injuries and Disease: Lessons from Experience with Ionizing Radiation." Amer. Jour. Indust. Med., (1987) : 300-301.

Upton analyzed the effects of ionizing radiation and the incidence of breast cancer in women from different sources, i.e., A-bomb radiation, therapeutic irradiation for postpartum mastitis, multiple fluoroscopic examinations, and exposure occupationally to external gamma radiation in the painting of luminous clock and dials. Upton states that "The similarity of the dose-incidence relationships in all four groups of women, in spite of marked differences .... in the duration of exposure, implies that the carcinogenic effect of a small dose on the breast is largely irreparable and that the effect of successive doses are additive.' He states '....there may be no threshold in the dose-incident relationship.'

37 C. Waldren, et al, "Measurements of low-levels of X-ray mutagenesis in relation to human disease." Genetics, 83 : 4839-4843.

Waldren and coworkers studied the direct measurement of the effects of low doses of radiation and other mutagens. Extrapolation procedures were not used to estimate effects. The data demonstrate 'that the true mutagenesis efficiency at low doses of ionizing radiation that approximate human exposures is more than 200 times greater than those obtained with conventional methods.' With increasing dose, a point reached, where the mutational effect can not be detected in the chromosomes because the cell is killed off. Unequivocal mutagenesis took place for dose as low as 2.4 rads. Waldren states that 'observed mutational efficiency at low doses is considerably higher than that observed at higher doses.'

## CITIZENS AWARENESS NETWORK

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## CITIZENS AWARENESS NETWORK

### GLOSSARY

A activity - The number of atoms of a radioactive substance that disintegrate per unit of time.

air Inversion - A condition in which a dense substance lies over a less dense substance. In an atmospheric temperature inversion, the air temperature increases and therefore the density decreases with height. Such inversions occur locally in very still air and tend to be stable because rising air, warmed at the surface, loses its buoyancy and is trapped when it meets air at the same temperature and density as itself so tending to reinforce the inversion. Pollutants entering the air close to the ground level are similarly trapped, and so temperature inversions are sometimes associated with severe pollution incidents.

alpha particle - A positively charged particle emitted by certain radioactive material consisting of two neutrons and two protons. A dangerous carcinogen when inhaled or ingested.

atom - The smallest unit of an element, consisting of a dense central, positively charged nucleus surrounded by a system of electrons. The structure is usually electrically neutral and is indivisible by chemical reactions.

atomic nucleus - The core of an atom, composed of protons and neutrons.

atomic waste - Radioactive solids, gases and contaminated liquids produced by nuclear reactions. Generally classed as high, intermediate, or low-level waste, dependent on curie per liter count.

B

background radiation - Ambient radiation from outer space [cosmic] and materials found at the surface of the earth.

beta - A type of radiation

beta-emitter - A radioactive element characterized by its beta radiation.

beta particle - A high energy electron emitted by decay in a radioactive nucleus. Can cause skin burns and, when ingested, cancer.

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## CITIZENS AWARENESS NETWORK

### GLOSSARY

c

carcinogen - A cancer causing substance or agent.

chromosomal strands -

curies - (radiation units). Units of measurement used to express the activity of a radionuclide and the dose of ionizing radiation.

D

decay - Gradual disintegration of radioactive material over time.

DNA - (deoxyribonucleic acid). The genetic material of most living organisms which is a major constituent of the chromosomes within the cell nucleus and plays a central role in the determination of hereditary characteristics.

dose - The amount of energy absorbed in a unit mass, organ, or individual from irradiation.

Down's Syndrome - A congenital condition characterized by mental deficiency and related to the tripling of certain human chromosomes.

## E

effluent - Liquid or gaseous radioactive discharge from a nuclear reactor.

effluent pathway - the pathway that radioactive waste travels after it is emitted from a nuclear reactor.

electron - A negatively charged atomic particle, lighter than a proton or neutron.

epidemiology - A branch of medical science that deals with the incidence, distribution and control of disease in a population.

etiology - All of the causes of a disease or abnormal condition.

    exposure - Being exposed to radiation.

## F

    fission - The splitting of a nucleus into two lighter fragments, accompanied by the release of energy and generally one or more neutrons. Fission can occur either spontaneously or as a

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## CITIZENS AWARENESS NETWORK

### GLOSSARY

consequence of absorption of a neutron.

fluoroscope - An instrument used chiefly in industry and medical diagnosis for observing the internal structure of opaque objects (as the living body).

fuel rod - A single tube of cladding filled with uranium fuel pellets.

G gamma ray - High energy, short wavelength, electromagnetic radiation emitted by a nucleus.

H half-life - The time it takes for half of any radioactive substance to disintegrate. Half-lives range from seconds to millions of years.

## I

ion - An atom, molecule, or elementary particle that has lost or gained one or more electrons, therefore taking on an electrical charge. A positive ion has lost one or more electrons; a negative ion has gained one or more electrons.

ionization - The process of adding or removing electrons so as to form ions. Ionization can be caused by high temperatures, electrical discharges, or nuclear radiation.

ionizing radiation - Alpha, beta, or gamma radiation, which, when passing through matter can ionize it. Ionizing radiation can cause cell damage as it passes through tissue.

irradiated - Having been exposed to or treated with radiation.

isotope - A radioactive variant of a common element with a different atomic weight but equivalent atomic

number. Isotopes are generally created by the fission process.

## L

latent period - The amount of elapsed time between exposure and the first sign of disease symptoms.

low-level - Refers to radioactivity of low intensity.

## M

Micro-dosimetry - Dosimetry involving micro-doses of radiation or minute amounts of radioactive materials.

millirem [mR] - One thousandth of a rem.

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## CITIZENS AWARENESS NETWORK

molecule - A group of atoms held together by chemical forces.

mongolism - See Down's Syndrome. A sudden variation; offspring differing from its parents in one or more heritable characteristics

mutation changes within the chromosome or the gene.

## N

neutrino - A subatomic particle of negligible mass, named by Enrico Fermi.

neutron An uncharged particle in the nucleus of every atom heavier than hydrogen. A free neutron is unstable. with a half life of 13 minutes, it will decay into a proton, electron and a neutrino.

nondisjunction - Failure of two chromosomes to separate subsequent to meta phase in meiosis or mitosis so that one daughter cell has both/and the other, neither of the chromosomes.

nuclide - Any atom that exists for a measurable length of time. A nuclide can be identified by its atomic weight, atomic number, and energy state.

O. oocyte - An egg before maturation: a female gametocyte.

organically bound - Held in chemical or physical combination.

## P

photon - A 'packet' of energy with no mass, which travels at the speed of light. Photons range from very low energies [such as infrared and visible light], moderate energies [ultraviolet and X-rays] to high energy [gamma].

pressurized water reactor (PWR) - A reactor in which the heat from the nuclear core is transferred to a heat exchanger under constant pressure to achieve a high water temperature without boiling. A secondary circuit produces steam for the generators.

proton - A elementary particle with a single positive charge that is a part of all nuclei.

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## CITIZENS AWARENESS NETWORK

## GLOSSARY

## R

Rad- - A measure of exposure to, or the absorbed dose of radiation.

rad waste- radioactive waste.

Radiation- The emission of neutrons, alpha particles, beta or gamma rays from a radioactive source.

rem - The unit measuring an absorbed dose of ionizing radiation in biological matter; abbreviated from 'Reentgen Equivalent, Man.'

## S

soft x-rays - (soft radiation) Ionizing radiation of low penetrating power, usually used in reference to x-rays of long wavelength.

## T

teratogenic (teratogen) Any environmental factor that acts on a fetus to cause congenital abnormality.

transmutational - The transformation of one element into another by bombardment of a nucleus with particles. For example, plutonium is obtained by the neutron bombardment of uranium.

tritium - A radioactive nuclear by-product, also known as H3, consisting of a hydrogen nucleus, or proton, with two additional neutrons.

Memo to: Nancy Burton, Esq.  
From: E. J. Sternglass  
Date: March 8, 2005  
Subject: Synergistic interaction of radiation, air pollutants and chemicals

The synergistic or "super-additive" action of radioactivity and chemicals or air pollutants has been discussed extensively in the scientific literature. A very comprehensive review of the subject was published in a monograph by Wriedt in the Department of Labor and Health of the City of Hamburg, Germany in 1989 (1). Particularly strong synergistic effects have been found for radiation exposure combined with such chemicals as lead, mercury, magnesium, sulfate and carbon-tetrachloride known or suspected to be emitted by the Millstone Nuclear Plant together with fission products and neutron-activated radioactive elements.

Also, an unexpected super-additive effect was discovered for the action of tranquilizers taken by a woman during pregnancy with radiation exposure in the cancer mortality of her children (2).

The synergistic action of smoke particles and radioactive gases and particulates, such as exist in uranium mines and in heavily polluted urban areas near nuclear plants, was discussed in an article by Radford and Hunt as long ago as 1963 (3).

The increase in cancer rates due to the combination of small airborne particles such as cigarette smoke and radioactive gases was studied by a series of authors beginning as early as 1938 (4)(5)(6). This explains the extremely high incidence of lung cancer in uranium miners who smoked. In the particular case of radioactive gases such as Radon and other radioactive gases such as Xenon and Krypton isotopes that are routinely emitted in large quantities by nuclear plants. Thus, Cassarett pointed out in his introductory article in "Radionuclide Carcinogenesis" in 1972 (7) that "the lung is highly vulnerable to the potential cancer promoting action of localized damage resulting from infections and inflammatory conditions caused by other air pollutants."

Increased risk of infections is known to be produced by the fission product Strontium-90 emitted from nuclear plants due to its action on the cells of the immune system produced in the bone marrow, and so are inflammatory conditions produced by abnormal white cells mutated by the beta particles emitted by Strontium-90 and other bone-seeking fission products such as Barium-140. Moreover, Yttrium-90, the highly radioactive daughter product of Strontium-90, is known to seek out soft tissues like the lung, causing inflammation and cancer. This is strongly supported by the fact reported by the U.S. Department of Health and Human Services in the report "Health in the United States 1994 and 1996" that the age-adjusted respiratory cancer mortality of white U.S. females over 16 years of age began to rise only after 1960, increasing more than five-fold from 5 to 28 per hundred thousand by 1995, while the percent smoking actually declined from 35 to 23% (See enclosed graph).

Not only cancer but also infant mortality, first linked to Strontium-90 releases in nuclear weapons testing (8), can be increased by the synergistic interaction with fine particulates in the urban atmosphere (9). Thus, the 2002 rise in infant mortality (10) which was the first increase since 1958 following the largest atmospheric tests in Nevada in 1957, was probably due to the combination of urban Diesel exhaust and nuclear fission product releases that increased in direct relation to the record rise in nuclear energy generated per reactor as capacity factors were pushed from 58 to over 90% (11) with decreased time for inspection, maintenance and repair of aging nuclear power plants.

Still another way in which the airborne releases from nuclear power plants produce unforeseen biological damage to humans as well as to animals and plants arises from the interaction of the radioactive rare gases Krypton-85 and Xenon-133 that cannot be readily filtered out of the effluent with the nitrogen and oxygen molecules in clean air. This has been described in detail by Graeub (12), who reviewed the evidence that the radiation emitted by these gases ionizes the air just as ultraviolet radiation from the Sun does, resulting in the formation of toxic ozone and nitric oxides. The ozone in turn interacts with the chemicals emitted in automobile exhaust, producing smog that damages the lung, and contributes to the dying of the trees seen downwind from nuclear plants. Furthermore, when the nitric oxides are brought down by precipitation, they act like fertilizer run-off that is carried by the rivers into the estuaries where they lead to blooming plankton that produce dead-zones depleted in oxygen where marine animals live, leading to declines in shrimp and other fisheries as recently seen especially in the Gulf of Mexico.

Thus, not only human life but marine life and the life of birds, land animals and plants is adversely affected not only by the direct effect of fission and neutron-activated radioactive chemicals released from nuclear plants, but also by the indirect effects involving clean air as well as chemical and particulate pollutants..

#### REFERENCES

- (1) H. Wriedt, Department of Labor, Health and Social Services, Hamburger Strasse 47, 2000 Hamburg 76, Germany, December 1989.
- (2) L. M. Kinnier-Wilson, G. W. Kneal and A. M. Stewart, Lancet 11 ,314-315 (1981)
- (3) E. P. Radford and V. R. Hunt, Science 143, January 12,. 247-249. (1964)
- (4) J. C. Mottram, Am. J. Cancer 32, 76 (1938)
- (5) P. Shubik et al, Nature,171, 934 (1953)
- (6) F. G. Bock and G. E. Moore J. Nat'l. Cancer Institute 22, 401 (1959)

- (7) G. W. Cassarett, Radionuclide Carcinogenesis C. L. Sanders et al Editors, U. S. Atomic Energy Commission, Office of Inf. Services CONF-720505, 15-24, June 1973
- (8) E. J. Sternglass, Radiation Biology of the Fetal and Juvenile Mammal, Edited by M. R. Sikow and D. D. Mahlum, U. S. Atomic Energy Commission, 693-717, December 1969.
- (9) T. J. Woodruff, J. Grillo and K. C. Schoendorf , Environmental Health Perspectives 105, 608-612 (1997)
- (10) Health United States 2004, Table 19, Center for Disease Control, Dep't of Health and Human Services.
- (11) Nuclear Regulatory Commission (NRC) Information Digest 2000 Edition, NUREG 1350, Vol. 12.
- (12) R. Graeb, The Petkau Effect: Nuclear Radiation, People and Trees. Four Walls Eight Windows, New York (1992).

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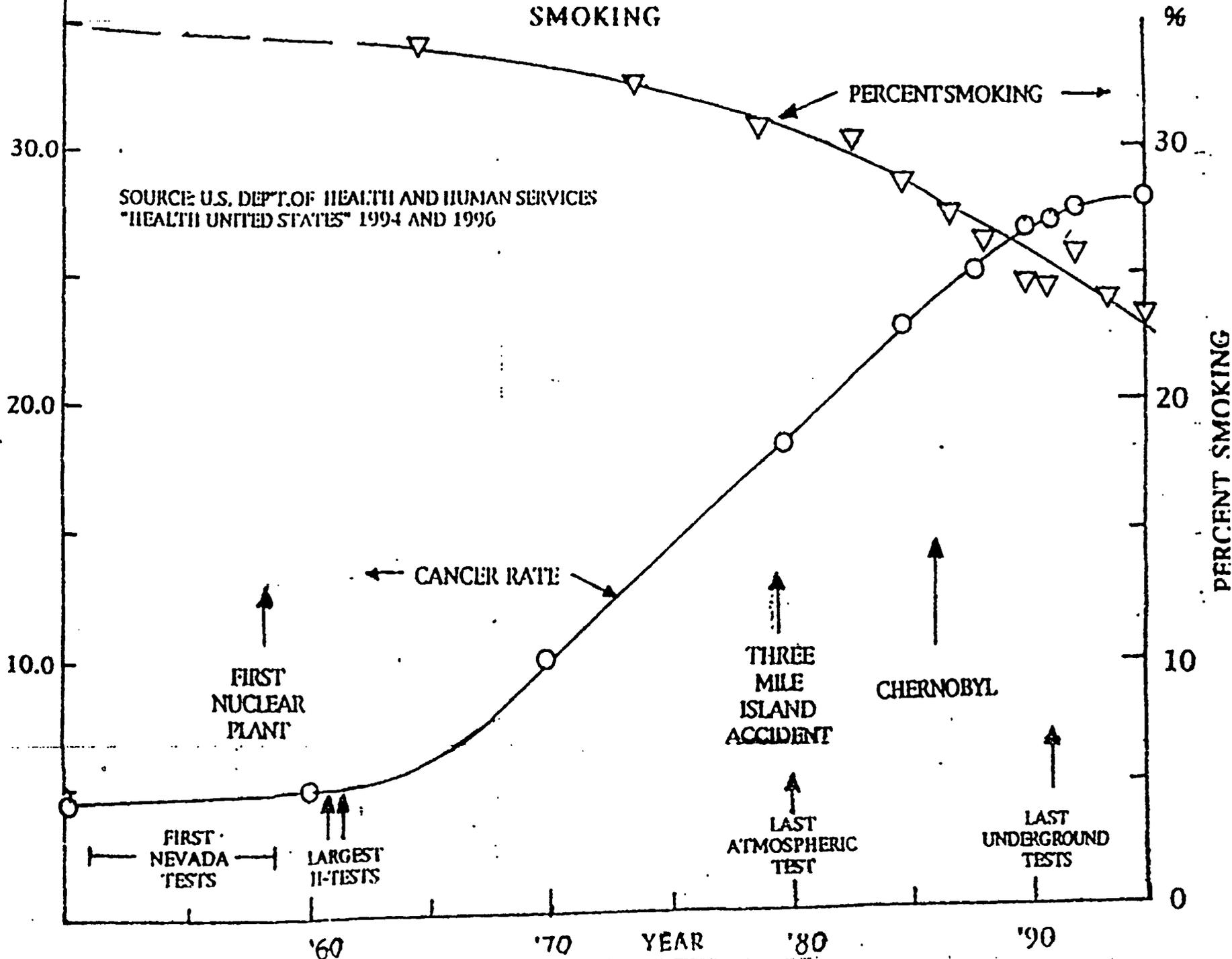
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# AGE-ADJUSTED RESPIRATORY CANCER MORTALITY WHITE U.S. FEMALES OVER 18 YEARS AND PERCENT SMOKING

SOURCE: U.S. DEPT. OF HEALTH AND HUMAN SERVICES  
"HEALTH UNITED STATES" 1994 AND 1996

MORTALITY RATE PER 100,000



PERCENT SMOKING

CANCER RATE

FIRST NUCLEAR PLANT

FIRST NEVADA TESTS

LARGEST H-TESTS

THREE MILE ISLAND ACCIDENT

LAST ATMOSPHERIC TEST

CHERNOBYL

LAST UNDERGROUND TESTS

'60

'70

YEAR

'80

'90

0

10

20

30

36

30.0

20.0

10.0

0

Send video of meeting and history of CY's releases and  
PWR issues —

**Epidemiological Evaluation of the CASE Report Entitled  
"Study of Radiation Exposure from the  
Connecticut Yankee Nuclear Power Plant"**

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February 21, 2001

## Epidemiological Evaluation of the CASE Report Entitled "Study of Radiation Exposure from the Connecticut Yankee Nuclear Power Plant"

### Summary of Report's Findings

After over three years of investigation into the potential association between incidence of cancer and community exposure radiation emission from the Connecticut Yankee Nuclear (CYN) Power Plant, researchers from the Connecticut Academy of Science and Engineering (CASE) reported four principal findings:

- (1) Exposure to radiation emissions from CYN based on Committed Effective Dose Equivalents (CEDE) is negligible (using US Environmental Protection Agency model).
- (2) There is no association between the incidence rates of the cancers studied (leukemia and thyroid cancer) and geographic proximity to CYN (using spatial/cluster analysis).
- (3) There is no statistically significant increased cancer incidence in towns located on the Connecticut River downstream from CYN (using cluster analysis).
- (4) There is no meaningful association between radiation exposure and cancer incidence (using logistic regression).

### Limitations of the Study

Careful examination of the reported methodology and results leads to a number of epidemiological questions about the quality of the analysis and appropriateness of certain methods employed by the CASE. The limitations of the study bring into question the validity of all four of the above conclusions.

### *Exposure Assessment*

The investigators state that because the committed effective dose equivalents (CEDE) were so low, "a more detailed analysis [was] unlikely to add significantly to the dose estimates" (CASE, 1999: page 8). They may be so low, however, because of the methods used to calculate them. The Connecticut Academy of Science and Engineering, in its efforts to save human and financial resources, used the most readily available data in its analysis of the CYN Power Plant. The authors admit repeatedly that they "could" have done more than they did. First, the investigators decided to focus exclusively on airborne emissions, instead of including surface or groundwater transport as well. They claimed that a spatial (cluster) analysis of the area showed that there were no increased rates of cancer in the towns down-river from the plant; any hypotheses concerning water transportation of exposure were therefore dismissed. Cluster analyses are notoriously inconclusive and dismissal of a potentially serious route of exposure based only on this type of analysis was inappropriate. Second, emissions data from earlier years were interestingly left out of the analysis – for reasons such as

Illegible data and reporting of information in a different format. It is specifically stated that the radiogenic emissions varied dramatically over time both between years, and within a given year, according to the season. The investigators made no attempt to account for this variability in their analysis. Third, only meteorological data from 1984 were used to represent atmospheric conditions over the entire 28-year lifespan of the plant. Use of more meteorological data would have led to a better representation of atmospheric conditions and a more reliable exposure assessment. Fourth, they could have analyzed the complex mix of radionuclides from each year's emissions release instead of assuming that the release was the same for all 28 years under consideration.

The calculation of the CEDE is another point of concern. First, in calculating the CEDE, they did not use actual soil, water, or food samples collected over the operating history of the plant to get a more accurate sense of the level of emissions instead of exclusively focusing on airborne transmission. The rationale for this strategy is unclear and unsubstantiated. Second, they assumed that "an individual remained at the same location for the entire exposure period" (CASE 1999: page 7), which is most certainly an incorrect assumption in the part of the investigators. Third, there is considerable discrepancy between the National Council on Radiation Protection (NCRP) dose estimates and the CEDE estimates. The NCRP average estimates are consistently higher than those estimated by CASE, in some instances about a 20-fold. Also, the ratio of the NCRP dose to the CEDE dose tends to get larger as the distance from the CYN Power Plant and NCRP dose increase. This is an unexpected finding and indicates that perhaps the CASE model for exposure assessment may not have been accurate.

The authors of the CASE report note that "the towns closest to CYN do not necessarily receive the greatest doses", but then, in apparent contradiction of this statement, they provide a map (Figure 2) showing a dosage gradient when traveling in any given direction from the plant. They also indicate that exposure assessment could not be considered accurate for towns closest to the plant (those within 5 miles), which if true, would mean that the authors have no authority to state whether the greatest doses are received by the towns closest or not.

Given the concerns outlined above, it is not clear that appropriate assumptions were used to calculate exposure estimates, and that the CASE conclusion of "negligible" exposure is correct.

#### *Outcome Assessment (Analysis of Cancer Incidence)*

In the introduction to the report, the authors state that the community's concern is based on information with "no scientific data" and that has "little or no statistical significance" (CASE, 1999: page v). Rarely, communities have the expertise and resources available to collect data and analyze and interpret the results. It is the

responsibility of public health professionals to address these concerns adequately using resources that are usually not available to concerned communities.

It is very easy to conduct a study that does not provide statistically significant results using a flawed study design, including crude exposure assessment and inappropriate statistical analysis. The challenge to the CASE investigators was to design a sensitive enough study to detect an association between excess disease in 169 cities in Connecticut and the emission of radiogenic elements from CYN, if such an association truly exists. Arguably, their comparison of exposure and cancer incidences may not have been sensitive enough to detect such an association.

To determine the geography of leukemia and thyroid cancer, they appropriately calculated Standardized Incidence Ratios (SIRs) for each town by dividing the number of observed cases by the number of expected cases for that area. The problem arose in how they used the adjusted incidence rates to see how they related to the exposure measures calculated for each town. They used the statistical technique of logistic regression, in which the "likelihood that an individual would be diagnosed with a specific form of cancer, per unit of radiation exposure" was calculated (CASE, 1999: page 10). It is unclear whether logistic regression was the appropriate statistical method to employ and their procedures are not clearly outlined. The authors admit to "weighting" the reported information according to the population of each town; the significance of this is unclear. In addition, it is expected that researchers explain the structure and coding of variables. For example, they state that "low" and "increased" exposure was used in their analysis, but if they are attempting to estimate the risk of cancer "per unit of radiation exposure" this implies that they are using the CEDE as a continuous variable, not categorized into low and increased exposure. Their description of the "data and methodology" lacks any detail, and provides insufficient information to determine the dependent (how was disease coded?) or independent (how was exposure coded?) variables used in the logistic regression, and the "individuals" assumed to be at risk.

Any study that attempts to quantify risk of disease must quantify that risk based on a comparison group. The comparison group in this study is unidentified and the summary table (Table 6), which should be self-explanatory and reveal the details of the statistical analysis and its results, is difficult to understand for even the trained epidemiologist.

Figure 10 shows "crude associations" of cancers rates to exposure levels. But these are not individual-level data as the statistical model would imply – these are plots of the disease incidence in the towns under study against the exposure to radiation in those towns. The relationship between the statistical model described and the plots of the data is quite unclear and misleading to the reader.

who may assume (incorrectly) that the CASE investigators actually used individual-level data in their analysis.

Time and resources permitting, an individual-level analysis (using cancer cases and a sample of controls from the population at risk of disease) would likely have yielded a more accurate measure of individual risk of disease. By using the aggregate (town) level data, the investigators were not able to explore other factors that may be related to both the risk of cancer and the radiogenic emissions, which could be confounders in the analysis. These factors include such basic demographic characteristics as age and gender, but also additional factors such as occupation and migration in and out of the area. Collecting individual-level data would have also allowed the investigators to specify suspected "windows" of exposure to the radiogenic emissions. Because cancers can have a long latency period (the time between the exposure and the diagnosis of disease), it would be beneficial to know exactly when and for how long each individual who was diagnosed with cancer and control subjects were exposed to emissions. This study did not take the long latency periods into consideration at all. In addition, an individual level analysis would have allowed investigators to gather some basic information on migration patterns, which could have been useful to increase the accuracy of the exposure estimates.

In conclusion, the CASE report found no "meaningful" association between radiogenic emissions from the CYN Plant and incidence of leukemia and thyroid cancer in 169 Connecticut towns. The reasons, perhaps, for their lack of "significant" findings is not because there is no association, but because they conducted a methodologically flawed analysis.

# ECRR REPORT CHALLENGES ENTRENCHED RADIATION ASSUMPTIONS

**A recently-released report claims that the radiation dose model of the International Commission on Radiological Protection (ICRP) is inadequate for internal irradiation, and proposes a new model. The report made headlines with its predictions of over 61 million deaths from cancer attributable to nuclear activities since 1945.**

(583.5493) NIRS – The European Committee on Radiation Risk (ECRR) is an independent committee formed in 1997 after a meeting at the European Parliament to review the controversial issue of low-level radiation.

Shortly after it was set up, a meeting of the European Parliament's Scientific and Technological Options Assessment unit (STOA) considered evidence that low-level exposure to man-made radiation caused ill health and that models used by ICRP failed to predict these effects.

The ECRR was asked to come up with an alternative analysis.

The resulting report, *2003 Recommendations of the European Committee on Radiation Risk*, addresses not only the science behind the low-dose debate, but also the ethical basis for allowable radiation exposures.

*The intellectual breadth and depth, and scientific inclusiveness of this report are a refreshing change from current radiation establishment tactics.*

If society is ever to have a proper debate on the effects of low-doses and dose rates of ionizing radiation, it must challenge the very basis of radiation dose and risk assessment. This report does.

For its models, the ICRP uses ethical justifications which are based on overall societal benefit rather than individual benefit. This does not account for rights-based philosophies which are part of the UN declaration of human rights. Since any dose of radiation has a small probability of fatal harm, the ECRR argues, the "collective dose" should be employed for all practices and time scales dealing with avoidable radiation exposure.

*Among inadequacies in the ICRP risk model, the ICRP makes assumptions that are based on a series of value judgments. Often the risk model runs counter to actual and epidemiological study results. Additionally, population dose is not accurate for each individual since it averages the effects of many people who are genetically variable.*

Current ICRP risk models do not differentiate enough between radiation delivered externally and that delivered internally; a difference the report likens to "a man warming himself in front of a fire and a man eating a red hot coal."

Further, the ICRP risk model takes a high dose to a single cell and averages it over a larger tissue mass.

The ECRR accepts the ICRP's "linear no threshold" model for external irradiation. However, because of the complex mechanism of cells, the ECRR says that the current linear damage model is not suitable for internal irradiation. The linear model must, according to the committee, be superseded in favor of relationships that show much higher effects at low doses.

To help correct for these shortcomings, ECRR has developed mathematical terms that extend the risk model of the ICRP. They include two new weighting factors in the calculation of effective dose (for internal exposures) which address ionization density in time and space at the cellular level. Ionization densities vary by radiation type (alpha, beta or gamma).

The committee also makes weighting adjustments for certain types of radionuclides which undergo damaging transmutation; and they make enhancement weightings based on biological and biophysical aspects of certain exposures.

ECRR derives these weighting factors from studies showing harm from low-dose exposures.

The committee recommends:

- the total maximum permissible dose to members of the public from all human nuclear practices be not more than 0.1mSv and 5mSv for workers
- all new nuclear practices must be justified by considering the rights of all individuals.
- total consequences of radioactive discharge must be assessed for both direct and indirect effects on all living systems.
- radiation exposures must be kept as low as reasonably achievable using best available technology.

For more information, visit the committee website at [www.euradcom.org](http://www.euradcom.org).  
Source and contact: Cindy Folkers at NIRS ([cindyf@nirs.org](mailto:cindyf@nirs.org))

**Cancer Incidences in Connecticut Towns 1995-1999**  
**Source: Connecticut Tumor Registry**

All Sites – Female

Town	Cancers	Expected	SIR
East Lyme	251	239.04	1.05
Groton	475	469.02	1.05
New London	365	302.10	1.21
Old Lyme	134	114.58	1.17
Waterford	320	323.42	.99
<b>TOTAL</b>	<b>1,545</b>	<b>1,448.16</b>	<b>1.07</b>

All Sites – Male

Town	Cancers	Expected	SIR
East Lyme	222	253.68	.88
Groton	448	468.98	.96
New London	314	292.52	1.07
Old Lyme	143	134.05	1.07
Waterford	325	337.83	.96
<b>TOTAL</b>	<b>1,452</b>	<b>1,487.06</b>	<b>.98</b>

Lung (Males)

Town	Cancers	Expected	SIR
East Lyme	24	38.59	.62
Groton	69	69.92	.99
New London	54	43.70	1.24
Old Lyme	10	20.88	.48
Waterford	46	52.39	.88
<b>TOTAL</b>	<b>203</b>	<b>225.48</b>	<b>.90</b>

Lung (Females)

East Lyme	32	29.81	1.07
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Groton	67	58.87	1.14
New London	51	37.51	1.36
Old Lyme	16	14.86	1.08
Waterford	48	42.56	1.13
TOTAL	214	183.61	1.17

Colorectal (Males)

East Lyme	26	29.62	.88
Groton	55	55.58	.99
New London	32	34.99	.91
Old Lyme	46	41.08	1.12
TOTAL	170	177.2	.96

Colorectal (Female)

East Lyme	24	26.32	.91
Groton	77	57.58	1.34
New London	50	37.79	1.32
Old Lyme	13	13.21	.98
Waterford	40	41.37	.97
TOTAL	204	176.27	1.16

Prostate

East Lyme	80	71.88	1.11
Groton	118	128.37	.92
New London	83	79.67	1.04
Old Lyme	57	39.00	1.46
Waterford	97	97.22	1.00
TOTAL	435	416.14	1.05

Breast, Females

East Lyme	78	77.33	1.01
Groton	139	143.17	.97
New London	103	91.22	1.13
Old Lyme	53	36.62	1.45
Waterford	78	98.17	.79
TOTAL	451	446.51	1.01

Melanoma, Males

East Lyme	15	11.63	1.29
Groton	33	21.42	1.54
New London	10	13.33	.75
Old Lyme	13	5.79	2.25
Waterford	12	14.53	.84
TOTAL	83	66.53	1.25

Melanoma, Females

East Lyme	18	8.92	2.02
Groton	17	16.48	1.03
New London	13	10.57	1.23
Old Lyme	6	3.95	1.52
Waterford	14	10.46	1.34
TOTAL	68	50.38	1.35

Uterine/Cervix

East Lyme	7	4.72	1.48
Groton	9	8.52	1.06
New London	9	5.44	1.65
Old Lyme	3	1.98	1.52
Waterford	6	5.10	1.18
TOTAL	34	25.76	1.32

**Health Effects**  
**of Selected Industrial Chemicals**  
**and Radionuclides:**  
*an introduction*

**STAND**  
**Technical Report 2003 – 2**

**July 2003**

**STAND** is a 501(c)(3) non-profit grassroots organization  
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*to citizen responsibility for the welfare of our communities,*  
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**STAND's** goal is  
the protection of human health and the long-term  
preservation of the natural resources entrusted to our care.

Supported by a grant from the  
**Citizens' Monitoring and Technical Assessment Fund.**

**Health Effects**  
**of Selected Industrial Chemicals**  
**and Radionuclides:**  
*an introduction*

*by*

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*Radioactive Waste Management Associates*

*prepared for*



**July 2003**

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## **Introduction**

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The purpose of this report is to provide information about the health hazards that exposures to industrial chemicals and radionuclides may pose to the community. Sources of additional information are provided in Appendix 3. In this way, the community might better understand the health issues and hazards related to these chemicals and contaminants.

Determining and classifying health hazards to humans exposed to varying amounts of contaminants is difficult and subtle. The risks of serious illness as a function of exposure is not the same for all compounds, and one should not be misled by the similarities of the health effects due to the different toxic chemicals inventoried in this report. The quantitative aspects of exposure are as important as the seriousness of the health consequences. Indeed, the geographical spread of the contaminants and their temporal evolutions would also vary; leading us to naturally consider the seriousness of contamination as a function of quantity, consequences, and also temporal evolution. Therefore, the notion of "acceptable" risk levels for a site goes much further than just establishing a list of contaminants and their legal dose limits.

Some of the reasons that make the understanding of "acceptable" exposure more subtle than it first appears are provided below.

### **Regulating Agencies and Guidelines**

The federal government is charged with developing regulations and recommendations to protect public health. These regulations can be enforced by law.

Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

It is important to remember in this regard that as far as radioactive materials are concerned, the Department of Energy (DOE) regulates

its own facilities. Through its contractors, DOE also operates these facilities. DOE funds health studies that determine the hazard of radioactive materials.

National Primary Drinking Water Regulations are determined by the EPA for certain toxic and radioactive chemicals. These regulations, known as the Maximum Contaminant Level (MCL), are legally enforceable in the United States. These legal standards set limits to the amount of contamination in the public drinking water supply.

Many other agencies study the effects and patterns of some toxic materials, such as the World Health Organization (WHO), the International Agency for Research on Cancer (IARC), and the United States Department of Health and Human Services (US DHHS). These organizations recommend limits on the concentrations, or amounts, of contamination to be allowed in drinking water.

In this report, many of the chemicals discussed do not have assigned MCLs. In these cases, additional guidelines are provided. The American Conference of Governmental Industrial Hygienists (ACGIH) has set Threshold Limit Values (ACGIH TLV); these values are time-weighted averages to which a worker can be exposed in a normal 8-hour day, 40-hour workweek without any effect on human health. The NIOSH has determined Recommended Exposure Limits (REL) which are guidelines based on risk evaluations using human health effects for levels feasibly achieved and measured by engineering controls. However, these two guidelines are difficult to compare. In addition, the WHO has set its own recommended levels for contaminants allowed in drinking water.

## Standards

Regulations and recommendations can be expressed in "not-to-exceed" levels in air, water, soil, or food that are usually based on levels that affect animals, then adjusted to protect people. Sometimes these "not-to-exceed" levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors. Recommendations and regulations are also periodically updated and change as more information becomes available. Unfortunately, the number of new chemicals introduced into the workplace each year numbers in the hundreds or thousands, completely over-whelming the ability of federal agencies to determine the hazards of each.

So, it is not uncommon that different studies reach different conclusions about which contaminants are most prevalent or of highest priority. Similarly, the Hazard Rating (HR) assigned to each material in the form of a number (1, 2, and 3) that briefly identifies the level of toxicity or hazard varies according to different agencies and organizations.

### **Factors**

When a substance is released from a large area, such as an industrial plant, or a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. One can be exposed to a substance only when in contact with it by breathing, eating, touching, or drinking. The consequences may vary in each case.

When exposed to a chemical, many factors determine whether a person would likely be harmed or not. These factors include the dose (how much), the duration (how long), the form (which chemical compound), and the way the contact occurs. Other important parameters could be the presence of other chemicals that enhance or diminish the toxicity, and the age, sex, diet, family traits, lifestyle, and state of health of the person. Therefore, classifying the health hazards to humans becomes difficult and research-intensive. Varying test environments and procedures will alter results in the patient. Also, health effects for the majority of these chemicals are better known for animals than humans. The same effects seen in animals may also be seen in humans to some extent. However, humans do not react in the same way when exposed to the same chemicals and, therefore, more research is needed to determine the full extent of harm to human health.

In addition, medical tests on individuals to detect and evaluate exposures to a chemical may have used various "techniques" and resulted in contradictory results. Measurements in the blood, feces, or urine can determine if one has been exposed to larger-than-normal amounts of chemicals. But these measurements will obviously depend on each individual, their overall health and how long after the exposure the measurement is taken.

It is difficult to obtain information on target organs. For example, all the persons suspected of having died prematurely because of a precise exposure have not necessarily been autopsied so the information

about which organs have been partially or completely damaged is lacking.

Further, correlations can be difficult to establish. An organ may not be lethally damaged, but its malfunction could accelerate the deterioration of another part of the body and lead to a fatality. For example, smoking or chronic bronchitis due to exposure to dust would make a person more sensitive to radioactivity.

Fetuses, children, and adults also exhibit different susceptibilities to various contaminants.

### **Cancer Reviews and Classifications**

Along with other agencies, the U.N. International Agency for Research on Cancer (IARC) examines suspected potential carcinogens. The results, which vary widely between animals and humans, usually fall into one of three groups defined as follows:

- 1) **Class I – Confirmed Carcinogens**  
These substances are capable of causing cancer in exposed humans.
- 2) **Class II – Suspected Carcinogens**  
These substances may be capable of causing cancer in exposed humans. The evidence is suggestive, but not sufficient to convince expert review committees. Some entries have not yet had expert review, but contain experimental reports of carcinogenic activity.  
As more studies are published, many Class II carcinogens will have their carcinogenicity confirmed. On the other hand, some may be judged non carcinogenic.
- 3) **Class III – Questionable Carcinogens**  
These entries have minimal published evidence of possible carcinogenic activity. The reported endpoint is often neoplastic growth with no spread or invasion characteristic of carcinogenic pathology.

It should be noted that these three categories refer only to the strength of the experimental evidence that a chemical is carcinogenic, and not to the extent of its carcinogenic activ-

ity nor to the mechanism involved. The classification of any chemical may change as new information becomes available.

For a substance to belong in Class III, the report may simply have lacked control animals, may have used a very small sample size, lacked complete pathology reporting, or may have suffered other design defects. Many of these were designed for other-than-carcinogenic evaluation, and the reported carcinogenic effect is a by-product of the study, not the goal. The data were presented because some of the substances may be carcinogens. There are simply insufficient data to affirm or deny the possibility.

### **Synergistic Effects of Multiple Contaminants**

Complicating the assessment of toxicity for a contaminated site is the presence of a mixture of contaminants. Aggregated chemicals could mean aggregated risks.

In a survey of 91 DOE waste sites, for example, Riley and Zachara (1992) found that mixtures of two or more compounds were present at 65 % of the sites. In soils, the most frequently occurring mixtures were metals combined with radionuclides, but various combinations of metals and radionuclides with organic contaminants were also observed at some sites. In groundwater, the most common mixtures were metals and chlorinated hydrocarbons.

The consequences of the synergy, linked to the presence of several contaminants at a time in a contaminated site, still need to be thoroughly examined. Chemical and radioactive risks are generally increased if these substances are carcinogenic to the same organ.

Other auxiliary parameters may also interfere with the total toxic impact of chemicals, and should not be underestimated. For example, a smoker with damaged cilia in his lung passages will not be able to properly expel radioactive materials, and therefore could be subject to greatly increased health effects. Weather and temperature, for example, may also have favorable or deleterious consequences.

## Chlorinated Solvents

---

A solvent is typically a liquid that dissolves another substance, thereby forming a solution. A chlorinated solvent is one that is a chlorine compound. As chlorinated solvents move through the ground, the materials act as an oily liquid. Groundwater flowing in the soil will dissolve only a small portion of the contaminant and the rest enters and contaminates the groundwater.

A dioxin is a specific type of chlorinated solvent; dioxins are a group of 219 different toxic chlorinated solvents. These solvents are fat-soluble and therefore accumulate in the tissues of animals and humans in the food chain. Humans are typically exposed to these chemicals through the consumption of fish, meat, and milk. Dioxins are formed through the burning of chlorine-based compounds. Dioxins may be transported great distances if airborne. Materials that enter the water will bind to sediments and are transported along with marine wildlife through ingestion. Similarly, dioxins can settle on the leaves of plants and are ingested by animals.

Exposure results in a drop in sperm count, an increase in testicular and prostate cancer, endometriosis, and an increased risk of developing breast cancer. The toxicity of these chemicals varies but dioxins have similar potencies.<sup>1</sup> Results of exposure to dioxins create adverse health effects and vary depending on the level of exposure, time of exposure, and length of exposure. Typical effects as a result of exposure to large amounts of dioxin include skin rashes, skin discoloration, excessive body hair, and possibly mild liver damage. Cancer as a result of excessive dioxin exposure is a main concern in adults.

Although the carcinogenicity of chlorinated solvents remains unknown, cancer as a result of exposure is a great concern.

### Carbon Tetrachloride

Carbon tetrachloride, also known as carbon chloride, methane tetrachloride, perchloromethane, tetrachloroethane, or benziform, is a clear liquid with a sweet smell that can be detected at low-levels. This synthetic chemical was most typically used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as

a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. It is now only used in some industrial applications as a result of its harmful health effects. High-levels of exposure through inhalation and ingestion and possibly through exposure to the skin can cause liver, kidney, and central nervous system damage. The liver and kidney cells are damaged or destroyed by this chemical. Kidney and liver repair can occur when low-levels of exposure are stopped. High-levels of exposure affect the nervous system, including the brain. This chemical has been linked to brain cancer. Effects of exposure include: headaches, intoxication, dizziness, drowsiness, nausea, and vomiting, and can lead to coma and even death. The US DHHS has determined this chemical is a probable carcinogen. The MCL is set at 0.005 mg/L and the ACGIH TLV is set at 5 ppm. The NIOSH REL is set at 2 ppm or 12.6 mg/m<sup>3</sup>.

#### **Chloride**

Chloride has a very low toxicity. Ingestion of large amounts of chloride may lead to fluid retention and altered acid-base balance. Chlorine as a gas or liquid is irritating and toxic. The main source of exposure is through the consumption of salt. Effects of long-term exposure are unknown.

#### **Chlorobenzene**

Chlorobenzene, also known as benzene chloride, was used to make other chemicals such as phenol and DDT. Currently, this chemical is used as a solvent to make other chemicals. This chemical is a strong narcotic with slight irritant qualities. Health effects from repeated low-levels of exposure are unknown. Symptoms of exposure include: irritation to the eyes, skin, and nose, drowsiness, incoordination, and central nervous system depression. The carcinogenicity of this chemical is unknown. The ACGIH TLV is set at 10 ppm.

#### **Chloroform**

Chloroform, also known as trichloromethane and methyl trichloride, is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. This chemical will burn only when it reaches very high temperatures. Initially, chloroform was used as an anesthetic. Currently, it is used to make other chemicals. Inhalation results in irritation to the respiratory tract, and effects on the central nervous system including headache, drowsiness, and dizziness. Results of inhalation may also lead to unconsciousness, liver injury, blood disorders, and even death. Ingestion results in severe burning to the mouth and

throat, vomiting and similar results as inhalation. Sores develop on skin with contact to large amounts of chloroform. The US DHHS declares chloroform to be a probable carcinogen. The MCL is not determined for this chemical, but the ACGIH TLV is set at 10 ppm. The NIOSH REL is set at 2 ppm or 9.78 mg/m<sup>3</sup>.

#### **Chloromethane**

Chloromethane is also known as methyl chloride. Symptoms often seen include: convulsions, nausea or vomiting, dizziness, drowsiness, incoordination, confusion, abdominal pains, hiccoughs, diplopia, delirium, convulsions, irritation to the eye, coma, and even death. High levels of exposure greatly affect the nervous system, liver, kidneys, and heart. No evidence exists to imply that chloromethane is a carcinogen. However, the EPA has determined that it is a probable carcinogen. The ACGIH TLV is set at 50 ppm. The NIOSH REL is set at 100 ppm.

#### **Dibromochloromethane**

Dibromochloromethane is also known as chlorodibromomethane. Symptoms often seen include: irritation and narcotic effects. No cases of cancer are seen in humans exposed to this chemical. The MCL for this chemical is set at 0.10 ppm.

#### **Dichlorodifluoromethane**

Dichlorodifluoromethane exposure symptoms often seen include: dizziness, tremor, asphyxia, unconsciousness, cardiac arrhythmias, cardiac arrest, conjunctiva irritation, fibrosing alveolitis, liver changes, and narcotic effects. The ACGIH TLV and NIOSH REL are set at 1000 ppm.

#### **Freon-113**

Freon-113, also known as 1,1,2-Trichloro-1,2,2-trifluoroethane, is a mildly toxic chemical. Symptoms often seen include: irritation to skin and throat, drowsiness, dermatitis, and central nervous system depression. The NIOSH REL is set at 1000 ppm.

#### **Methylene Chloride**

Methylene Chloride, also known as dichloromethane, is not found naturally in the environment. This chemical is a colorless liquid with a mild, sweet odor used as an industrial solvent and paint stripper. Inhalation of low-levels results in a person becoming less attentive and less accurate. Effects of inhalation at high-levels have a narcotic

effect. Symptoms often seen include: dizziness, nausea, mental confusion, fatigue, vomiting, headaches, and a tingling sensation in the fingers and toes. Contact with this chemical by skin results in irritation, redness, pain, and even burning. The WHO declares methylene chloride as carcinogenic to humans. The US DHHS and the EPA have determined that this chemical is a probable carcinogen. The MCL has not been determined for this chemical, but the ACGIH TLV has been set at 50 ppm.

#### **Octachlorodibenzo-p-dioxin (OCDD)**

Octachlorodibenzo-p-dioxin (OCDD) is an experimental teratogen and an irritant to the eye. Ingestion of this chemical results in poisoning. These solvents are fat-soluble and therefore accumulate in the tissues of animals and humans in the food chain. Humans are typically exposed to these chemicals through the consumption of fish, meat, and milk. Exposure to dioxins results in a drop in sperm count, an increase in testicular and prostate cancer, endometriosis, and an increased risk of developing breast cancer. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Pentachlorinated dibenzofurans**

Pentachlorinated dibenzofurans is a chemical with great health effects to the human body. A significant reduction of thymus weight and suppression of the activity of cytotoxic T lymphocytes, in addition to a suppression on both cell-mediated and humoral immunity. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Perchloroethylene (PCE)**

PCE, also known as perchloroethylene or tetrachloroethylene, is a moderately toxic chemical. Inhalation results in conjunctiva irritation, general anesthesia, hallucinations, distorted perceptions, local anesthesia, coma, and pulmonary changes. Symptoms of exposure may include irritation to eyes, skin, nose, throat, and respiratory system, as well as nausea, dizziness, incoordination, headache, drowsiness, skin erythema, and liver damage. Ingestion results in irritation to the gastrointestinal tract. This chemical is a potential carcinogen. The MCL has not been determined for this chemical, but the ACGIH TLV is set at 50 ppm. The NIOSH REL recommends that workplace exposure is minimized.

**Titanium tetrachloride**

Titanium tetrachloride is a colorless to pale yellow liquid that has fumes with a strong odor. If it comes in contact with water, it rapidly forms hydrochloric acid, as well as titanium compounds. It is not found naturally in the environment and is made from minerals that contain titanium. It is used to make titanium metal and other titanium-containing compounds, such as titanium dioxide, which is used as a white pigment in paints and other products.

Titanium tetrachloride is very irritating to the eyes, skin, mucous membranes, and the lungs. Breathing in large amounts can injure the lungs seriously enough to cause death. There is no evidence that chronic exposure to titanium tetrachloride causes cancer in humans. The MCL and ACGIH TLV haven't been determined for this chemical. The NIOSH REL is set at 0.001 mg/m<sup>3</sup>.

**1,2,4-Trichlorobenzene**

1,2,4-Trichlorobenzene is an experimental teratogen. This chemical is an irritant to the eyes, skin, and mucous membrane. Symptoms often affect the liver, kidney, and adrenal gland. The carcinogenicity of this chemical is unknown. The MCL is set at 0.07 mg/L. The ACGIH TLV is set at 5 ppm.

**1,1,1-trichloroethane**

1,1,1-trichloroethane is synthetic material that is also known as methyl chloroform. Symptoms often seen include: dizziness, conjunctiva irritation, hallucinations or distorted perceptions, motor activity changes, irritability, aggression, hypermotility, diarrhea, poor equilibrium, dermatitis, nausea or vomiting, cardiac arrhythmias, and other gastrointestinal changes. The IARC has determined the carcinogenicity of this chemical is not classifiable. The ACGIH TLV and NIOSH REL are set at 350 ppm.

**Trichloroethylene (TCE)**

TCE is also known as trichloroethylene. Symptoms of inhalation and ingestion are mildly toxic to humans and include: eye irritation, somnolence, hallucinations or distorted perceptions, gastrointestinal changes, and jaundice. Addiction results in those that work with the chemical. High-levels of exposure lead to headache and drowsiness, and eventual ventricular fibrillation resulting in cardiac failure, which in turn damages the liver and other organs. NIOSH has determined this chemical to be a potential occupational carcinogen; the recom-

mended REL is 2 ppm. The MCL is set at 0.005 mg/L and the ACGIH TLV is set at 50 ppm.

#### **Tetrahydrofuran**

Tetrahydrofuran, also known as tetramethylene oxide or THF, is a mildly toxic chemical. Symptoms often seen include: general anesthesia, irritant to eyes, mucous membranes, and upper respiratory system, narcotic in high concentrations, liver and kidney damage, and central nervous system depression. The NIOSH REL is set at 200 ppm.

#### **Vinyl Chloride**

Vinyl Chloride is moderately toxic by ingestion and a severe irritant to skin, eyes, and mucous membranes. High concentrations of vinyl chloride act as an anesthetic and chronic exposure can lead to liver injury. The carcinogenicity of vinyl chloride is confirmed in producing a rare cancer in the liver and blood tumors. The production of vinyl chloride is also a source of dioxins.<sup>2</sup> The MCL is set at 0.002 mg/L and the ACGIH TLV is set at 5 ppm.

## **High Explosives Compounds** ---

Explosives are chemical compounds or mixtures that are typically used in detonators in bombs. Large amounts of gas and heat are generated with the production of sudden pressure effects. As a result, the explosives vary in intensity and resistance. Mixing of chemicals produces varied effects and intensities upon explosion.

#### **1,3-Dinitrobenzene**

1,3-dinitrobenzene, also known as 2,4-dinitrobenzene, is a synthetic explosive formed as a by-product from the manufacturing of TNT. Mixing this chemical with tetranitromethane results in a high explosive that is very sensitive to sparks. No odor or taste is associated with this chemical. This chemical is slightly soluble in water and does not stick strongly to soil and as a result travels through the soil into the groundwater. Symptoms of exposure include headache, anoxia, cyanosis, visual disturbance, central scotomas, bad taste, burning mouth, dry throat, thirst, anemia, liver damage, nausea, and dizziness. Long-term exposure results in a reduction of the number of red blood cells. The carcinogenicity of this chemical is undetermined for humans. The NIOSH REL is set at 1 mg/m<sup>3</sup>.

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#### **Dinitrotoluene (DNT)**

Dinitrotoluene (DNT) is a poison that is carcinogenic with experimental tumorigenic and teratogenic data. Symptoms of exposure may include anozia, cyanosis, anemia, jaundice, and reproductive effects. The MCL has not been determined for this chemical but the ACGIH TLV is set at 1.5 mg/m<sup>3</sup>. The NIOSH REL is set at 1.5 mg/m<sup>3</sup>.

#### **2,6-Dinitrotoluene**

2,6-Dinitrotoluene is a synthetic explosive that is one of the six forms of chemicals of dinitrotoluene. This chemical is a pale yellow solid with a slight odor. Health effects from exposure to this chemical are uncertain. The nervous system and blood of exposed workers may be affected. The IARC has determined that this chemical is a potential carcinogen.

#### **HMX**

HMX, also known as cyclotetramethylene tetranitrate, is an acronym for High Melting Explosive. Other names for this chemical include: octogen and cyclotetramethylene-tetranitramine. It is a colorless solid that dissolves slightly in water with an unknown taste and smell. This chemical is made from other chemicals known as hexamine, ammonium nitrate, nitric acid, and acetic acid. The high volatility of this chemical enabled its use in explosives, rocket fuels, and burster chargers. No information is known on how you might be exposed to HMX in the environment and the information on adverse health effects is limited. The EPA has concluded that the carcinogenicity to humans is not classifiable. The MCL and ACGIH TLV have not been determined for this chemical.

#### **4-Nitrotoluene**

4-Nitrotoluene is a poison that is moderately toxic by ingestion. Contact with skin is mildly toxic. This chemical is combustible upon exposure to heat or flame. Symptoms of exposure may include anoxia, cyanosis, headache, weakness and exhaustion, dizziness, ataxia, difficulty breathing, tachycardia, nausea, and vomiting. When it is combined with tetranitromethane a very sensitive high explosive is created. The NIOSH REL is set at 11 mg/m<sup>3</sup>.

#### **4-PETN (Pentaerythritol Tetranitrate)**

PETN, also known as Pentaerythritol Tetranitrate, is a hazardous chemical that explodes when shocked or exposed to heat. Ingestion

results in dermatitis. Other symptoms of exposure include: headaches, weakness, and fall in blood pressure. The MCL and ACGIH TLV have not been determined for this chemical.

#### **4-Perchlorate**

Perchlorate is synthetic and man-made. Perchlorates are incredibly unstable materials. Irritation to the body results in contact with any perchlorate. Mixtures of this chemical form explosives. This chemical affects the functioning of the thyroid gland. Alteration to thyroid gland functions can potentially lead to the formation of tumors.

#### **4-RDX**

RDX, otherwise known as Royal Demolition Explosive, is one of the most powerful high explosives in use today. Other names for this chemical include: cyclotrimethylene-trinitramine cyclonite, cyclonite, and 1,3,5-trinitro-1,3,5-triazine. As a synthetic, white powder, when RDX is burned fumes are created. This chemical is rarely used alone and is typically combined with other explosives, oils, or waxes. Symptoms of exposure to RDX include: seizures, nausea, headache, irritability, weakness and exhaustion, tremor, dizziness, insomnia, and vomiting. Knowledge of birth defects or effects on reproduction in humans is yet to be discovered. The carcinogenic properties of RDX are unknown. The MCL has not been determined for this chemical, but the ACGIH TLV is set at 1.5 mg/m<sup>3</sup>. The NIOSH REL is set at 1.5 mg/m<sup>3</sup>.

#### **Tetryl**

Tetryl is also known as nitramine and 2,4,6-trinitrophenyl-n-methylnitramine. This explosive is an extremely sensitive high explosive, more so than TNT to shock and friction. When combined on contact with trioxxygen difluoride the chemical explodes on contact. This chemical is an irritant, sensitizer, and allergen. Symptoms of exposure may include sensitization dermatitis, redness, inflammation of the cornea, sneezing, anemia, cough, coryza, irritability, malaise, headache, weakness and exhaustion, insomnia, nausea, vomiting, and liver and kidney damage. The NIOSH REL is set at 1.5 mg/m<sup>3</sup>.

#### **2,4,6-Trinitrotoluene**

2,4,6-Trinitrotoluene is an explosive commonly referred to as TNT. Ingestion results in hallucinations or distorted perceptions, cyanosis, and gastrointestinal changes. Contact with this chemical results in

skin irritation. Health effects include jaundice, cyanosis, sneezing, cough, sore throat, peripheral neuropathy, muscle pain, kidney damage, cataract, sensitization dermatitis, headaches, weakness, anemia, and liver injury. The MCL has not been determined for this chemical, but the ACGIH TLV is set at 0.5 mg/m<sup>3</sup>. The NIOSH REL is set at 0.5 mg/m<sup>3</sup>.

## **Fuel Components and other Organic Chemicals——**

Toxic chemicals are known to disrupt normal bodily functions, including the functions of hormones. Hormones provide a number of services as natural chemicals to the human body including: act as messengers, travel through the blood stream, regulate various bodily processes, and coordinate the body's activities to maintain health through controlling growth, development, and behavior.<sup>2</sup>

### **Acenaphthylene**

Acenaphthylene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters in all tissues that contain fat. Acenaphthylene is stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The US DHHS has determined that acenaphthylene is a known animal carcinogen; however, the EPA has determined that the human carcinogenicity is not classifiable. The MCL and ACGIH TLV have not been determined for this chemical.

### **Acetone**

Acetone is a colorless liquid with a distinct smell and taste that is naturally found in the environment as well as manufactured. Other names for this chemical include: dimethylketone, 2-propanone, and beta-ketopropane. In small amounts, the liver breaks acetone down into energy making chemicals used for normal body functions. Exposure results in entry of acetone into the blood stream and is subsequently carried to the rest of the organs. Inhalation of moderate-to-high amounts for even short periods of time can result in nose, throat, lung, and eye irritation, headaches, light-headedness, confusion, increased pulse rate, effects on blood, nausea, vomiting, unconsciousness and possibly coma, and the shortening of the menstrual cycle in women. Ingestion of small amounts typically does not cause harm. However, ingestion of high levels results in abdominal pain, nausea,

and vomiting. Effects of long-term exposure to acetone include kidney, liver, and nerve damage, increased birth defects, metabolic changes, and coma. The use of alcoholic beverages enhances the toxic effects of acetone. The US DHHS, the IARC, and the EPA have not classified acetone for carcinogenicity in humans. The MCL has not been determined for this chemical. The ACGIH TLV is set at 750 ppm. The NIOSH REL is set at 0.1 ppm.

#### **Ammonia**

Ammonia exposure symptoms often seen include: irritation to eyes and mucous membranes. Symptoms often seen include: breathing difficulty, wheezing, chest pain, pulmonary edema, skin burns, liquid, and frostbite. High-levels of exposure result in blindness, lung damage, heart attack, or death. The US DHHS, IARC, and the EPA have not classified the carcinogenicity of ammonia. The ACGIH TLV and NIOSH REL are set at 25 ppm.

#### **Anthracene**

Anthracene is a skin irritant and allergen. The carcinogenicity of this chemical is probable.

#### **9,10-Anthracenedione**

9,10-Anthracenedione, also known as anthraquinone, is a mild allergen.

#### **Asbestos**

Asbestos is comprised of six different minerals that are found in nature. This chemical enters the drinking water from natural sources in addition to corroded asbestos worn away from cement pipes. The separable, heat resistant fibers that make up the minerals are strong and flexible enough to be spun and woven. As a result, asbestos was widely used in building materials, friction products, heat resistant fabrics, packaging, gaskets, and coatings. Inhalation of lower levels of asbestos may result in changes called plaques in the linings. Long-term inhalation of asbestos fibers may result in scar-like tissue in the lungs and in the lining that surrounds the lung. Breathing difficulties, restricted pulmonary function, and heart enlargements arise as a result of exposure, eventually leading to disability and death. The US DHHS, the WHO, and the EPA have determined that asbestos is a human carcinogen and produces lung tumors. The MCL is set at 7 million fibers/L and the ACGIH TLV is set at 2 fibers/cubic centimeters.

**Benzaldehyde**

Benzaldehyde is an allergen. Symptoms often seen include: dermatitis, central nervous system depression, and anesthetic. The carcinogenicity of this chemical is probable.

**Benzene**

Benzene is a colorless liquid with a sweet odor that is formed from natural processes as well as human activities. With its wide distribution throughout the US, the uses of benzene are expansive, some of which include rubbers, lubricants, dyes, degreasers, detergents, drugs, pesticides, and as a major component of gasoline. This chemical enters the drinking water through leaking underground gasoline and petroleum tanks or improper waste disposal. Inhalation of high levels of benzene can result in drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, unconsciousness, and even death. Diseases that result from inhalation include Hodgkin's Disease and lymphomas. Ingestion of benzene is moderately toxic and is a severe eye and moderate skin irritant. Long-term exposure results in harmful effects on the bone marrow, leading to myeloid leukemia, as well as a decrease in red blood cells that leads to anemia. In addition excessive bleeding can occur and the immune system can be affected. Long-term exposure of workers to this chemical is linked to brain cancer and leukemia. Additionally, other possible health complications may arise in reproductive and developmental effects. The US DHHS has determined that benzene is a known human carcinogen. The MCL is set at 0.005 mg/L and the ACGIH TLV is set at 10 ppm. The NIOSH REL is set at 0.1 ppm.

**n-Butanol**

n-Butanol is also known as n-butyl alcohol. Symptoms often seen include: conjunctiva irritation, unspecified respiratory system and nasal effects, severe skin and eye irritant, corneal inflammation, slight headache and dizziness, slight irritation of the nose and throat, and dermatitis. The ACGIH TLV and NIOSH REL are set at 50 ppm.

**Delta-BHC**

Delta-BHC is also known as delta-benzenhexachloride and is a moderately toxic chemical.

### **Gamma BHC**

Gamma BHC is also known as the gamma isomer of benzene hexachloride. Symptoms often seen include: irritation to the eyes skin, nose, and throat, headache, nausea, respiratory difficulty, convulsions, dyspnea, and cyanosis. This chemical is a known carcinogen. The ACGIH TLV and NIOSH REL are set at 0.5 mg/m<sup>3</sup>.

### **Benzo(a)anthracene**

Benzo(a)anthracene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. This chemical is a poison by intravenous routes that is commonly an air contaminant of food, water, and smoke. The IARC and the EPA have determined it is a probable human carcinogen. The MCL and ACGIH TLV levels have not been determined.

### **Benzo(a)pyrene**

Benzo(a)pyrene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. This chemical is a poison via subcutaneous, intraperitoneal, and intrarenal routes that is commonly an air contaminant of food, water, and smoke. Experimental teratogenic and reproductive effects have been found. The IARC and the EPA have determined it is a probable human carcinogen. The MCL is set at 0.0002 mg/L and the ACGIH TLV has not been determined for this chemical.

### **Benzo(b)fluoranthene**

Benzo(b)fluoranthene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The IARC and the EPA have determined this chemical to be a possible human carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

**Benzo(k)fluoranthene**

Benzo(k)fluoranthene is a known carcinogen.

**Benzo(g,h,i)perylene**

Benzo(g,h,i)perylene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The IARC and the EPA have determined this chemical not classifiable as to the carcinogenicity to humans. The MCL and ACGIH TLV have not been determined for this chemical.

**Benzoic Acid**

Benzoic Acid is found naturally in resins and manufactured synthetically. It is a colorless crystalline solid and is used as a food preservative and in pharmaceuticals and cosmetics. Inhalation affects the human nervous system, dyspnea, and allergic dermatitis. This chemical is a poison by subcutaneous route and is moderately toxic by ingestion and intraperitoneal routes. In addition, it is a severe eye and skin irritant. The MCL and ACGIH TLV have not been determined for this chemical.

**Bis-(2-ethylhexyl)phthalate**

Bis-(2-ethylhexyl)phthalate, also known as di-sec-octyl phthalate, is a poison upon entry into the blood stream. Ingestion affects the gastrointestinal tract. In addition, this chemical is a mild skin and eye irritant and can cause liver damage. This chemical is a confirmed carcinogen with experimental carcinogenic and tumorigenic data. The MCL is set at 0.006 mg/L and the ACGIH TLV is set at 5 mg/m<sup>3</sup>. The NIOSH REL is set at 5 mg/m<sup>3</sup>.

**Carbazole**

Carbazole is a pesticide poisonous by intraperitoneal routes. Ingestion is moderately toxic. It is a questionable carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

**Carbon disulfide**

Carbon disulfide is found naturally as well as a commercially made chemical. Symptoms often seen include: narcotic and anesthetic ef-

fects to the central nervous system, dizziness, headache, poor sleep, anorexia, weight loss, Parkinson-like syndrome, coronary heart disease, gastritis, kidney, liver injury, eye and skin burns, respiratory failure, and even death. The US DHHS, the IARC, and the EPA have not determined the carcinogenicity of this chemical. The ACGIH TLV is set at 10 ppm. The NIOSH REL is set at 1 ppm.

#### **Chrysene**

Chrysene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The IARC has determined the carcinogenicity is not classifiable for humans. The EPA has determined that this chemical is a probable human carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Cyclohexane**

Cyclohexane is also known as benzene hexahydride and hexahydrobenzene. Symptoms often seen include: irritation to eyes, skin, and respiratory system, drowsiness, dermatitis, narcosis, and coma. The ACGIH TLV and NIOSH REL is set at 300 ppm.

#### **Cyclohexanone**

Cyclohexanone is a severe eye irritant. Symptoms often seen include: changes in the sense of smell, headache, narcosis, coma, dermatitis, conjunctiva irritation, and unspecified respiratory system changes, mild narcotic, and a skin and eye irritant. The ACGIH TLV and NIOSH REL are set at 25 ppm.

#### **Dibenz(a,h)anthracene**

Dibenz(a,h)anthracene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The US DHHS has determined that this chemical is a known animal carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Di-n-octylphthalate**

Di-n-octylphthalate is also known as di-sec-octylphthalate. This chemical affects the gastrointestinal tract, central nervous system, liver, reproductive system, and gastrointestinal tract. This chemical is also a mild skin and eye irritant. This chemical is a known carcinogen. The ACGIH TLV and NIOSH REL are set at 5 mg/m<sup>3</sup>.

#### **1,2-Diphenylhydrazine**

1,2-Diphenylhydrazine, also known as Hydrazobenzene, is a white solid with no information on smell or flammability. This manufactured chemical does not dissolve easily in water and when placed in water it rapidly breaks down into other toxic chemicals. This chemical is currently used in medicines to treat inflammation and a type of arthritis. Effects of ingestion lead to chemical poisoning. Diphenylhydrazine is a confirmed carcinogen with experimental carcinogenic and tumorigenic data. Poison by ingestion. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Ethyl Acetate**

Ethyl Acetate is a chemical that can cause dermatitis. Inhalation results in severe irritation to mucous membranes and upper respiratory tract, poisoning, human systemic effects such as olfactory changes, conjunctiva irritation, and pulmonary changes. Ingestion of this chemical is mildly toxic in causing irritation to the gastrointestinal tract with symptoms such as nausea, vomiting, and diarrhea. Long-term exposure yields conjunctival irritation and corneal clouding, congestion of the liver and kidneys. High concentrations have a narcotic effect in addition to resultant liver and kidney damage. Chronic poisoning may lead to anemia with leukocytosis (a transient increase in the white blood cell count), cloudy swelling, and fatty degeneration of the viscera. The MCL has not been determined for this chemical and the ACGIH TLV is set at 400 ppm. The NIOSH REL is set at 400 ppm.

#### **Ethylbenzene**

Ethylbenzene is a moderately toxic chemical. Symptoms often seen include: eye, sleep, and pulmonary changes, eye and skin irritation, headache, dermatitis, narcosis, coma, dizziness, irritation of the nose and throat, and a sense of constriction in the chest. The ACGIH TLV and NIOSH REL are set at 100 ppm.

**Fluoranthene**

Fluoranthene is a moderately toxic chemical. The carcinogenicity is probable.

**n-Hexane**

n-Hexane is a slightly toxic chemical made from crude oil. Symptoms often seen include: irritation to the eyes, skin, respiratory system, central nervous system, and peripheral nervous system, paralysis, and hallucinations. The US DHHS, the IARC, and the EPA have not classified the carcinogenicity of this chemical. The ACGIH TLV and NIOSH REL are set at 50 ppm.

**2-Hexanone**

2-Hexanone is also known as Butyl methyl ketone or Methyl butyl ketone. This chemical is moderately toxic. Symptoms often seen include: irritation to the eyes and nose, peripheral neuropathy, weakness, exhaustion, paresthesia, vomiting, dermatitis, headache, and drowsiness. This chemical is a skin and eye irritant. The ACGIH TLV is set at 5 ppm. The NIOSH REL is set at 1 ppm.

**Indeno(1,2,3-c,d)pyrene**

Indeno(1,2,3-c,d)pyrene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The IARC has determined this chemical to be a possible human carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

**Methyl Ethyl Ketone (MEK)**

Methyl Ethyl Ketone (MEK) is a strong irritant that affects the peripheral nervous system and central nervous systems. Effects of inhalation at low-levels of exposure result in human systemic effects, including conjunctiva irritation and effects on the nose and respiratory system. Inhalation at high levels results in headaches, dizziness, nausea, shortness of breath, and vomiting, in addition to central nervous system depression and unconsciousness. Effects of ingestion result in abdominal pain and nausea. Contact by skin results in redness, itching, and pains; long-term exposure results in dermatitis. The MCL has not been determined for this chemical, but the ACGIH TLV has been set at 200 ppm. The NIOSH REL is set at 200 ppm.

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### **Methyl methacrylate**

Methyl methacrylate is a moderately toxic chemical. Symptoms often seen include: sleep effects, excitement, anorexia, and blood pressure decrease. This chemical is a severe skin, eye, nose, and throat irritant. The ACGIH TLV and NIOSH REL are set at 100 ppm.

### **2-Methylnaphthalene**

2-Methylnaphthalene is a white solid that is found naturally in fossil fuels. High-levels of exposure damages red blood cells. Symptoms of acute poisoning include: fatigue, lack of appetite, restlessness, and pale skin. Symptoms of a higher exposure include: nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. The US DHHS, the IARC, and the EPA have not classified the carcinogenicity of this chemical. The MCL and ACGIH TLV have not been determined for this chemical.

### **Nitrates**

Nitrates ingested in large amounts can result in death. Symptoms often seen include: dizziness, abdominal cramps, vomiting, bloody diarrhea, weakness, convulsions, collapse, and even mental impairment. The carcinogenicity of this chemical is probable.

### **Nitrobenzene**

Nitrobenzene is an industrial chemical typically used to manufacture aniline. Symptoms often seen include: general anesthetic, anoxia, dermatitis, anemia, respiratory stimulation, and vascular changes. This chemical is also an eye and skin irritant and is absorbed readily through the skin. The IARC has determined this chemical to be a probable carcinogen. The ACGIH TLV and NIOSH REL are set at 1 ppm.

### **N-nitrosodi-n-propylamine**

N-nitrosodi-n-propylamine is a manufactured chemical for use in research and as a weed killer. The effect on humans remains unknown for this chemical. The US DHHS has determined that n-nitrosodi-n-propylamine is a probable carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

### **Octadecanoic acid**

Octadecanoic acid is also known as stearic acid. This chemical is a skin irritant. The carcinogenicity of this chemical is probable.

**Pentachlorophenol (PCP)**

Pentachlorophenol (PCP) occurs as a colorless crystal. The smell varies with the temperature of this manufactured chemical. Uses of this chemical include use as a biocide and wood preservative.

Symptoms of exposure may include sneezing, cough, weakness and exhaustion, anorexia, weight loss, sweating, headache, dizziness, nausea, vomiting, dyspnea, chest pain, high fever, and damage to the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. Contact with skin and eyes cause dermatitis and irritation. The IARC has determined that this chemical is a possible carcinogen to humans. The MCL is set at 0.001 mg/L and the ACGIH TLV is set at 0.5 mg/m<sup>3</sup>. The NIOSH REL is set at 0.5 mg/m<sup>3</sup>.

**Pheneanthrene**

Pheneanthrene is a Polycyclic Aromatic Hydrocarbon (PAH). The presence of this chemical arises from the use of fuel components and other organic chemicals. This chemical is a danger to humans and enters all tissues that contain fat. PAHs are stored mostly in the kidneys, liver, and fat with smaller amounts stored in the spleen, adrenal glands, and ovaries. The US DHHS has determined that pheneanthrene is a known animal carcinogen; however, the EPA has determined not classifiable to human carcinogenicity. The MCL and ACGIH TLV have not been determined for this chemical.

**PCBs**

PCBs are also known as polychlorinated biphenyls. Of the 109 PCBs, many affect hormones and are linked with brain cancer. This chemical is moderately toxic by ingestion and skin contact. The carcinogenicity of this chemical is probable. The MCL is set at 0.0005 mg/L, but the ACGIH TLV has not been determined for this chemical.

**Pyrene**

Pyrene is a poison through inhalation. This chemical is a skin irritant. The carcinogenicity of this chemical is probable.

**Sulfates**

Sulfates are elements combined with both sulfur and oxygen. These materials vary in toxicity.

### **Toluene**

Toluene is a poison to humans via various routes. Inhalation, intravenous and subcutaneous routes prove to be mildly toxic. Effects of inhalation result in hallucinations, distorted perceptions, motor activity changes, antipsychotic, psychophysiological test changes, and bone marrow changes. Other Symptoms of exposure may include irritation to nose and eyes, weakness and exhaustion, confusion, dizziness, headache, anxiety, muscle fatigue, insomnia, paresthesia, dermatitis, and liver and kidney damage. This chemical is an irritant to the eyes and skin and is linked to brain cancer. The MCL is set at 1 mg/L and the ACGIH TLV is set at 100 ppm. The NIOSH REL is set at 100 ppm.

### **1,3,5-Trinitrobenzene**

1,3,5-Trinitrobenzene is a powerful explosive that has more power for shattering than TNT, but less sensitive to impact. This chemical is difficult to produce. Ingestion has proven moderately toxic. The MCL and ACGIH TLV have not been determined for this chemical.

## **Metals**

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Metals are found naturally in the environment and tend to remain for a long time, thereby increasing a greater likelihood for exposure. Some metals are useful in small amounts and even necessary for good health. Metals can accumulate in vegetables, grains, fruits, fish, and shellfish from surrounding soil and water. Health effects caused by heavy metals include reduced growth and development, cancer, and organ damage, which can lead to autoimmunity, rheumatoid arthritis, and diseases of the kidneys, circulatory system, and nervous system. Metals have a greater effect on children and exposure can result in learning difficulties, memory impairment, damage to the nervous system, and behavioral problems.<sup>3</sup>

### **Aluminum**

Aluminum occurs naturally and makes up about 8% of the surface of the earth. It is always found combined with other elements such as oxygen, silicon and fluorine. This metal is silver-white and flexible. Uses primarily include cooking utensils, containers, appliances, build-

ing materials, paints, fireworks, glass, rubber, ceramics and consumers products such as antacids, astringents, buffered aspirins, food additives and antiperspirants. Low-level exposure to aluminum from food, air, water, or contact with skin is not thought to harm your health. Aluminum, however, is not a necessary substance for our bodies and too much may be harmful. People who are exposed to high levels of aluminum may have respiratory problems, bone diseases and skeletal problems, skin rashes and delays in neurological development. The Department of Health and Human Services, the International Agency for Research on Cancer, and the EPA have not classified aluminum for carcinogenicity. The SMLC is set at 0.05-0.2 mg/L. Both ACGIH and NIOSH have established guidelines values from 2 mg/m<sup>3</sup> for soluble salts to 10 mg/m<sup>3</sup> for aluminum for total dust.

#### **Antimony**

Antimony is a silvery-white, corrosive metal found naturally in the earth's crust. Typically, antimony is brought into the United States for processing, mixed with alloys for strength, and used in the flame retardant industry. Other uses of this chemical include: ceramics, glass, batteries, fireworks, and explosives. Antimony enters the drinking water through natural weathering of rock, industrial production, municipal waste disposal or manufacturing processes. Inhalation of high-levels will result in lung problems. Ingestion of high-levels of antimony will result in heart problems, stomach pain, diarrhea, vomiting, and stomach ulcers; other unknown effects may result from ingestion. Contact with this chemical results in irritation and burns. Medicinal uses of antimony exist in treating people infected with parasites. The US DHHS, the IARC, and the EPA have not classified antimony as to its human carcinogenicity. The MCL is set at 0.006 mg/L and the ACGIH TLV is set at 0.5 mg/m<sup>3</sup>. The NIOSH REL is set at 0.5 mg/m<sup>3</sup>.

#### **Arsenic**

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine and sulfur to form inorganic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. It is mainly used to preserve wood. Its use in pesticides has been canceled or restricted.

It cannot be destroyed in the environment; it can only change its form. Organic arsenic compounds are less toxic than inorganic arsenic compounds.

Arsenic was listed as the most dangerous substance in the Top 20 hazardous substances on the CERCLA priority List of Hazardous Substances for 2001.

Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white cells, abnormal heart rhythm, damage to blood vessels, darkening of the skin, and a sensation of "pins and needles" in hand and feet. Arsenic is a human carcinogen and can notably increase the risk of cancer in the lung, skin, bladder, liver, kidney and prostate. The MLC is set at 0.05 mg/L, the ACGIH TLV at 0.5 mg/m<sup>3</sup>, and the NIOSH REL at 0.002 mg/m<sup>3</sup>. The WHO has established a provisional guideline value of 0.01 mg/L for arsenic in drinking water.

#### **Barium**

Barium is a silvery-white metal found in nature and can be produced synthetically. This chemical is typically found in compounds combined with sulfur, carbon, or oxygen and enters the drinking water after dissolving from naturally occurring minerals in the ground. Uses of barium include: oil and gas drilling muds, auto paint, bricks, tiles and jet fuels. The effect on a person's health is greatly dependent on how well the compound dissolves in water. Compounds that do not dissolve well in water are not generally harmful and are often used for medicinal purposes. Ingestion of high-levels result in difficulties in breathing, increased blood pressure, changes in heart rhythm, stomach irritation, brain swelling, muscle weakness, damage to the liver, kidney, heart, and spleen. Symptoms of barium contamination include vomiting, colic, diarrhea, slow irregular pulse, transient hypertension, and convulsive tremors and muscular paralysis. Death may occur in a few hours to a few days. The US DHHS, the IARC, and the EPA have not classified barium as to its human carcinogenicity. The MCL is set at 2 mg/L and the ACGIH TLV is set at 0.5 mg/m<sup>3</sup>.

#### **Beryllium**

Beryllium in its pure form is a hard, grayish metal with no particular smell. Naturally, it can be found in compounds within mineral rocks, coal, soil, and volcanic dust and enters the drinking water from runoff from mining operations, discharge from processing plants and improper waste disposal. This chemical is often used in electrical equipment and electrical components. Effects of inhalation depend on exposure possibly causing lung damage and a disease resembling pneumonia leading to death. Ingestion of beryllium is not known to

cause effects in humans due to the restriction of movement from the stomach and intestines into the bloodstream. However, it is a deadly poison by intravenous routes. Rashes or ulcers arise from direct contact. The US DHHS has determined that this chemical is a probable human carcinogen. The MCL is set at 0.004 mg/L and the ACGIH TLV is set at 0.002 mg/m<sup>3</sup>. The NIOSH REL is set at 0.0005 mg/m<sup>3</sup>.

#### **Bismuth**

Bismuth is poisonous to humans. Symptoms often seen include: kidney damage, malaise, albuminuria, diarrhea, skin reactions, exodermatitis, and even death

#### **Boron**

Boron is an incredibly toxic material. Symptoms often seen include: irritation of the nose, throat, and eyes, depression of the circulation, persistent vomiting and diarrhea, shock, coma, and even death. Ingestion of large amounts may damage the stomach, intestines, liver, kidney, and brain. Health effects for long-term exposure are not known. The US DHHS, the IARC, and the EPA have not classified the carcinogenicity of boron.

#### **Cadmium**

Cadmium is found naturally in the crust, typically as a mineral combined with other elements. This chemical does not corrode easily and is used in batteries, pigments, metal coatings, and plastics. Inhalation of high levels of cadmium will severely damage the lungs and can lead to death. Ingestion of high levels of cadmium irritates the stomach, leading to vomiting and diarrhea. Cadmium will build up in the kidneys, cause damage to the lungs, and creates fragile bones through long-term exposure to lower levels of cadmium. Skin contact with cadmium is not known to cause health effects in humans or animals. Beneficial effects of cadmium are unknown. The US DHHS has determined cadmium and cadmium compounds are probable carcinogens. The MCL is set at 0.005 mg/L and the ACGIH TLV is set at 0.005 mg/m<sup>3</sup>.

#### **Chromium**

Chromium occurs naturally in the ground with no taste or smell associated with this element. This element is found in a few different forms, namely chromium (III) as an essential nutrient and chromium (VI) and chromium (0) typically produced industrially for use in electroplating of metals. Runoff from old mining operations and improper

waste disposal are the modes in which chromium typically enters the groundwater. Inhalation of high-levels of chromium (VI) causes irritations to the nose, such as runny nose, nosebleeds, ulcers, and holes in the nasal septum. Ingestion of high-levels of chromium (VI) can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and even death. Skin contact also results in skin ulcers. Other symptoms to exposure include severe redness and swelling of the skin in addition to an increased risk of lung cancer. The World Health Organization has determined that chromium (VI) is a human carcinogen. The MCL is set at 0.1 mg/L and the ACGIH TLV is set at 0.5 mg/m<sup>3</sup>. The NIOSH REL is set at 0.5 mg/m<sup>3</sup>.

#### **Cobalt**

Cobalt is a naturally occurring metal that may cause dermatitis or pulmonary damage. This metal is important to human health as a part of vitamin B12 and used to treat anemia. However, high levels of exposure severely affect the lungs. Symptoms often seen from inhalation include: cough, breathing difficulty, wheezing, decreased pulmonary function, weight loss, dermatitis, respiratory hypersensitivity, and asthma. Ingestion of soluble salts produces nausea and vomiting. The IARC has determined that cobalt is a probable carcinogen. The ACGIH TLV and NIOSH REL are set at 0.05 mg/m<sup>3</sup>.

#### **Copper**

Copper is an essential element for all living things. This metal is also a potentially explosive chemical. Liquid copper explodes on contact with water. Symptoms often seen include: nausea and vomiting, diarrhea, stomach cramps, irritation to the eyes and respiratory system, cough, difficulty breathing, and wheezing. The IARC has determined the carcinogenicity of this chemical is unknown. The ACGIH TLV and NIOSH REL are set at 1 mg/m<sup>3</sup>.

#### **Fluoride**

Fluoride is a pale, yellow-green gas that has a strong sharp odor. Fluorides are found throughout the environment at very low levels. Inhalation of high-levels of hydrogen fluoride gas causes damage to the lungs and heart and can even lead to death. Low-levels of hydrogen fluoride gas can irritate the eyes, skin, and lungs. Low-levels of sodium fluoride do help reduce tooth cavities, while high levels of sodium fluoride are dangerous to one's health. The carcinogenicity of fluoride has not been determined. The MCL is set at 4 mg/L, but the ACGIH TLV has not been determined.

### **Lead**

Lead naturally occurs in the crust and is found throughout the environment. This element is used for many purposes and can affect nearly every organ and system of the body. It typically enters the drinking water supply through contact of water with corroded materials containing lead. The effects of inhalation and ingestion are the same; however, the major systems affected by lead poisoning include the nervous system, blood system, and kidneys. Symptoms of lead poisoning include: decreased reaction time, muscle weakness, loss of appetite, anemia, malaise, insomnia, headache, irritability, muscle and joint pains, tremors, flaccid paralysis without anesthesia, hallucinations, and distorted perceptions. Lead poisoning greatly diminishes the intellectual capacity of children, creates delays in normal physical and mental development in babies and young children, and slight deficits in attention span. The US DHHS has determined that more information is needed to determine the carcinogenicity in humans. The MCL has not been determined for this chemical, but the ACGIH TLV has been set at 0.15 mg/m<sup>3</sup>. The NIOSH REL is set at 0.05 mg/m<sup>3</sup>.

### **Manganese**

Manganese is a naturally occurring metal that is critical to human health in trace amounts. This chemical reacts violently with certain compounds. Symptoms often seen include: degenerative brain changes, change in motor activity, muscle weakness, insomnia, mental confusion, metal fume fever, dry throat, cough, chest tightness, breathing difficulty, vomiting, malaise, kidney damage, and a skin and eye irritant. The carcinogenicity of this chemical is probable. High levels of exposure include: mental and emotional disturbances and slow and clumsy body movements. The EPA has determined the carcinogenicity to be unclassifiable. The ACGIH TLV is set at 5 mg/m<sup>3</sup>. The NIOSH REL is set at 1 mg/m<sup>3</sup>.

### **Mercury**

Mercury occurs naturally in the environment occupying several forms. The nervous system is greatly affected by this element. High-levels of exposure can lead to permanent damage of the brain, kidneys, and developing fetus. Other limited effects of long-term effects result in irritability, shyness, and tremors, changes in vision or hearing and memory problems. This chemical is corrosive to skin, eyes, and mucous membranes. Symptoms of exposure may include gastrointes-

tinal disturbance, muscle weakness, anorexia, weight loss, headache, tinnitus, hypermotility, diarrhea, liver changes, dermatitis, and fevers. Mercury builds up in the tissues of fish and can then be ingested by humans. The carcinogenic effect of all forms of mercury is unknown. However, the EPA has determined that mercuric chloride and methylmercury are possible human carcinogens. The MCL is set at 0.002 mg/L and the ACGIH TLV is set at 0.05 mg/m<sup>3</sup>. The NIOSH REL is set at 0.05 mg/m<sup>3</sup>.

#### **Molybdenum**

Molybdenum is a poison and an experimental teratogen. Symptoms often seen in animals include: irritation to the eyes, nose, and throat, anorexia, diarrhea, weight loss, listlessness, liver, and kidney damage. This chemical reacts violently with oxidants. The ACGIH TLV is set at 5 mg/m<sup>3</sup>.

#### **Nickel**

Nickel is an abundant, hard, silvery-white metal found in nature with no characteristic odor or taste. Uses for nickel are expansive and include plating, jewelry, and as catalysts for chemical reactions. Small amounts of nickel are possibly essential to human life. Contact to skin may include allergic contact dermatitis, pulmonary asthma, conjunctivitis, and inflammatory reactions. Inhalation of high-levels of nickel affects the lungs, including chronic bronchitis and reduced lung function. Ingestion of high-levels of nickel affects the stomach, blood, and kidneys. The US DHHS has determined that nickel is a probable carcinogen. The MCL has not been determined for this chemical, but the ACGIH TLV is set at 1 mg/m<sup>3</sup>. The NIOSH REL is set at 0.015 mg/m<sup>3</sup>.

#### **Potassium**

Potassium is an essential dietary element. This chemical is a dangerous fire hazard. Ingestion of excessive amounts results in kidney failure, nausea, vomiting, abdominal discomfort, diarrhea, heart arrhythmia leading to cardiac arrest., muscular weakness, and temporary paralysis.

#### **Selenium**

Selenium is found in the environment in rocks and soil. Inhalation of selenium can result in soreness, coughing, labored breathing, and lung edema. Symptoms of exposure to high-levels include: dizziness, fatigue, irritation, collection of fluid in the lungs, and severe bronchi-

tis. Ingestion of high-levels could result in irritation to the mouth and throat, in addition to nausea, gastrointestinal disturbance, and vomiting. Other results of exposure include brittle hair, anemia, cirrhosis, deformed nails, and even death. Contact with skin results in rashes, swelling, and pain. Chronic exposure might result in pallor, nervousness, depression, garlic odor of breath and sweat, gastrointestinal disturbances, and dermatitis. The US DHHS has declared that selenium sulfide is a probable carcinogen. The EPA has declared that the carcinogenicity of selenium compounds is not classifiable. The MCL is set at 0.05 mg/L and the ACGIH TLV is set at 0.2 mg/m<sup>3</sup>. The NIOSH REL is set at 0.2 mg/m<sup>3</sup>.

### **Silver**

Silver occurs naturally and is typically found in the environment combined with other elements. Uses primarily include jewelry, brazing alloys and solders, disinfectant of drinking water and water in swimming pools, and as an antibacterial agent. Inhalation of high-levels may lead to lung and throat irritation, and stomach pains. Ingestion of high-levels may result in death. Skin contact may result in a rash, swelling, and inflammation. Exposure at low-levels may result in the deposition of silver into the skin. Long-term exposure at high-levels may lead to argyria, a discoloration of the skin and other body tissues. The carcinogenicity of silver is unknown for humans. The MCL is not determined for this chemical, but the ACGIH TLV is set at 0.1 mg/m<sup>3</sup>. The NIOSH REL is set at 0.1 mg/m<sup>3</sup>.

### **Tin**

Tin is a natural element in the earth's crust. It is a soft, white, silvery metal that doesn't dissolve in water, Tin is used mainly to make cans. The EPA has limited its use in paints. Large amounts of tin compounds can cause stomachaches, anemia, liver and kidney problems. Breathing or swallowing this chemical can cause breathing problem, eye irritation, and can interfere with the way your brain and nervous system work. In severe cases, it can cause death.

There is no evidence that tin or tin compounds cause cancer in humans or animals, and tin hasn't been classified for carcinogenicity. The MLC hasn't been determined for this chemical. Both the ACGIH TLV and the NIOSH REL are set at 2 mg/m<sup>3</sup>.

### **Thallium**

Thallium is a radionuclide found in nature. Ingestion of this chemical results in nerve or sheath structural changes, extra-ocular muscle

changes, sweating, and other effects. The MCL is set at 0.002 mg/L and the ACGIH TLV is set at 0.1 mg/m<sup>3</sup>.

#### **Vanadium**

Vanadium has a variable toxicity. Exposure to this chemical results in conjunctivitis, rhinitis, reversible irritation of the respiratory tract, bronchitis, bronchospasms, and asthma-like diseases in more severe cases. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Zinc**

Zinc is a skin irritant. Symptoms often seen include: cough, dyspnea, sweating, throat dryness, sweet taste in mouth, cough, weakness, aches, chills, fever, nausea, and vomiting.

## **Pesticides**

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After the publication of Rachel Carson's book *Silent Spring* in 1962, concern arose for the use of chemical pesticides entering the food chain. Pesticides are toxic to living organisms and yet little is known about the extent of health effects on humans. Despite the obvious benefit to eradicating disease-carrying and crop-eating insects, the behavior of such chemicals is not completely understood. It is known that pesticides accumulate in fat deposits in the body. A mode of excretion occurs through breast milk, thereby transferring the harmful chemicals ingested from mother to child. Pesticides greatly affect the developing fetus, infants and young children. Health effects resulting from exposure cause serious diseases and disorders, damage to the nervous system, reproductive system and other organs, developmental and behavioral abnormalities, disruption of normal hormonal function, and immune dysfunction.

#### **Acrylonitrile**

Acrylonitrile is synthetic material used to make other chemicals. In the past, acrylonitrile was combined with carbon tetrachloride for use as a pesticide. Symptoms often seen include: conjunctive irritation, somnolence, general anesthesia, cyanosis, diarrhea, increased salivation, photophobia, deepened respiration, nausea, vomiting, weakness, headache, jaundice, anemia, nose and eye irritant, and leucocytosis. The effect that this chemical has on the human body in-

hibits respiratory enzymes of tissue and renders the tissue cells incapable of oxygen absorption. This chemical is carcinogenic. The US DHHS has determined that acrylonitrile is a probable carcinogen. The ACGIH TLV is set at 2 ppm. The NIOSH REL is set at 1 ppm.

#### **Aldrin and Dieldrin**

Aldrin and Dieldrin are chemicals that are similar in nature and in effect on humans. In pure form, both are white powders with a mild chemical odor and do not occur naturally in the environment. Aldrin quickly breaks down into dieldrin in the body and in the environment. By 1987 all uses of these chemicals were banned, including the use as a pesticide and for termite control. These chemicals mainly affect the central nervous system. Ingestion of significantly high-levels of these chemicals results in buildup, convulsions, coma and even death. The effects of low-levels of exposure include headaches, dizziness, vomiting, irritability, uncontrolled muscle movements. The IARC has determined that both aldrin and dieldrin are not classifiable as to their carcinogenicity to humans. The MCL has not been determined for these chemicals. The ACGIH TLV and NIOSH REL for both aldrin and dieldrin is set at 0.25 mg/m<sup>3</sup>.

#### **Alpha BHC**

Alpha BHC, also known as Benzene Hexachloride-alpha-isomer, is a poison by ingestion. This chemical is a confirmed carcinogen with experimental carcinogenic, tumorigenic, and neoplastigenic data. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Beta BHC**

Beta BHC is also known as trans-alpha-benzenehexachloride. This chemical is a confirmed carcinogen with experimental neoplastigenic data. Ingestion of Beta BHC is mildly toxic. The MCL and ACGIH TLV have not been determined for this chemical.

#### **Chlordane**

Chlordane is a thick liquid whose color ranges from colorless to amber with a mild and irritating smell that was manufactured for use as a pesticide. Uses of this chemical were completely banned in 1988 by the EPA. Although chlordane is not very mobile in soils, it is known to enter the drinking water after application on crops near the water supply intakes or well. Exposure to this chemical affects the nervous system, digestive system, and the liver. It has been found that chlordane lacks the ability to disrupt hormones by itself but greatly

magnifies the ability of other chemicals to disrupt hormones. Inhalation of high-levels of chlordane include: headaches, irritability, confusion, weakness, vision problems, vomiting, stomach cramps, diarrhea, and jaundice have occurred in people who breathed air containing high concentrations of chlordane or accidentally swallowed small amounts of chlordane. Ingestion of high-levels leads to convulsions and death. The IARC has determined that chlordane is not classifiable as to its carcinogenicity to humans. The MCL is set at 0.002 mg/L and the ACGIH TLV and NIOSH REL are set at 0.5 mg/m<sup>3</sup>.

#### **DDD**

DDD, also known as 1,1-bis(4-chlorophenyl)-2,2-di-chloroethane, was once used as a pesticide. Uses for this chemical have been banned. This chemical contaminates DDT products and DDT typically breaks down into DDE or DDD. The nervous system is greatly affected. Symptoms often seen include: excitability, tremors, and seizures. Ingestion results in poisoning. The US DHHS has not determined the carcinogenicity for DDD. This pesticide is a known carcinogen.

#### **DDE**

DDE, also known as 2,2-Bis(p-Chlorophenyl)-1,1-Di-Chloroethylene, sometimes is a contaminant for DDT products with no commercial use. The US DHHS has not classified DDE as to the carcinogenicity to humans. The EPA has determined that this chemical is a probable carcinogen. The MCL and ACGIH TLV have not been determined for this chemical.

#### **DDT**

DDT, also called 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, is a manufactured chemical used as a pesticide. This chemical is a white, crystalline solid with no odor or taste. The use of this chemical was banned in the United States, aside from public health emergencies. Symptoms of exposure may include irritation to the eyes and skin, anxiety, dizziness, confusion, discomfort, headache, weakness and exhaustion, convulsions, vomiting, excitability, tremors, and seizures. Long-term exposure to this chemical affects the nervous system and results in changes in the levels of liver enzymes. The US DHHS has determined that this chemical is a probable human carcinogen. The MCL has not been determined for this chemical, but the ACGIH TLV is set at 1 mg/m<sup>3</sup>. The NIOSH REL is set at 0.5 mg/m<sup>3</sup>.

**Di-n-butyl phthalate**

Di-n-butyl phthalate exposure symptoms often seen include: eye, stomach, and upper respiratory irritation, hallucinations, distorted perceptions, nausea or vomiting, and kidney, ureter or bladder changes. The ACGIH TLV and NIOSH REL are set at 5 mg/m<sup>3</sup>.

**Dicamba**

Dicamba, also known as 2-Methoxy-3,6-Dichlorobenzoic Acid, is moderately toxic by ingestion. The MCL and ACGIH TLV have not been determined for this chemical.

**1,2-Dichloroethane**

1,2-Dichloroethane, also known as ethylene dichloride, is a synthetic chemical that is used to make other chemicals. Symptoms often seen include: somnolence, cough, jaundice, nausea or vomiting, hypermotility, diarrhea, ulceration or belching from the stomach, fatty liver degeneration, change in cardiac rate, cyanosis, coma, dermatitis, edema of the lungs, toxic effects on the kidneys, and severe corneal effects. The US DHHS, the IARC and the EPA have not classified the carcinogenicity of this chemical. The ACGIH TLV is set at 10 ppm. The NIOSH REL is set at 1 ppm.

**Dinoseb**

Dinoseb, also known as 2-sec-Butyl-4,6-dinitrophenol, is a widely used herbicide. This chemical enters the drinking water after application on orchards, vineyards, and other crops. This chemical is a poison by ingestion and a severe irritant to the eyes. Pathways the chemical may travel into the body include: skin contact, subcutaneous, and intraperitoneal routes. The carcinogenicity is questionable with experimental tumorigenic data. The MCL is set at 0.007 mg/L for the chemical, while the ACGIH TLV has not been determined.

**Endosulfan II**

Endosulfan II is a pesticide and wood preservative found in solid form as crystals or flakes. This chemical smells similar to turpentine and does not burn. This chemical affects the central nervous system but does not accumulate significantly in human tissue. Symptoms of exposure may include irritation to the skin, hyperactivity, nausea, dizziness, headache, tremors, or convulsions, and even death may occur. The carcinogenicity of this chemical is unknown. The MCL has not been determined for this chemical, but the ACGIH TLV and NIOSH REL are set at 0.1 mg/m<sup>3</sup>.

**Endothall**

Endothall is a poison extremely irritating to skin, eyes, and mucus membranes. Symptoms often include: diarrhea.

**Endrin**

Endrin is a pesticide that is a solid, white, almost odorless substance that is banned from use in the United States. This chemical accumulates in sediments and aquatic and terrestrial biota. Exposure to endrin can cause various harmful effects including death and severe central nervous system (brain and spinal cord) injury. Ingestion of this chemical may cause convulsions and will kill you in a matter of minutes to a matter of hours. This chemical does not accumulate in human tissue. Symptoms resulting from exposure include headaches, dizziness, nervousness, confusion, nausea, vomiting, and convulsions. Effects of inhalation or contact are not known. The EPA has declared the human carcinogenicity to be unknown. The MCL is set at 0.002 mg/L and the ACGIH TLV and NIOSH REL are set at 0.1 mg/m<sup>3</sup>.

**Gamma-chlordane**

Gamma-chlordane is no longer permitted for use as a termiticide or pesticide. Symptoms often seen include: tremors, convulsions, excitement, diarrhea, jaundice, vomiting, stomach cramps, vision problems, ataxia, central nervous system stimulant, and gastritis. The IARC has not determined the carcinogenicity of this chemical. The ACGIH TLV and NIOSH REL are set at 0.5 mg/m<sup>3</sup>.

**Heptachlor and Heptachlor Epoxide (Epoxyheptachloris)**

Heptachlor and Heptachlor Epoxide (Epoxyheptachloris) are manufactured chemicals found as a white powder that smell like camphor (mothballs). Heptachlor breaks down into heptachlor epoxide. These chemicals were used primarily as insecticides until 1988. Ingestion of heptachlor results in dizziness, confusion, or convulsions. The full extent of heptachlor and heptachlor epoxide poisoning are unknown for humans, other than damage to the nervous system. Low-levels of exposure have caused liver damage and the symptoms include tremors, convulsions, kidney damage, respiratory collapse, and death. The IARC has determined that heptachlor and heptachlor epoxide are not classifiable to their carcinogenicity to humans. The MCL for heptachlor is set at 0.0004 mg/L and the MCL for heptachlor epoxide is set at 0.0002 mg/L. The ACGIH TLV has not been determined for these chemicals. The NIOSH REL is set at 0.5 mg/m<sup>3</sup>.

### **Heptachlorinated dibenzo-p-dioxins**

Heptachlorinated dibenzo-p-dioxins is a type of dioxin. Dioxins are understood to function in a similar manner as a steroid hormone. This implies that the dioxins enter the body and bind to a protein. A complex is then formed that attaches to the cell's chromosomes, thereby altering the genetic material and affecting the body in many different ways. The MCL and ACGIH TLV have not been determined for these chemicals.

### **Isopropanol**

Isopropanol is also known as Isopropyl alcohol and is a moderately toxic chemical. Symptoms often seen include: flushing, pulse rate decrease, blood pressure lowering, anesthesia, narcosis, headache, dizziness, mental depression, drowsiness, hallucinations, distorted perceptions, dyspnea, respiratory depression, nausea or vomiting, and coma. The ACGIH TLV and NIOSH REL are set at 400 ppm.

### **Lindane**

Lindane, also known as benzene hexachloride, is a pesticide that mimics natural hormones. Under favorable soil and climatic conditions, lindane enters the drinking water through runoff of contaminated materials into surface water or by leaching into the groundwater. Inhalation results human systemic effects by headache, nausea or vomiting, and fever. Pathways taken by this chemical into the body include: ingestion, skin contact, and subcutaneous routes. This chemical is more toxic than DDT or dieldrin and is shown to damage the nervous system and circulatory system. Lindane is a confirmed carcinogen with experimental carcinogenic, neoplastigenic, and tumorigenic data by ingestion and skin contact. The MCL is set at 0.0002 mg/L, but the ACGIH TLV has not been determined for this chemical.

### **Methylene chloride**

Methylene chloride is a synthetic material that is also a severe skin and eye irritant. Symptoms often seen include: dizziness, nausea, decreased attentiveness, paresthesia, somnolence, altered sleep time, convulsions, euphoria, change in cardiac rate, and a severe eye and skin irritant. The US DHHS, the WHO, and the EPA have determined that methylene chloride is a probable carcinogen. This chemical is a known carcinogen. The ACGIH TLV is set at 50 ppm.

### **Napthalene**

Napthalene is a naturally occurring material typically used to make the insecticide carbaryl. Symptoms often seen include: damage to red blood cells, fatigue, lack of appetite, restlessness, nausea, skin and eye irritant, headache, diaphoresis, hematuria, fever, anemia, liver damage, vomiting, renal shutdown, corneal damage, convulsions, and coma. The US DHHS, the IARC, and the EPA have determined the carcinogenicity of this chemical is not classifiable. The ACGIH TLV and NIOSH REL are set at 10 ppm.

### **Pentachlorophenol**

Pentachlorophenol is a synthetic chemical that is extremely dangerous and was used as a pesticide. Symptoms often seen include: acute poisoning marked by weakness, changes in respiration, blood pressure, and urinary output, dermatitis, convulsions and collapse, anorexia, weight loss, sweating, headache, dizziness, nausea, vomiting, breathing difficulty, chest pain, and liver and kidney injury. The EPA and the IARC have determined this chemical to be a probable carcinogen. This chemical is a known carcinogen. The ACGIH TLV and NIOSH REL are set at 0.5 mg/m<sup>3</sup>.

### **Phenol**

Phenol is a synthetic chemical that was widely used as a pesticide. Symptoms often seen include: severe eye and skin irritation, kidney, liver, pancreas, and spleen damage, edema of the lungs, anorexia, weight loss, weakness and exhaustion, muscle ache, pain, corrosion of the lips, mouth, throat, esophagus and stomach, gangrene and even death. The carcinogenicity of this chemical is unknown. The ACGIH TLV and NIOSH REL are set at 5 ppm.

### **Toxaphene**

Toxaphene, also known as Chlorinated Camphene, is an insecticide that mimics natural hormones. Ingestion and skin contact result in somnolence, convulsions or effect on seizure threshold coma, and allergic skin dermatitis. Symptoms of exposure may include nausea, confusion, agitation, tremor, convulsions, unconsciousness, or dry and red skin. Carcinogenicity of toxaphene is probable. The MCL is set at 0.003 mg/L and the ACGIH TLV is set at 0.5 mg/m<sup>3</sup>.

### **2,4,5-TP**

2,4,5-TP, also known as (2,4,5-Trichlorophenoxy)Propionic Acid, is commonly referred to as Silvex. Ingestion results in poisoning.

The carcinogenicity of Silvex is probable. The MCL is set at 0.05 mg/L, but the ACGIH TLV has not been determined.

#### **2,4,5-T**

2,4,5-T, also known as 2,4,5-trichlorophenoxyacetic acid, is readily absorbed through inhalation and ingestion and slowly through contact. Effects of exposure include: weakness, lethargy, anorexia, diarrhea, ventricular fibrillation. Chronic exposure can result in cardiac arrest and even death. The MCL has not been determined, but the ACGIH TLV and NIOSH REL are set at 10 mg/m<sup>3</sup>.

#### **Xylene**

Xylene is a naturally occurring material in petroleum and coal tar. This chemical is a severe skin and eye irritant and greatly affects the brain. Symptoms often seen include: olfactory changes, conjunctiva irritation, pulmonary changes, headaches, lack of muscle coordination, dizziness, confusion, difficulty breathing, and gastrointestinal discomfort. This chemical is a dangerous fire hazard when exposed to heat or flame. The IARC has determined the carcinogenicity of this chemical is not classifiable. The ACGIH TLV is set at 100 ppm.

#### **o-Xylene**

o-Xylene, also known as 1,2-Dimethylbenzene, is a mildly toxic chemical. This chemical is a very dangerous fire hazard when exposed to heat or flame. Symptoms often seen include: irritation to the eyes, skin, nose, and throat, dizziness, excitement, drowsiness, incoordination, staggering gait, corneal vacuolization, anorexia, nausea, vomiting, abdominal pain, and dermatitis. The ACGIH TLV and NIOSH REL are set at 100 ppm.

## **Radionuclides**

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Radionuclides are atoms with structures that are out of balance. The atoms are continually changing, or decaying, into a more stable form. The decay process releases energy, otherwise known as radiation. Any alteration to the delicate balance that atoms maintain affects the structure and stability of the cell. As radiation strikes an atom, the balance is disrupted and the atom gains a positive or negative charge. These atoms are called ions and the ionization of atoms and molecules inside a living cell results in damage to the cell.

Ionizing radiation results in health problems. There are three important types of radiation that cause ionizing radiation: alpha and beta particles, and gamma rays. Alpha particles are large enough particles that the outer layer of dead skin will prevent the penetration of alpha particles into the human body. However, if an alpha particle does indeed enter into the lungs, the ionizing energy will break through cell walls. These particles have a charge of +2. The positive charge enables these particles to be effective ionizers that travel at relatively slow speeds and short ranges.

Beta particles are smaller negatively charged particles that are the equivalent to electrons. These particles originate in the nucleus whereas electrons originate outside the nucleus. Although beta particles are not radioactive, the atoms that emit the particles are. The energy and speed result in damage to cells. Solid objects stop these particles easily.

Gamma rays have incredibly high energy and can easily pass through lead and several feet of concrete. These particles don't need to be ingested or inhaled to seriously damage the human body.

Damage brought about by exposure to radioactivity results in cancer. All radionuclides are known carcinogens. In regards to other chemicals, the carcinogenicity is not always certain.

#### **Plutonium**

Plutonium is a radionuclide that is extremely dangerous. Plutonium-236 is an alpha emitter. The high radiotoxicity of plutonium determines the toxicity of plutonium compounds in addition to other atoms in the compounds they form. Any event that further spreads this radionuclide into the environment is dangerous to the life and land. This chemical was created expansively in nuclear weapons production and nuclear power plants. The MCL is set at 15 pCi/L.

#### **Strontium**

Strontium is a radionuclide with similar properties to calcium. Strontium-90 is a beta emitter. The stable form has low toxicity and ignites spontaneously in air. When strontium is combined with water or steam, it reacts vigorously to evolve into hydrogen. The MCL is set at 50 pCi/L.

**Thorium**

Thorium is a radionuclide found in nature. Thorium -232 is an alpha emitter. The carcinogenicity of thorium is probable. The MCL is set at 15 pCi/L.

**Tritium**

Tritium is a radionuclide that is not an external radiation hazard. This radionuclide is an alpha emitter. When tritiated water is ingested, the blood distributes the materials equally among all of the body fluids. As a human is exposed to tritium, the soft tissues are irradiated. The MCL is set at 20,000 pCi/L.

**Uranium**

Uranium is a radionuclide found in the environment that is highly toxic on an acute basis. Uranium-238 is an alpha emitter. Exposure at high-levels to uranium results in kidney damage, acute arterial lesions, and cancer. Soluble uranium compounds can be absorbed rapidly into the body. The MCL is set at 20 µg/L and the ACGIH TLV is set at 0.2 mg/m<sup>3</sup>.

**ENDNOTES** 

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<sup>1</sup> Rachel's Environmental Health News, #640 – Chlorine Chemistry News, March 04, 1999.

<sup>2</sup> Rachel's Environmental Health News, #498 – Dangers of Chemical Combinations, June 13, 1996.

<sup>3</sup> [http://www.envirohealthaction.org/toxics/heavy\\_metals/](http://www.envirohealthaction.org/toxics/heavy_metals/)

## APPENDIX 1. Abbreviations and Acronyms

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ACGIH – American Conference of Governmental Industrial Hygienists

ATSDR – Agency for Toxic Substances and Disease Registry

DHHS – Department of Health and Human Services

DOE – U.S. Department of Energy

EPA – Environmental Agency

FDA – Food and Drug Administration

HR – Hazard Rating

IARC – International Agency for Research on Cancer

MCL – Maximum Contaminants Levels (mg/L)

NIOSH – National Institute for Occupational Safety and Health

OSHA – Occupational Safety and Health Administration

The OSHA sets permissible exposure limits (PELs) to protect workers against adverse health effects resulting from exposure to hazardous substances.

PAH – Polycyclic Aromatic Hydrocarbon

PCB – Polychlorinated biphenyl

pCi – pico-Curies, measurement of radioactivity

PELs – Permissible Exposure Limits

The PELs determined hazardous substances are enforceable, regulatory limits on allowable indoor air concentrations.

PETN – Pentaerythritol tetranitrate

REL – Recommended Exposure Level

SMCL – Secondary Maximum Contaminants Levels (mg/L)

TLV – Threshold Limit Value

WHO – World Health Organization

## APPENDIX 2. Glossary

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- **Anemia:** A decreased ability of the blood to transport oxygen
- **Carcinogen:** Any substance that produces or promotes cancer
- **Carcinogenicity:** Ability to cause cancer
- **Irritant:** Abnormal reaction to a substance
- **Long-term:** 365 days or longer
- **Milligram (mg):** One thousandth of a gram
- **Tumor:** An abnormal mass of tissue

### APPENDIX 3. Bibliography

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BWXT-Pantex, LLC. "2000 Site Environmental Report for Pantex Plant", DE-AC04-00AL66620, May 2001: Tables 6.1-6.2.

Lewis, Richard J. "Hazardous Chemicals Desk Reference," 1993.

Office of the Federal Registry National Archives and Records Administration. *Code of Federal Regulations: Protection of Environment*. Volume 40, Parts 100 to 149. Revised as of July 1, 1994: p. 722-742.

Office of Water, US EPA. "Drinking Water Standards and Health Advisories", EPA 822-B-00-001, Summer 2000.

S.M. Stoller Corporation. "Final FY 2000 Summary and Progress Report for Groundwater Investigations at DOE Pantex Plant", Volume 1. January 29, 2001.

#### Websites:

ATSDR. "ToxFAQs: Frequently Asked Questions about Contaminants Found at Hazardous Waste Sites", <<http://www.atsdr.cdc.gov/toxfaq.html>>.

ESER Program. "Gross Alpha Radiation", "Gross Beta Radiation". <<http://www.stoller-eser.com/FactSheet/>>.

National Institute for Occupational Safety and Health. "NIOSH Pocket Guide to Chemical Hazards", <<http://www.cdc.gov/niosh/npg/npg.html>>.

US EPA. "Chemicals in the Environment: OPPT Chemical Fact Sheets", April 25, 2001, <[www.epa.gov/opptintr/facts.htm](http://www.epa.gov/opptintr/facts.htm)>.

US EPA. "Current Drinking Water Standards", January 23, 2002, <<http://www.epa.gov/safewater/mcl.html>>.

US EPA. "IRIS Substance List", <<http://www.epa.gov/iris/subst/index.html>>.

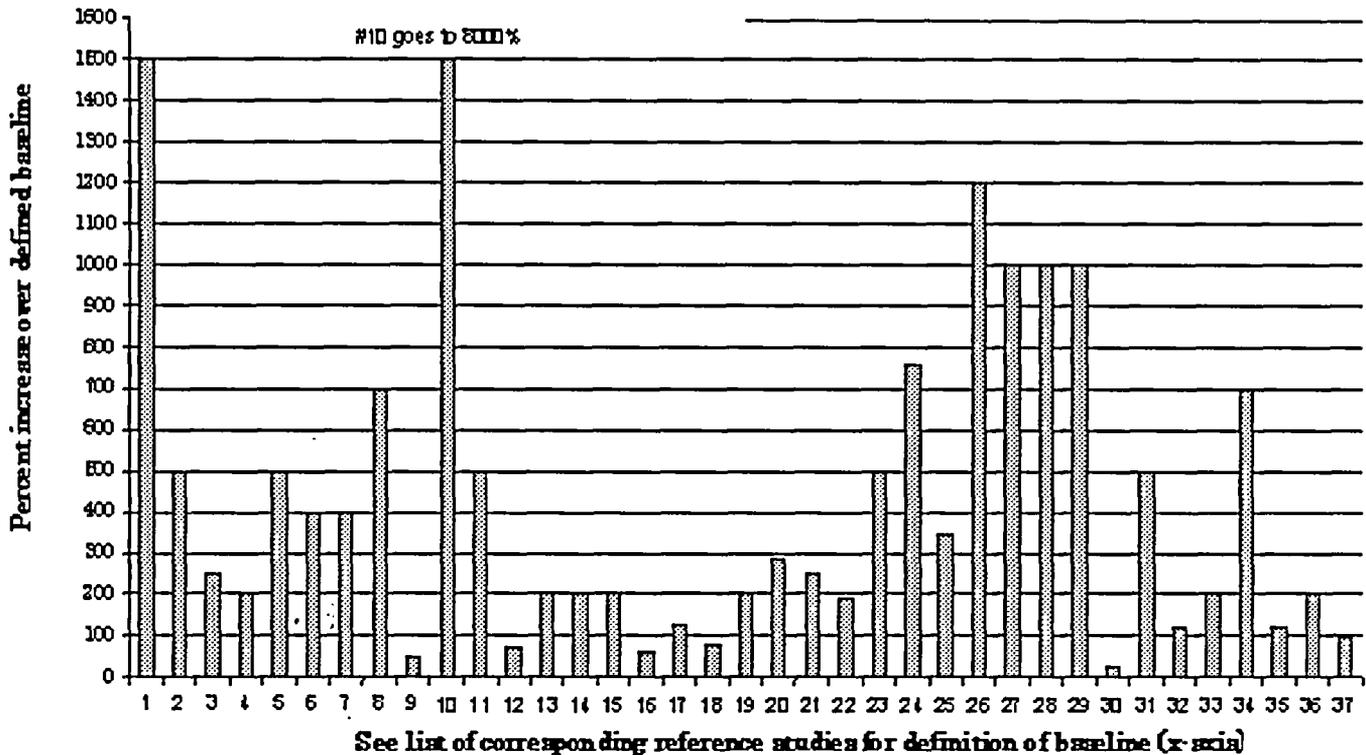
US EPA. "List of Contaminants and MCLs", <<http://www.epa.gov/safewater/mcl.html>>, <<http://www.epa.gov/safewater/regs/cfr141.pdf>>.

WHO. "Guidelines for drinking water quality." <[http://www.who.int/water\\_sanitation\\_health/GDWQ/](http://www.who.int/water_sanitation_health/GDWQ/)>.

Reigart, J. & Roberts, J. "Recognition and Management of Pesticide Poisonings", Fifth Edition, 1999: <<http://www.epa.gov/oppfead1/safety/healthcare/handbook/handbook.pdf>>.

<http://www.gis.usu.edu/~sanduku/papers/gisca/node14.html>

**Percent Increase in Cancer Incidence, Cancer Mortality and Other Health Effects of Human Exposure to Ionizing Radiation**



**Legend for "Percent Increase in Cancer Incidence, Cancer Mortality, and Other Health Effects of Human Exposure to Ionizing Radiation"**

- 1500% increase in incidence of testicular and ovarian cancer in children on Navaho reservation in uranium mining area
- 500% increase in bone cancer in children affected by uranium
- 250% increase in leukemia (all ages) in the Navaho population
- 200% increase in each of the following non-cancer effects: miscarriage, infant death, congenital defects, genetic abnormalities, learning disorders.  
**Baseline for 1-4:** Navajo residents living near Uranium facilities were compared to Navajo resident in non-uranium areas
- 500% increase in birth defects when compared to the national average.  
(Southwest Research and Information Center. "Uranium Legacy." *The Workbook*, v 8, no 6. Albuquerque, NM: 1983.)
- 400% increase in leukemia incidence in the population living downwind of the Pilgrim nuclear power reactor in Massachusetts in the first 5 years after fuel was known to have leaked excess radioactivity  
**Baseline:** Disease in population before and after Pilgrim radioactive releases and comparison to

upwind population.

(Morris M. Knorr R. *The Southeastern Massachusetts Health Study 1978-1986-Report of the Massachusetts Department of Public Health*. October 1990. See also: Clapp R. Cobb S. et al. "Leukemia Near Massachusetts Nuclear Power Plant." Letter in *Lancet*. December 5, 1987.)

7. 300—400% increase in lung cancer in the general population within the plume of the Three Mile Island accident releases
8. 600—700% increase in leukemia in the general population within the plume of Three Mile Island accident releases **Baseline:** Disease in population upwind (out of the radiation plume path) is compared to disease in population downwind (in the pollution plume.)  
(Wing S. Richardson D. et al. "A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Power Plant: The Collision of Evidence and Assumptions." *Environmental Health Perspectives*, v 105, no 1. National Institutes of Health. Bethesda, Maryland. January 1997.)
9. 50% increase in childhood cancer incidence in the Three Mile Island area for each 10 millirem increase in radiation exposure per year.  
**Baseline:** Children living with different radiation levels are compared for evidence of disease.  
  
(Hatch M. et al. "Background Gamma Radiation and Childhood Cancers Within Ten Miles of a US Nuclear Power Plant." *International Journal of Epidemiology*, v 19, no 3. 1990.)
10. 8000% increase in thyroid cancer in Belarussian children living near Chernobyl, reported 6 years after the meltdown.  
**Baseline:** Comparison of population health before and after the Chernobyl explosion.  
(Hudson RL. "Child Cancers Found to Rise Near Chernobyl." *The Wall Street Journal*. September 1992. *The article they quote was published in Nature on the same day and was researched by the World Health Organization.*)  
  
**Further effects found in victims of the Chernobyl accident less than ten years after the meltdown.**
11. 500% increase in thyroid cancer in Ukrainian children.
12. 75% increased incidence of heart disease
13. 200% increase in respiratory and digestive disease
14. 200% increase in birth defects
15. 200% increase in spontaneous abortions  
**Baseline:** Comparison of population health before and after the Chernobyl explosion  
(Rupert J. "Illness Tied to Disaster Still on Rise." *The Washington Post*. June 24, 1995. *The reporter was quoting Britain's Imperial Cancer Research Fund, The Ukrainian Health Ministry and the United Nations.*)
16. 63% increase in leukemia incidence among workers at Oak Ridge National Laboratories(US) who received very low doses of external (gamma) radiation on the job.
17. 123% increase in leukemia incidence in the same population where there were also very low internal doses of radioactivity  
**Baseline:** Cohort comparison of worker deaths and radiation exposure levels  
(Wing S. Shy C. et al. "Mortality Among Workers at Oak Ridge National Laboratory: Evidence of Radiation Effects in Follow-up Through 1984." *JAMA*, v 265 no 11. March 20, 1991.)
18. 80% increase in eight types of cancer deaths in Department of Energy atomic workers exposed to

external doses of radiation. **Baseline:** Various baselines. Usually cohort comparison of workers with various doses and their deaths from resulting diseases were used.

(Mancuso TF, Stewart A, Kneale G. "Radiation Exposures of Hanford Workers Dying From Cancer and Other Causes." *Health Physics*, v 33. Pergamon Press, Great Britain. November 1977.)

19. 200% increase in leukemia in children of atomic workers **Baseline:** The parents of children with cancer were compared for occupation to discern if those adults who worked with radiation had more children with cancer than those who worked in other jobs.  
(Roman E. et al. "Case-control Study of Leukemia and Non-Hodgkin's Lymphoma Among Children Aged 0-4 years Living in West Berkshire and North Hampshire Health Districts." *BMJ* 1993 #306.)
20. 287% increase in cancer incidence in children of nuclear workers who received internal radiation in England  
**Baseline:** The parents of children with cancer were compared for occupation to discern if those adults who worked with radiation had more children with cancer than those who worked in other jobs.  
(Sorahan T, Roberts PJ. "Childhood Cancer and Paternal Exposure to Ionizing Radiation: Preliminary Findings From the Oxford Survey of Childhood Cancers." *American Journal of Industrial Medicine* 23: 343-354. 1993.)
21. 250% increase in all cancers among atomic workers
22. 190% increase in leukemia incidence  
**Baseline:** General Population  
(Kendall, GM. et al. "Mortality and Occupational Exposure to Radiation: First Analysis of the National Registry for Radiation Workers." *BMJ* v 304: 220-5. 1992.)
23. 500% increase in childhood leukemia in children visiting the beach once a week near the French nuclear reprocessing facility at LaHague
24. 760% increase in childhood leukemia if they ate the local fish regularly
25. 345% increase in childhood leukemia associated with drinking well water from the vicinity of the nuclear facility  
**Baseline:** Observed leukemia cases were compared to expected leukemia cases.  
(Viel JF, Pobel D. Incidence of Leukaemia in Young People Around the La Hague Nuclear Waste Reprocessing Plant: A Sensitivity Analysis." *Statistics in Medicine*, v 14: 2459-2472. 1995.)
26. 1200% increase in all cancers exist around the Sellafield, (formerly Windscale) reprocessing facility and of these,
27. 600-1000% increase in leukemia of children whose fathers were exposed to certain amounts of radiation prior to conception
28. 1000% increase in lymphoma was found in children near a reprocessing facility in Cumbria  
**Baseline:** Local and Area Controls  
(Gardner et al. "Results of Case-control Study of Leukemia and Lymphoma Among Young People Near Sellafield Nuclear Plant in West Cumbria." *BMJ* v 300. February 17, 1990.)
29. 1000% increase in leukemia incidence in children living near a nuclear reprocessing facility  
**Baseline:** Children of the same age in the same area prior to the facility's operation.  
(Heasman et al. "Childhood Leukemia in Northern Scotland." *Lancet*, v 1:266. 1986.)
30. 27.3% increase in all cancer deaths among atomic workers exposed to internal doses of radiation  
**Baseline:** Comparison of worker deaths and radiation exposure levels.  
(Morgenstern H, Froines J. Epidemiologic Study to Determine Possible Adverse Effects to Rocketdyne/Atomics International Workers from Exposure to Ionizing Radiation. State of California)

Health and Welfare Agency. June 1997.)

31. 500% increase in leukemia among Utah nuclear bomb test Downwinders
32. 121% increase in thyroid cancer incidence in the same group
33. 200% increase in breast cancer
34. 700% increase in bone cancer  
**Baseline:** Utah Mormons exposed to bomb fallout are compared to all Utah Mormons.  
 (Johnson CJ. "Cancer Incidence in an Area of Radioactive Fallout Downwind From the Nevada Test Site." JAMA, v 251 n 2: 231-6. January 13, 1984.)
35. a greater than 120% increase in thyroid cancer in those who drank milk laced with Iodine-131 from atmospheric nuclear weapons tests  
**Baseline:** Estimated cases are based on dose reconstruction where estimated exposures were between 6-112 rads per individual child in the bombs' plumes.  
 (Ortmeyer P. Makhijani A. "Let Them Drink Milk." *The Bulletin of the Atomic Scientists*, Nov/Dec 1997.)
36. 200% increase in lung cancer in women who received radiation treatments for breast cancer  
**Baseline:** Breast cancer patients treated with radiation were compared to those who were treated or by other methods.  
 (Bishop JE. "Study Links Breast Cancer Treatment to Higher Risk of the Disease in Lungs." *The Wall Street Journal*, May 14, 1993: B6.)
37. 66—96% increase in early cancer deaths due to background radiation  
**Baseline:** Deaths of children living with different radiation levels are compared for cancer.  
 (Kneale GW. Stewart AM. "Childhood Cancers in the UK and their Relation to Background Radiation." *Radiation and Health*. 1987.)

This list was compiled by Cindy Folkers & Mary Olson on 4/24/98, Nuclear Information & Resource Service, 1424 16th St, NW Suite 404, Washington, DC 20036 (202)328-0002 -- it is arbitrarily based on what studies are on file at NIRS.

**A partial list of non-cancer health effects of human exposure to radiation:**

Downs Syndrome  
 Hydrocephaly  
 Microhydrocephaly  
 Cleft Lip and Palate  
 Epilepsy  
 Kidney and Liver Damage  
 Thyroid Disease  
 Low Birthweight  
 Increased Infant Mortality  
 Increased Stillbirth  
 Genetic Mutations/Chromosomal Aberrations  
 Spinal Defects  
 Congenital Malformations