

# **Say Yes to Michigan, Say No to the “Plutonium State Park”**

## **Backgrounder on Big Rock Nuclear Power Plant**

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## Time Capsule

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# Table of Contents

Radioactive Waste: Terrorist Bull’s Eye.....	Page 4
Radioactive Contamination.....	Page 6
Radiation Releases into the Environment.....	Page 6
Scores of Radiological Incidents Admitted....	Page 11
Other incidents listed in Consumers’ “Radiological Event History”.....	Page 12
Environmental Clean Up, or Lack Thereof.....	Page 18
Lakeshore Contaminated.....	Page 25
Duration of Radiological Hazards.....	Page 26
Impacts on Human Health.....	Page 28
Liability.....	Page 32
Opportunity Costs: Other Potential Park Sites.....	Page 34
Conclusion.....	Page 34

## Tables

<i>Table I.</i> Airborne Effluents Comparisons by Year Fission and Activation Gases.....	Page 7
<i>Table II.</i> Airborne Effluents Comparison by Year I-131 and Particulates.....	Page 8
<i>Table III.</i> Liquid Effluents Comparison By Year Tritium.....	Page 9
<i>Table IV.</i> Liquid Effluents Comparison by Year Mixed Fission and Activation Products.....	Page 9
<i>Table V.</i> Solid Waste Comparison by Year.....	Page 10
<i>Table VI.</i> Hazardous persistence of radioactive contaminants at Big Rock.....	Page 27
<i>Table VII.</i> Radionuclides at Big Rock: Type of Radiation, Biological Effect.....	Page 28

## Figures

<i>Figure 1.</i> Big Rock Point Industrial Area.....	Page 18
<i>Figure 2.</i> Tritium Plume in Shallow Groundwater Zone.....	Page 20
<i>Figure 3.</i> Tritium Plume in Intermediate Groundwater Zone...	Page 21
<i>Figure 4.</i> Tritium Plume in Bedrock Groundwater Zone.....	Page 22
<i>Figure 5.</i> Discharge Canal Survey Unit.....	Page 23
<i>Figure 6.</i> Big Rock Point Owner-Controlled Area.....	Page 26

[Note to readers: brackets denote reference documentation, as well as questions or comments upon Consumers Energy or government agency assertions discussed throughout this briefing paper. All references are available from the author or his sources, upon request. *Also, any passages italicized and in bold represent the emphasis added by the author.*]

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The Big Rock Nuclear Plant on the shores of Lake Michigan near Charlevoix was permanently shut in 1997 after 35 years of atomic power production and radioactive waste generation. But the site continues to be haunted by high-level radioactive waste storage on-site, as well as soil, groundwater, shoreline, and very likely Lake Michigan sediment radiological contamination. The health risks of exposure and bio-accumulation of radioactive poisons in plants, animals, the food chain, and people should be of great concern. The hazards to human health, safety, and security will persist indefinitely.

## **Radioactive Waste: Terrorist Bull's Eye**

“Electricity is but the fleeting byproduct from atomic reactors. The actual product is forever deadly radioactive waste.” ---Michael Keegan, Coalition for a Nuclear-Free Great Lakes

Despite the permanent shutdown of the Big Rock reactor nearly a decade ago, and its subsequent dismantlement and decommissioning, risks still abound at the site. This is emphasized by the presence of 441 bundles (nearly 64 tons) of highly radioactive nuclear fuel rods stored in 8 concrete and steel silos on a concrete pad surrounded by fencing, heavily armed security personnel, and guard dogs. [Description of site visit by Lana Pollack, President, MEC; radioactive waste inventory from U.S. Department of Energy, “Final Environmental Impact Statement for Yucca Mountain,” Feb. 14, 2002, Table A-7, “Proposed Action spent nuclear fuel inventory,” page A-15; U.S. Nuclear Regulatory Commission, “Cask Registration Data for General Licensees,” Nov. 11, 2006, emailed to author by NRC Spent Fuel Project Office on 11/27/06.]

The casks – BNFL FuelSolutions W150 casks, about 20 feet tall, 10 feet in diameter, sitting out in full view in the open air -- represent a radioactive bull's eye on the shore of Lake Michigan, the source of drinking water for millions.

Even the security measures in place at Big Rock, however, are of questionable efficacy against airborne, or remotely launched land-based and waterborne, attack scenarios. Remotely fired missiles, high explosives, and shaped charges could break open the containers and release

the radioactivity into the environment. In April, 2006 the investigative arm of the U.S. Congress, the Government Accountability Office, chastised the NRC for giving priority to the nuclear industry's bottom line over needed security upgrades at nuclear power plants.

[ <http://www.nirs.org/reactorwatch/security/sec04042006gaorpt.pdf> ]

A 1998 test at the U.S. Army's Aberdeen Proving Ground in Maryland showed that radioactive waste storage casks are vulnerable to anti-tanks missiles. The first missile obliterated the concrete shielding around the cask, and the second missile punched a hole through the cask wall to the inner waste chamber. Combined with incendiaries, the resulting fire could release catastrophic amounts of radioactivity into the environment. Each of the 8 casks at Big Rock contains about 240 times the long-lasting radioactivity released by the Hiroshima atomic bomb. Release of even a fraction of the contents of a single cask would be disastrous.

The 9/11 Commission report documented that Al Qaida had originally planned to hijack 10 jets on 9/11/2001. Two of the jets were going to be crashed into nuclear power plants. Al Qaida commanders, interviewed in Pakistan after the attacks, explained that the attack on nuclear facilities was called off for fear that the radiation release might "get out of hand," but that such attacks had not been ruled out in the future.

[<http://www.nirs.org/factsheets/nirsfctshdrycaskvulnerable.pdf> ; "240 times Hiroshima" calculation done by Dr. Marvin Resnikoff, Radioactive Waste Management Associates, New York City, a conservative figure, because it only accounts for the five radio-isotopes of cesium, but not the hundreds of other radioactive poisons in the waste; <http://www.9-11commission.gov/>; Giles Tremlett, The Guardian, "Al-Qaida leaders say nuclear power stations were original targets," Sept. 9, 2002; Curt Anderson, "Sept. 11 Commission: Al-Qaida Planned 10 Hijackings: White House, CIA and FBI headquarters, nuclear plants originally targeted," June 17, 2004, page 1.]

These wastes will remain stored on-site for at least a decade. The U.S. Department of Energy is now saying that 2017 is the earliest possible date that the proposed national dumpsite at Yucca Mountain, Nevada can be opened. However, this estimate assumes that no litigation will delay the schedule even longer, but the State of Nevada and environmental organizations – adamantly opposed to the proposed dump due to the site's geologic unsuitability – are likely to file further legal interventions.

[[http://www.ocrwm.doe.gov/info\\_library/newsroom/documents/ym-schedule-2006.pdf](http://www.ocrwm.doe.gov/info_library/newsroom/documents/ym-schedule-2006.pdf) ]

If and when the dumpsite opens, however, it would still take many additional years to transport Big Rock's wastes there. [DOE Yucca FEIS] Michigan law forbids the transfer of Big Rock's wastes to another site ("Spent fuel rods shall not be transported from a nuclear power generating facility for storage at any other nuclear power generating facility."), such as to the Palisades nuclear plant in southwest Michigan. [RADIOACTIVE WASTE, Act 113 of 1978, Amended 1989, Section 325.491 Radioactive waste; depositing or storing in state prohibited; exceptions.] Thus, high-level radioactive waste will remain in storage at Big Rock for many years or even decades to come.

Consumers has even gotten permission from NRC to only inspect the casks once every two weeks. The casks do not have radiation or heat monitors directly installed upon them. Thus,

it would be possible for a radiation release or overheating incident to unfold for two weeks before being detected by the company.

A national coalition of environmental organizations, including groups in Michigan, has petitioned the U.S. Congress to fortify radioactive waste storage such as at Big Rock against terrorist attacks, as well as to safeguard it against accidents, as by requiring radiation and heat monitoring equipment on each cask. [See “Principles for Safeguarding Nuclear Waste at Reactors,” <http://www.citizen.org/documents/PrinciplesSafeguardingIrradiatedFuel.pdf> ]

In the meantime, the radioactive rods at Big Rock raise obvious questions about public health, safety, and security risks, especially in regards to their susceptibility to terrorism or sabotage. The development of a state park is incongruous with a potentially catastrophic terrorist target. Inviting large numbers of families and children into close proximity to high-level radioactive waste for public recreation makes no sense.

The U.S. Environmental Protection Agency is due, by the end of the year, to publish its radiation release regulations for the proposed high-level radioactive waste dump at Yucca Mountain, Nevada. EPA has proposed, and will enact in its regulations, a one million year regulatory compliance period for high-level radioactive waste management at Yucca. This shows how long these wastes will remain hazardous to human health and the environment. [ <http://www.epa.gov/radiation/yucca/index.html> ]

# Radioactive Contamination

## Radiation Releases into the Environment

Ironically, despite its small size (it was a 75 megawatt-electric reactor, compared to a more typical 1,000 megawatt reactor), Big Rock released among the largest amounts of radioactivity of any single atomic reactor in the country. Many millions of curies of radioactivity were released into the air, soil, and groundwater, as well as into Lake Michigan’s waters and sediments, risking concentration in flora, fauna, and the food chain.

By way of comparison, a large university medical center, with as many as 1,000 labs in which radioactive materials are used for research, diagnosis, and treatment, may have a combined radiological inventory of only about two curies, which are not spewed into the environment as at Big Rock, but rather carefully handled and managed. [see <http://www.nirs.org/factsheets/greatlakespamp.pdf> ]

To give a sense of the levels of radioactivity that Big Rock generated, the company hired to decommission the site reported: “BNG America removed and disposed the 280-ton reactor vessel at Big Rock Point – *the most radioactive reactor vessel removed in the US to date.*”

Consumers admits that the large-scale radiation releases from Big Rock were due in large part to “*significant [nuclear] fuel failures*” in the operating core, as well as to scores of radioactive waste and material leaks, spills, overflows, floods, and sloppy handling over the decades. [Big Rock Point Restoration Project LICENSE TERMINATION PLAN, Revision 1, July 1, 2004, Prepared by Consumers Energy Company: “Environmental Impact of Historical Fuel Failures,” Page 2-5; “Radiological Event History,” Page 2B-1.]

British Nuclear Group (BNG) America (formerly British Nuclear Fuels, Ltd., BNFL) went on to report: “*Because the reactor had been used for experimental purposes, it had elevated radiation levels and workers performing the decommissioning and the environment required more protection than is required when decommissioning reactors used solely for commercial electricity generation.*” [see <http://www.bngamerica.com/> under Projects/Commercial Work/Big Rock; accessed 11/28/2006]

The following tables, containing data provided by Consumers Energy to NRC, show that many millions of curies of radioactivity were spewed into the environment from Big Rock atomic reactor over the four decades of its operations.

These figures are taken from “Radioactive Materials Released from Nuclear Power Plants,” NUREG/CR-2907, by Brookhaven National Laboratory, Upton, NY 11973, prepared for Office of Information Resources Management, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 (NRC FIN B2234)

**Table I.** Airborne Effluents Comparisons by Year

Fission and Activation Gases (Total Curies)

1965	132,000
1966	705,000
1967	284,000
1968	232,000
1969	290,000
1970	280,000
1971	284,000
1972	258,000
1973	230,000
1974	188,000
1975	50,600
1976	15,200
1977	13,400
1978	18,900
1979	6,670
1980	21,500
1981	19,700
1982	12,900

1983	11,000
1984	141,000
1985	62,600
1986	67,900
1987	8,350
1988	7,770
1989	7,080
1990	5,550
1991	4,500
Total:	3,357,620

**Table II.** Airborne Effluents Comparison by Year

I-131 and Particulates (Curies)

(Half-Life Equal To or Greater Than 8 Days)

1970	0.13
1971	0.61
1972	0.15
1973	4.60
1974	0.16
1975	0.12
1976	0.05
1977	0.01
1978	0.00891
1979	0.0019
1980	0.0294
1981	0.0061
1982	0.00471
1983	0.00335
1984	0.132
1985	0.0825
1986	0.0756
1987	0.0294
1988	0.0507
1989	0.00487
1990	0.00571
1991	0.00307
Total	6.27

**Table III.** Liquid Effluents Comparison By Year

Tritium (Curies)

1970	54.0
1971	10.3
1972	10.4
1973	19.7
1974	5.10
1975	5.73
1976	2.41
1977	8.83
1978	4.05
1979	5.45
1980	6.18
1981	3.13
1982	2.98
1983	22.2
1984	1.11
1985	1.27
1986	0.351
1987	0.585
1988	0.347
1989	0.639
1990	0.589
1991	0.251
Total	166

[The figure for 1984 is questionable, because Consumers admits in its License Termination Plan that a 20,000 gallon spill of tritiated water into soil and groundwater took place, yet its admitted tritium release for that year appears low.]

**Table IV.** Liquid Effluents Comparison by Year

Mixed Fission and Activation Products (Curies)

1970	4.70
1971	3.50
1972	1.10
1973	2.70
1974	1.10
1975	2.02
1976	0.77
1977	0.392
1978	0.274

1979	0.903
1980	0.782
1981	0.391
1982	0.260
1983	0.0782
1984	0.148
1985	0.153
1986	0.0709
1987	0.273
1988	0.218
1989	0.232
1990	0.0364
1991	0.122
Total	20.2

**Table V.** Solid Waste Comparison by Year

Activity (Curies)

1977	968
1978	25.6
1979	277
1980	30.9
1981	317
1982	4.33
1983	274
1984	2.13
1985	114
1986	252
1987	2,300
1988	728
1989	371
1990	126
1991	On-site storage
Total	5,790

[Consumers admits in its License Termination Plan, Rev. 1, July 1, 2004 that it operated an open air, makeshift cement block “incinerator” pit from 1965 to 1978. Due to the presence of radioactive ash, and the admitted potential for radioactive contamination of the soil there, it appears that radioactive solid trash was burned in the incinerator. Thus, an unknown fraction of the curies listed above in the solid radioactive waste category could have been emitted into the air, to fallout onto the soil and surface waters downwind.]

Please note that the 3,357,812.47 curies of radioactivity that Consumers Energy reported to NRC was emitted into the environment by Big Rock is not an exhaustive figure. Fission

and activation gas emissions for the years 1962 to 1964 (likely very high, given the experimentation with nuclear fuels taking place at Big Rock then), as well as 1992 to 1997, still need to be added, once the necessary NRC documentation can be obtained by the author. Missing years for other radioactive release categories also have to be obtained. Regardless, even the radioactive releases that can be documented show that Big Rock was among the worst emitters of radioactivity of any single nuclear power plant in the country. This is all the more troubling, in that Big Rock was a small reactor (75 megawatts-electric) compared to others (typical reactors are 1,000 megawatts-electric).

## Scores of Radiological Incidents Admitted

The company's "*Radiological Event History*" in its July 1, 2004 revised "License Termination Plan" lists *63 radiation spills, leaks, overflows, and floods*, as well as *sloppy handling of radioactive wastes and radioactively contaminated materials across the site*. (LTP, Page 2B-1)

In just one of these incidents, on May 31, 1984 *Consumers leaked 20,000 gallons of tritium (radioactive hydrogen) into the soil and groundwater. It requested – and obtained – permission from the NRC for “on-site disposal” – that is, not cleaning up the spill, but rather leaving it in the soil and groundwater.* The company and NRC admit that this and other tritium spills violated the Safe Drinking Water Act from 1984 to 2000, in terms of the concentration of tritium in the site's groundwater.

Consumers holds that the tritium is flowing into Lake Michigan over time, and that dilution lowers the risk to public health and the environment. But this amounts to treating the land as a radioactive septic field, and regarding Lake Michigan as an industrial sewer or atomic cesspool for radioactive discharges. This contradicts the U.S.-Canadian International Joint Commission's call for virtual elimination of toxic chemical and radioactive discharges into the Great Lakes.

It must be pointed out that tritium can bind into the human biological system at the most intimate level, including in DNA, for decades, causing cellular and genetic damage to this and future generations. And radioactive hydrogen is simply the first radioactive poison to enter the groundwater and Lake Michigan. Others will inevitably follow. Just recently, breakthroughs in the scientific understanding of plutonium's solubility in groundwater have shown this most dangerous of radioactive poisons can relatively quickly travel great distances in the environment, threatening human health. In fact, plutonium contamination has been documented in groundwater samples taken at Big Rock.

[see: <http://www.nirs.org/radiation/tritium/tritiumhome.htm>; <http://www.nirs.org/press/02-04-2000/1>; <http://www.sciam.com/article.cfm?chanID=sa003&articleID=000D842E-0C4E-1541-8B6B83414B7F0000&ref=rss> ; Dale Condra, ORISE Table 4, "Concentrations of Plutonium Radionuclides in Water Samples, Big Rock," in "Analytical Results for Water Samples Collected December 2, 2003 at Big Rock Point Nuclear Power Plant, Charlevoix, Michigan," Inspection Report Number 050-00155/2003-07)[RFTA 04-001], Oak Ridge Institute for Science and Education (ORISE), Jan. 27, 2004 ]

NRC has allowed Consumers to release the Big Rock site for “unrestricted use” so long as radiation doses are no higher than 25 millirems per year. But the Safe Drinking Water Act limits radiation in drinking water to only 4 millirems per year, calling into question the status of Big Rock’s aquifers, which Consumers admits are contaminated with tritium. In a startling admission, *Consumers indicates that its future radiation dose projections for residents on the site excludes the drinking water pathway.* This seems to indicate that Consumers is not protecting future visitors or inhabitants of the Big Rock site who may be exposed to radioactivity through drinking the groundwater. (See page 19 for additional information.) [License Termination Plan (LTP), Rev. 1, July 1, 2004, page 2-18].

***Other incidents listed in Consumers’ “Radiological Event History” include:***

[all passages are taken verbatim from Consumers LTP, unless otherwise indicated; author’s clarifying comments within brackets]

1960’s: Radwaste Tanks and Resin Disposal Tanks were overfilled on many occasions, often with water standing on the floor...

1960’s: wooden pallets and paint chips from the “Protected Area” (radiologically contaminated) dumped along the Woods Road.[author abbreviation of longer passage]

12-1-62 Pipe Tunnel was flooded...water was from the Condensate System. Leaks of this type have occurred throughout the operational life of the plant. Some of this contaminated water may have entered...into the sand below the building.

8-8-63 It is likely that contaminated water may have entered the ground below the tanks...

8-6-64 Discharge Canal dredging...discharge canal is the effluent pathway for the radwaste batch release of contaminated water...dredging spoils may have been stored on the narrow strip of land north of the protected area and on the beach...

11-13-64 Contamination was identified on top of the Canal Process Monitor intake piping...source of contamination is believed to have originated from this licensed release pathway...

6-8-65 ...the incinerator was a simple enclosure constructed of cement block. Some of the ashes that were removed from the incinerator have contained low levels of contamination. The incinerator was in operation between 1965 and 1978...There is a potential that contamination may be present in the soil at this location. [open air burning of radioactively contaminated solid wastes for 13 years, with unknown amounts of airborne radioactive emissions, and downwind fallout]

7-25-73 Contaminated material is discovered in a temporary shelter near the [smoke] stack base...The potential exists for soil and pavement in this area to be contaminated...

8-18-75 Uranylacetate was spilled in the Annex Building. The Public Affairs Department likely used this radioactive chemical during [public] presentations. [contamination dumped at Waters Township landfill?]

2-21-77 “The radwaste transfer cask liner was banged against the cask during the transfer of spent filters. Contaminated debris was spilled on the ground by the open air Radwaste Vault in the Radwaste Compound. The liner read 2.3 Rem/hr. Clean up efforts included the removal of contaminated snow. It is likely that contamination remained on the ground in this area.” [at 2.3 Rem/hr, a worker would receive his annual “allowable” dose in just two hours.]

8-20-78 “Contamination was found in demineralized water collected at the chemistry lab and Machine Shop sample location. The source of contamination is suspected to have originated from a remote piping cross connection that established demineralized water as an alternate source for spent fuel pool make-up. The cross connect was removed, and in later years this contamination was reduced to trace levels found only in sample locations at lower elevations in the sphere. Many plant systems that are connected to the demineralized water supply have drain connections that may have provided a contamination release pathway. The investigation following this event could not identify a radioactivity release to the environment. This system is now surveyed on a routine basis.”

9-28-78 The Waste Hold Tank was found overflowing to the asphalt below the tanks.

11-20-81 Approximately 10 cubic feet of contaminated resin were spilled at the north end of the Pipe Tunnel in the Turbine Building. The spill was an operational error resulting from improper valve line up. Clean up efforts included the removal of the top 3-5 inches of gravel from the expansion joint area between the Pipe Tunnel and the Sphere. Over the course of the next several days the area was decontaminated and resurveyed several times. Fields of 2-3 Rem/hr were recorded at contact with the floor. It is suspected that contamination remains in the sphere expansion area and may have also migrated through the floor expansion joints to the environment below. [at 2-3 Rem/hr, workers could have received their annual “allowable” radiation dose in just a couple of hours]

11-5-82 Contamination was identified in asphalt rubble located near the Stack Base. The following events have occurred in the vicinity of the Stack Base that could have resulted in the contamination of this area: temporary contaminated material storage area, resin sluicing and pumping, numerous Waste Hold Tank leaks and overflows, Condensate Storage Tank leaks. This area was also the transfer point for the movement of radwaste filters casks to the Radwaste Building.

11-16-82 A transport pathway was identified between the Chemistry Lab sink and the septic system. This sink was used for the disposal of non-contaminated water samples. Modifications were made to correct this situation in December 1982.

There is a potential that this sink may have been used for the disposal of contaminated waste. The septic tanks and drain field (liquid, sludge and soil) were sampled for suspected contamination. This and subsequent investigations and analyses have never identified radioactive contamination. The septic tanks are presently sampled and analyzed three times per year. [did this unauthorized dumping of radioactive liquids in a non-radiological drain system take place from 1962 to 1982?]

11-24-82 Contaminated blocks of cement from the radwaste vaults were moved to the northeast corner of the Contaminated Materials Warehouse. The cement had fixed contamination levels of 100 to 800 cpm. These blocks may have been stored along the power line at the time the contamination was discovered. [10 to 20 cpm, counts per minute, is considered a normal natural background radiation level]

5-31-84 Water was found weeping through the wall of the Radwaste Pump Room. The water originated from a leak in a two-inch aluminum line below the Turbine Building floor. It was calculated that approximately 20,000 gallons of condensate system water had leaked into the soil. A section of the floor in the southwestern corner of the turbine building was cut out and eight barrels of contaminated soil were removed and shipped as low-level radwaste. On August 16, 1985, Consumers Power requested NRC approval to retain the remaining contaminated soil. Total activity estimated at  $1.4E-7$  microCi/g; nuclides present in 1984 included Mn-54, Cs-137, Co-60 and Ag-110m. The NRC granted approval on May 8, 1986. Voids were replaced by clean fill and the concrete floor was repaired. It is estimated that 5300 cubic feet of contaminated soil remained at this location. The summary section of this engineering study made the following conclusion: "Retaining the contaminated soil on-site with approximately 8 inches of concrete covering (turbine building floor) would result in no discernable impact on either the environment or on occupational and public health. The total activity is expected to be undetectable within seven years." [use of site as radioactive septic field, of Lake Michigan as radioactive industrial sewer]

11-9-84 Concrete blocks from the radwaste vault were found with activity levels of 100 to 500cpm. These are likely from the storage location along the power line. [10 to 20 cpm considered normal natural background]

9-30-86 Contaminated sludge was found in the heating boiler during a maintenance evolution. The source of this activity is believed to have originated from contaminated demineralized water make-up... Frisking performed on samples of the sludge detected 160 cpm over background and gamma analysis identified measurable levels of Co-60, Cs-134 and Cs-137. The sludge was removed and the area was decontaminated. A pathway existed for liquid drains from this system to have reached the environment. A new heating boiler was installed in 1990 and system drains are now batched by licensed effluent release. [Consumers simply got permission from NRC for these leaks into the environment]

2-13-87 Approximately 25 gallons of water is estimated to have leaked from the #1 Waste Hold Tank vent line due to overfilling. Less than one gallon was estimated to have reached the environment. Soil samples taken after this event identified  $1.2E-5$  xCi/gm (sic) of Co-60,  $3.4E-5$  xCi/gm (sic) of Cs-137, and  $2.0E-6$  xCi/gm of Mn-54. Two and a half fifty-five gallon drums of

soil were removed from the area below the tank. The pit was approximately 3 feet long and 2 1/2 feet deep when soil levels reached <100 cpm above background and the clean-up effort was terminated. [units of measurement are not clear in document]

3-17-87 The Discharge Canal was dredged. A direct frisk of dredge spoils identified only background activity levels. The refuse was likely placed on the elevated stretch of property between the beach and the protected area fence that is north of the Containment Building. [was radiation monitoring adequate?]

6-30-87 Maintenance removes sludge from the heating boiler water-box. Gamma isotopic analysis identified a Cs-137 activity of 1.60E-6 xCi/cc of sludge. During the process of clean-out approximately 500 gallons of heating boiler water was inadvertently released to the septic system. [Consumers has admitted that septic drain field has been left in place. What about radioactive contamination? Units of measurement again unclear.]

2-24-89 Drain line integrity is questioned in the floor drain of the Condensate Demineralizer Room (between cation and anion tanks). Maintenance personnel may have punctured the drain while attempting to unplug the line. Soil contamination is suspected below the concrete flooring.

9-19-91 A truckload of rip/rap and a concrete pad were frisked and released for storage along the power line behind the Swamp Warehouse. This material was likely from the canal dredging area.

8-13-93 The #1 Waste Hold Tank was overfilled and leaked to the ground. The area was boundaried off and decontaminated. [to what level of contamination?]

11-27-93 The overhead supply line to the Condensate Storage Tank was found leaking near the Turbine Building. A temporary cover was constructed to keep out rain and snow.

1-6-94 A leaking union was discovered on a section of the demineralized water transfer line located immediately west of the southern end of the Turbine Building. Snow and ice in the area below the piping leak was collected. The logbook entry gave no activity results for the samples. The leak was repaired on the same day as it occurred. [radiation levels were not reported, although contamination was clear]

6-27-94 Contractors removed asphalt and dirt from the Radwaste Compound in preparation for pouring a new cement slab in front of the loading bay. This asphalt and dirt were released to the power line storage area behind the Swamp Warehouse. This location from which these materials came was once a contamination area.

Area 1 - The edge of the asphalt directly west of the resin disposal tank plugs. Approximately 5-10 square meters. Nuclide activity levels in this area ranged from 4.7 to 13 pCi/gm of Co-60, and 2.8 to 100 pCi/gm of Cs-137. This is believed to have originated from the 1990 resin transfer work and the numerous spills and overflows of the Waste Hold Tanks that occurred over the years.

Area 2 - Approximately 5-10 square meters of soil west of the acid tank containment wall contained contamination levels up to 48 pCi/gm of Co-60 and 70 pCi/gm of Cs-137. This activity suspected to have originated from the 1984 Condensate Storage Tank leak and other spills and overflows of the Waste Hold Tanks. Clean up efforts were conducted at the completion of the Scoping Survey. [clean up to what levels of contamination?]

11-12-94 An activity analysis was performed on the storm drain effluent that empties into the west drainage ditch. Samples were taken from the eroded area near the drain and from nearby sediment and vegetation. The results of these analyses could not be located. However, it is known that radioactivity was limited to sediment passing through the drain and not to liquid effluent, and that a barrel was installed to collect sediment at the outfall of the drain. [but wouldn't radioactive particles, as well as dissolved radioactive substances, simply have flowed with the water through the barrel?]

6-6-95 Gravel containing Cs-137 was identified during repair of the Turbine Building roof. The gravel contained Cs-137 at soil background levels. The gravel is being stored under a tarp northwest of the sphere. [it appears, given the 2004 date on this document, and the use of the present tense, that radioactive gravel may have been stored under a tarp for nine years]

9-14-95 Heavy rains flooded an area below the [smoke] stack base. The storm drain at this location had been sealed due to ongoing resin transfer work and the seal was removed to allow flow to the west drainage ditch. A gamma analysis of the drain discharge to the drainage ditch identified radioactive contamination. No activity could be identified in additional samples taken of the sediment collection barrel and creek discharge to the lake. [was radiation detection adequate?]

8-23-96 Contamination was found (15 xCi/gm)[sic, prefix for unit of measurement unclear] in the collection barrel sediment of the storm drain discharge at the west drainage ditch. Samples were taken after a spent resin transfer evolution west of the Turbine Building. This location is the storm water collection source for the storm drain. An investigation identified the following known sources of contamination in this area:

- \* Spills or the migration of contamination during spent resin and filter cask transfer
- \* Waste Hold Tank overfills
- \* Contamination resulting from past leaks in area piping

9-16-96 Two loads of blacktop were removed from an area near the stack base. Both loads were frisked and identified no activity above background levels. These two loads were released to the storage area along the power line behind the Swamp Warehouse. An additional load evaluated on the following day contained numerous areas of surface contamination ranging from 1,000 to 10,000 cpm. The contaminated pieces were segregated and taken to the Radwaste Building. The remaining asphalt was released to the power line storage area. [normal natural background radiation is at 10 to 20 cpm]

11-18-96 Roof repair was performed on the Turbine Building...Gravel

from this location was removed and placed in the storage location northwest of the Containment Building. The average activity of the gravel stored in this area is 0.72 xCi/gm Cs-137, and 0.07 xCi/gm Co-60. [prefix on unit of measurement unclear]

3-13-97 Contamination was found in the soil below a cracked floor drain near the caustic tank in the Condensate Pump Room. This room is located in the Turbine Building north of Track Alley. Samples collected identified Cs-137, Mn-54, Sb-124, and Cs-134. Area clean up efforts were performed and the drain has been plugged to prevent further use. Soils in this location are expected to contain low levels of contamination. [Sb-124 was not listed in company or NRC documents of radioactive contaminants still on site. Why not, if “Soils in this location are expected to contain low levels of contamination”?]

3-98 An investigation of a system process monitor alarm event identified contamination (Co-60 and Mn-54) in the sediment of the east storm drain. For a brief period, radioactive contaminants were introduced into the Service Water System that provides supply water to many radiologically clean systems. The contaminants entered through an improperly seated condenser warming line and were the result of wave-suspended radioactivity that was previously discharged to the lake in permitted releases. The sediment radioactivity is likely to have originated from the condenser vacuum pump which uses sealing water from the Service Water System and discharges to the storm drain. Sediment activity levels in the drain piping were approximately 0.8 pCi/gm. No activity was identified in the samples taken from other connecting sections of drain system. The entire length of this drain line has been decontaminated and is now monitored on a routine basis by the Operational Health Physics Department. Any potential piping leaks in this system would have presented a release pathway to the environment. [backwash from Lake Michigan radioactive enough to sound radiation alarms in discharge canal six months after reactor shutdown]

No Date: Anti-Contamination clothing in a yellow radwaste disposal bag was found in a void under the asphalt near the Equipment Lock Area. No contaminated materials were present in the bag. This void may be the result of wash out that was caused by modifications that were made to the Alternate Shutdown Building drainage. No further information is known concerning the origin of the radwaste disposal bag. [are there other additional on-site burials of waste that *do* contain contamination that have been forgotten about?]

No Date: The integrity of all under ground piping is suspect due to inadequate cathodic protection. There is a potential of soil contamination in areas near underground piping carrying radioactive fluids.

No Date: Old steel from inside the sphere was stored in the area where the Swamp Warehouse is presently located. The steel was from plant modifications that were made over the years and is believed to contain low levels of contamination.

The following figure, from Consumers' July 1, 2004 revision to its License Termination Plan, shows the area of the Big Rock property that is likely the most contaminated – directly under and adjacent to the location of the nuclear power plant itself.

**Figure 1. Big Rock Point Industrial Area (next page)**

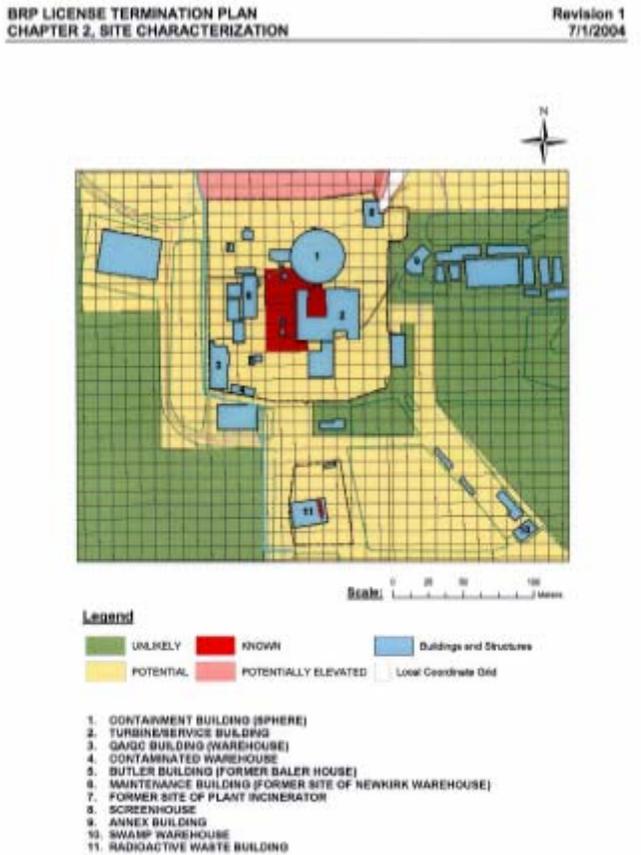


Figure 2-2. Big Rock Point Industrial Area

June 2003

It should be mentioned, though, that due to airborne and waterborne releases, as well as sloppy handling and storage of radioactive wastes and materials, areas other than this concentrated one are also likely radioactively contaminated.

## Environmental Clean Up, or Lack Thereof

The radioactivity that the Big Rock reactor routinely released over the decades of nuclear power operation (1962 to 1997) has not been completely removed from the land and waters. [see <http://www.nirs.org/factsheets/greatlakespamp.pdf> ]

Consumers Energy and the U.S. Nuclear Regulatory Commission (NRC) admit that “*residual radioactivity*” continues to contaminate the soil and groundwater at Big Rock, specifically the following 24 “fission and activation products” (radioactive poisons): Hydrogen-3 (tritium); Carbon-14; Manganese-54; Iron-55; Nickel-59; Cobalt-60; Nickel-63; Zinc-65; Strontium-90; Technetium-99; Silver-110m; Iodine-129; Cesium-134; Cesium-137; Europium-152; Europium-154; Europium-155; Plutonium-238; Plutonium-239; Plutonium-240; Plutonium-241; Americium-241; Curium-243; Curium-244.” [see NRC “Safety Evaluation” and “Environmental Assessment/Finding of No Significant Impact,” March 2005; Consumers “License Termination Plan, Revision 1,” July 1, 2004.]

Tritium (H-3, radioactive hydrogen) contaminates all three layers of groundwater at Big Rock, and has been -- and is likely still -- flowing into Lake Michigan. Consumers states that “The groundwater flow in all three of these units [underground aquifers] is northerly into Lake Michigan.” [LTP, Rev. 1, July 1, 2004, p. 2-26] Consumers goes on to state “any water carrying potential contamination would be at or beyond the northern limits of the site (at their discharge point to Lake Michigan) before mixing with upper portions of the bedrock aquifer...” [LTP, p. 2-28] Apparently, Consumers is untroubled by this projected tritium contamination of what it admits is potable groundwater, because it happens beyond the edge of its private property.

Consumers speaks of a “trapped subsurface source term of tritium,” and acknowledges persistent tritium contamination in the bedrock aquifer of 900 to 1,000 picoCuries per liter. [LTP, p. 2-28] NRC mentions even higher levels of contamination, up to 2,900 picoCuries per liter. [NRC “Environmental Assessment,” 3/11/2005, page 14]

Given that Consumers and NRC advocate “diluting” the radioactive contamination in Lake Michigan as an acceptable practice, this proposed recreation area could be called “Radioactive Septic Field State Park,” and Lake Michigan a radioactive industrial sewer.

***Up until the year 2000, Big Rock’s groundwater contamination was one to two times higher than EPA’s Safe Drinking Water Act limits.*** In a startling admission, ***Consumers indicates that its future radiation dose projections for residents on the site excludes the drinking water pathway*** [March, 2005 NRC “Safety Evaluation” and “Environmental Assessment/ Finding of No Significant Impact (FONSI);” <http://www.nirs.org/radiation/tritium/tritiumhome.htm> ; License Termination Plan (LTP), Rev. 1, July 1, 2004, page 2-18].

This is a dangerously non-conservative assumption, in that the groundwater is admitted to be contaminated, and it cannot be assumed that Big Rock’s groundwater will not be used for drinking water in the future. In fact, in its LTP, Consumers admits that the bottom aquifer is potable water. Consumers assumes that the two upper aquifers are non-potable, but this assumes institutional controls will be maintained for as long as the radioactive poisons contaminate that groundwater – an unreasonably optimistic assumption.

Below are reproduced three figures from Consumers’ July 1, 2004 revision to its License Termination Plan showing the theoretical flow paths for contamination via groundwater into Lake Michigan. “Figure 2-1” from the License Termination Plan, shown on page 25 below,

shows the extent of the “Impacted Area” (potentially radioactively contaminated) that Consumers will admit to.

**Figure 2. Tritium Plume in Shallow Groundwater Zone. (next page)**

**Figure 3. Tritium Plume in Intermediate Groundwater Zone. (page 21)**

**Figure 4. Tritium Plume in Bedrock Groundwater Zone. (page 22)**

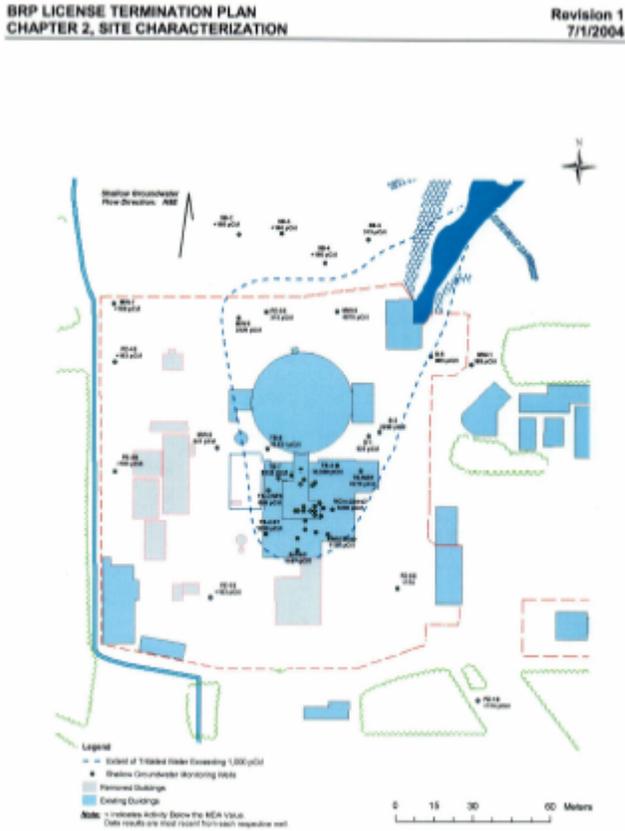


Figure 2-13. Tritium Plume in Shallow Groundwater Zone



Figure 2-14. Tritium Plume in Intermediate Groundwater Zone

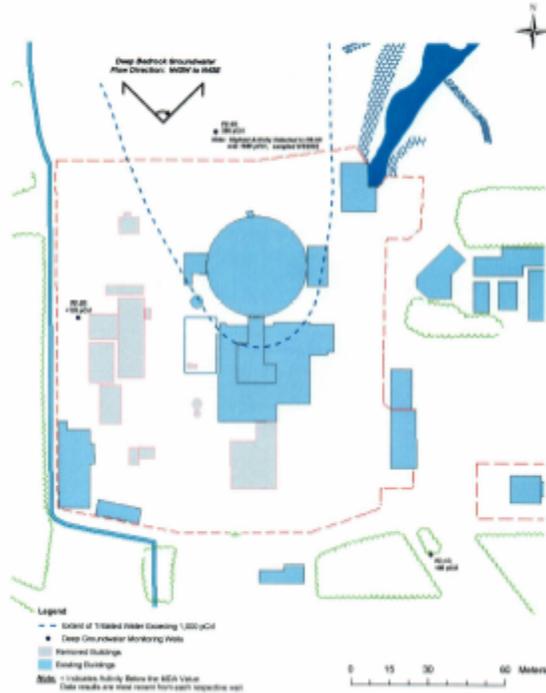


Figure 2-15. Tritium Plume in Bedrock Groundwater Zone

Page 2-75

Lake Michigan, and Lake Michigan sediments, have very likely not been adequately investigated – if at all -- by the company or federal regulators for radioactive contamination emitted from Big Rock. NRC and Consumers Energy have assumed that so-called adequate dilution of the radioactive poisons has taken place, but what about bio-magnification of radioactivity in Great Lakes organisms, as documented by the International Joint Commission in its 1999 Nuclear Task Force’s “REPORT ON BIOACCUMULATION OF ELEMENTS TO ACCOMPANY THE INVENTORY OF RADIONUCLIDES IN THE GREAT LAKES BASIN (<http://www.ijc.org/rel/boards/nuclear/bio/index.html>)”? In 1998, six months after Big Rock had permanently shut down, radioactivity suspended in Lake Michigan water -- likely bio-magnified in algae – was backwashed up the discharge canal, causing radiation monitor alarms to sound. [See 3-98 incident report, above] Radioactive contamination in Lake Michigan sediments could wash back ashore over time, be picked up on the wind as particles, and be inhaled by visitors to the state park at Big Rock. Children could also ingest radioactive particles contaminating the surface of the soil and beach.

Referring to the area of the Discharge Canal, NRC indicates that Lake Michigan sediment radioactive contamination is quite likely: “Radioactivity originating from licensed liquid release

is present in this area; characterization surveys identified elevated levels of radioactivity concentrate in the sediment below the water's surface." Of course, where Consumer's "private property" ends at the Discharge Canal and where Lake Michigan begins makes little difference to the ecosystem, which is radioactively contaminated throughout. [NRC "Environmental Assessment," 3/11/2005, page 10]

Although Consumers asserts that the Big Rock site is a "Greenfield," their own words and documents indicate otherwise. The author attended a meeting in February, 2003 between Consumers representatives and U.S. Nuclear Regulatory Commission staff at NRC headquarters in Rockville, Maryland. At the meeting, Consumers proposed to walk away from much of the radioactive mess they've made on the site. Claiming they did not want to disturb the radioactive contamination in the sediment in a canal leading out into Lake Michigan, Consumers proposed to not even look at how badly or far out into Lake Michigan the contamination extended. However, the following figure from the License Termination Plan indicates that some level of assessment was carried out.

**Figure 5. Discharge Canal Survey Unit.**



Figure 2-11. Discharge Canal Survey Unit

At the meeting, Consumers representatives also said that the groundwater under the site would wash the radioactive contamination into Lake Michigan, and since that was off their

property, they needn't worry about it. NRC, the mission of which is supposedly to protect public health and safety and the environment, did not object to that twisted logic.

[ <http://www.record-eagle.com/2003/feb/22letter.htm> : Kevin Kamps, "Profits over safety?", Letters to the Editor, Traverse City Record Eagle, February 22, 2003 ]

Consumers' flippant, carefree attitude shouldn't be a surprise, however. The company that Consumers hired to "clean up" Big Rock - British Nuclear Fuels. Ltd. - has turned the Irish Sea into one of the most radioactively contaminated bodies of water on earth, due to the large-scale discharges of plutonium, technetium, and other radioactive poisons from its Sellafield nuclear facility in the U.K. BNFL has discharged over 1,000 pounds of plutonium into the Irish Sea, when a mere microscopic speck inhaled into the human lung can initiate lung cancer. Wave action has washed plutonium back ashore, throwing it back up into the air as sea spray. Plutonium contaminated dust has been documented in residences in neighboring villages. An entire yard had to be dug up and treated as radioactive waste, due to radioactive pigeon droppings under bird feeders there. Plutonium in children's teeth has been documented hundreds of miles from Sellafield, with levels decreasing with distance from BNFL's facility. Governments from Ireland to Scandinavia have objected to the radioactive contamination of the seafood supply, and have launched legal interventions at the European Union. Radioactivity from Sellafield has been detected as far away as Canadian Arctic waters. In April, 2005 BNFL suffered another major radioactive leak at Sellafield. A full 90% of the entire radioactive emissions and discharges from the British nuclear power industry (including all reactors) emanate from the single reprocessing site at Sellafield, run by BNFL. Parents who work at BNFL have elevated incidences of stillbirths, leukemia, and non-Hodgkin's lymphoma in their children. *This* is the company that Consumers hired to "clean up" Big Rock, which hung a hand-made "BNFL, Ltd." clapboard sign in front of its office in a quaint rented house on the main street of Charlevoix. The "Ltd." stands for Limited, as in Liability. As in not responsible for any messes it makes.

[ <http://www.corecumbria.co.uk/> ; <http://www.nirs.org/factsheets/rwreprocessfactsheet.pdf> ]

BNFL, now called BNG (British Nuclear Group) America, is now owned by EnergySolutions of Salt Lake City, Utah. Radioactive wastes from Big Rock have been buried at EnergySolutions' "Envirocare" dump in Clive, Utah – including a train load that derailed in Clare County, Michigan in summer 2006 [ <http://www.nirs.org/press/06-20-2006/1> ]. Big Rock has also dumped radioactive wastes at the Barnwell dump in South Carolina, including its reactor pressure vessel, which also suffered numerous transport mishaps along the way.

[ <http://www.nirs.org/radwaste/hlwtransport/nukewatch122003.htm> ] As an indication of how much radioactivity Big Rock generated, BNG America reported that Big Rock's reactor pressure vessel was the most radioactive one yet decommissioned in the U.S.

[[http://www.bngamerica.com/index.php?load=projects&page=index&op=project\\_fetch&project\\_id=1](http://www.bngamerica.com/index.php?load=projects&page=index&op=project_fetch&project_id=1) ]

Consumers also admits that "*the potential exists that residual radioactivity may be present in subsurface areas of the drainfield,*" but still intends to leave the drainfield in place. In its 2<sup>nd</sup> revision of the License Termination Plan, Consumers states:

All equipment, components and structures, including subsurface foundations, but *excluding an onsite septic drainfield* and the plant intake water pipe, will be removed rather than undergo remediation. *The drainfield is being retained in place, with the concurrence from local and state health officials. The drainfield is in an impacted area, but characterization studies show that it will meet site release criteria without remediation.*

[License Termination Plans: Rev. 1, 2004, Page 2-37; Rev. 2, 2005, Page 4-2]

Thus, Consumers is knowingly leaving the radioactively contaminated drain field in place. How such abandonment of radioactively contaminated infrastructure comports with NRC's supposed requirement of ALARA (keeping radioactive doses As Low As Reasonably Achievable) is unclear.

On Page 2B-10 of the LTP, Rev. 1, Consumers reports on 5-99 that "Trace levels of contamination were found in the east storm drain..." It goes on to state that "removal of storm drains will be a requirement for license termination." Are those storm drains somehow related to the drainfield mentioned above? Have they been removed, as promised?

Also of concern are the literally shallow requirements for nuclear power plant decommissioning and release of the site for "unrestricted use" under the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) subscribed to by the U.S. Environmental Protection Agency, the NRC, the U.S. Department of Defense, and the U.S. Department of Energy. Soil analysis and remediation only need take place to a depth of 15 centimeters (5.9 inches) under MARSSIM, a point echoed in Consumers' Big Rock decommissioning documents, despite clear evidence of contamination at deeper locations in the soil and groundwater. It is not clear that any other federal or state regulations required Consumers to investigate deeper than six inches down for evidence of radiological contamination, despite knowing that contamination extends much deeper than that at Big Rock in the soil, subsurface, and groundwater.

Since Big Rock dealt directly with NRC for regulation, as opposed to an "agreement state" state agency, NRC did not address toxic, hazardous chemicals during decommissioning. Consumers attempted to simply say that no such issues existed at Big Rock, but Michigan Department of Environmental Quality did not immediately agree with that.

A Memorandum of Understanding between EPA and NRC focuses upon 25 radioactive contaminants to address during site decommissioning. But what of the dozens, even hundreds, of additional radioactive poisons generated by nuclear fissioning at Big Rock, many of which also escaped into the environment? [MARSSIM, NUREG-1575, Rev. 1; EPA 402-R-97-016, Rev. 1; DOE/EH-0624, Rev. 1; August 2000]

## **Lakeshore Contaminated**

Although the one and a half miles of "undisturbed" Lake Michigan shoreline is a major selling point for a state park at Big Rock, Consumers admits (in the figure below, from its July 1,

2004 revision to its License Termination Plan) that much of the shoreline is potentially contaminated with radioactivity.

**Figure 6. Big Rock Point Owner-Controlled Area** [showing “Impact Area,” that is, potentially radioactively contaminated]

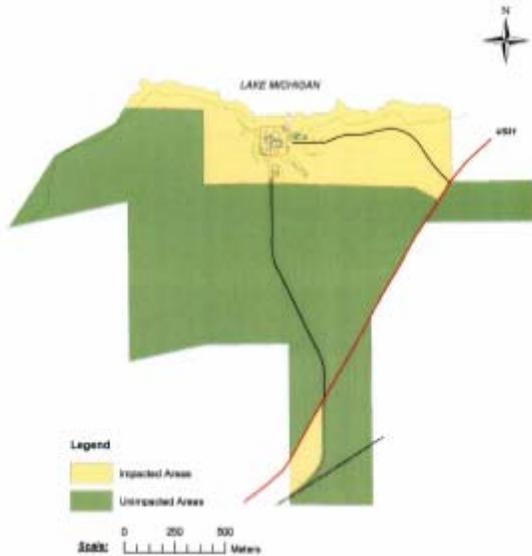


Figure 2-1. Big Rock Point Owner-Controlled Area

## Duration of Radiological Hazards

Here is the list of other radioactive poisons Consumers Energy and the U.S. Nuclear Regulatory Commission admit are in the soil and ground water at Big Rock [from page 3 of the NRC “Safety Evaluation,” March 24, 2005]:

***“24 radionuclides present at the site: H-3; C-14; Mn-54; Fe-55; Ni-59; Co-60; Ni-63; Zn-65; Sr-90; Tc-99; Ag-110m; I-129; Cs-134; Cs-137; Eu-152; Eu-154; Eu-155; Pu-238; Pu-239/240; Pu-241; Am-241; Cm-243/244. These radionuclides contain fission and activation products...”***

The NRC report goes on to state:

***“the licensee identified...the following radionuclides as contributing to dose after license termination: H-3; Mn-54; Fe-55; Co-60; Sr-90; Cs-137; Eu-152; Eu-154; and Eu-155.”***

We question why such radioactive poisons as Pu-239, Sr-90, Tc-99, and others acknowledged as “present at the site” are excluded from the list “as contributing to dose after

license termination.” They would contribute to dose far into the future, given their long hazardous persistence and biologically interactive properties.

Each radioactive poison has its distinctive hazardous persistence, some in the centuries, others in the millions of years. Certain radioactive poisons tend to target their risks at particular human organs: Sr-90 at bones, Cs-137 at muscles (including the heart), and Pu-239 at the lungs, for example. Please see the following two tables.

**Table VI. Hazardous persistence of radioactive contaminants at Big Rock.**

<u>Radioactive Poison</u>	<u>Half-Life*</u>	<u>Hazardous-Life**</u>
H-3, Tritium (radioactive hydrogen)	12 years	120 years
C-14, Carbon-14	5,730 yrs	57,300 yrs
Mn-54, Manganese-54	312 days	8.5 yrs
Fe-55, Iron-55	2.73 yrs	27 yrs
Ni-59, Nickel-59	76,000 yrs	760,000 yrs
Co-60, Cobalt-60	5.27 yrs	53 yrs
Ni-63, Nickel-63	100 yrs	1,000 yrs
Zn-65, Zinc-65	244 days	6 yrs 8 months
Sr-90, Strontium-90	28.8 yrs	290 yrs
Tc-99, Technetium-99	211,100 yrs	2,100,000 yrs
Ag-110m, Silver-110m	250 days	6 yrs, 10 months
I-129, Iodine-129	16 million yrs.	160 million yrs
Cs-134, Cesium-134	2 yrs	20 yrs
Cs-137, Cesium-137	30 yrs	300 yrs
Eu-152, Europium-152	13.5 yrs	135 yrs
Eu-154, Europium-154	8.6 yrs	86 yrs
Eu-155, Europium-155 (table continued, below)	4.8 yrs	48 yrs

<u>Radioactive Poison</u>	<u>Half-Life*</u>	<u>Hazardous-Life**</u>
Pu-238, Plutonium-238	88 yrs	880 yrs
Pu-239, Plutonium-239	24,110 yrs	241,100 yrs
Pu-240, Plutonium-240	6,563 yrs	65,630 yrs
Pu-241, Plutonium-241	14.4 yrs	144 yrs
Am-241, Americium-241	432 yrs	4,320 yrs
Cm-243, Curium-243	29 yrs	290 yrs
Cm-244, Curium-244	18 yrs	180 yrs

\*The “half-life” of a radioactive substance is the time period it takes for half the material to radioactively decay into another material. Note that the decay product, or radioactive “daughter,” may itself also be radioactive and/or hazardous, with its own half-life.

\*\*The “hazardous-life” of a radioactive substance is, at a minimum, ten times as long as its half-life. It could even be twenty half-lives long. Twenty half-lives would be twice as long as the “hazardous lives” reported in the table above, but would be a more conservative measure (as in requiring longer protective measures to safeguard human health)

[Half-lives taken from the Berkeley Laboratory Isotopes Project’s ‘Exploring the Table of Isotopes,’ May 22, 2000, downloaded on November 13, 2006]

## Impacts on Human Health

*Table VII. Radionuclides at Big Rock: Type of Radiation, Biological Effect*

<u>Radioactive Poison</u>	<u>Type of Radiation Emitted</u>	<u>Biological Effect/Organ Targeted</u>
H-3, Tritium (radioactive H)	Beta particle	Goes anywhere in human body H goes, including DNA; can stay in body for 10 years or more
C-14, Carbon-14	Beta particle	Once ingested or inhaled, distributed and bound throughout human tissue just like non-radioactive carbon
Mn-54, Manganese-54	Gamma ray	Mn is essential for a broad range of enzymes, which are essential to cellular function; gonads

(table continued below)

<u>Radioactive Poison</u>	<u>Type of Radiation Emitted</u>	<u>Biological Effect/Organ Targeted</u>
Fe-55, Iron-55	X-ray; Auger electron emitter (travels like a drill in a swirling pattern)	Hemoglobin, liver and spleen
Ni-59, Nickel-59	Electron capture	Fairly ubiquitous in human system
Co-60, Cobalt-60	Beta, Gamma	Liver, kidney, bones, ovaries/testes
Ni-63, Nickel-63	Beta	Fairly ubiquitous in human system
Zn-65, Zinc-65	Gamma	Ubiquitous in human system; gonads
Sr-90, Strontium-90	Beta particle	Bone
Tc-99, Technetium-99	Beta	Kidney
Ag-110m, Silver-110m	Beta, Photon	Whole body (also liver, brain)
I-129, Iodine-129	Beta, Gamma	Thyroid Gland, ovaries
Cs-134, Cesium-134	Beta, electron capture	Muscle, including heart; ovaries/testes
Cs-137, Cesium-137	Beta, Gamma	Muscle, including heart; gonads
Eu-152, Europium-152	Gamma, electron capture, positron	effect unknown
Eu-154, Europium-154	Gamma, beta, electron capture	effect unknown
Eu-155, Europium-155	Beta, gamma	effect unknown
Pu-238, Plutonium-238	Alpha, Gamma	Skeleton, liver, lung
Pu-239, Plutonium-239	Alpha particle	Skeleton, liver, lung, ovaries/gonads
Pu-240, Plutonium-240	Alpha, gamma	Skeleton, liver, lung, ovaries/gonads
Pu-241, Plutonium-241	Beta, Alpha, Gamma	Skeleton, liver, lung, ovaries/gonads
Am-241, Americium-241	Alpha, Gamma	Bone, liver, muscle; Lungs when inhaled
(table continued below)		

Radioactive Poison	Type of Radiation Emitted	Biological Effect/Organ Targeted
Cm-243, Curium-243	Alpha, Gamma	Bone marrow
Cm-244, Curium-244	Alpha, Gamma	Bone marrow

The reproductive organs are attacked by all radioactive isotopes emitting gamma radiation. In addition, the deadly Plutonium-239 is known to concentrate in the gonads. The radiation it emits can cause birth defects, mutations and miscarriages in the first generation after exposure and/or successive generations.

If you ingest alpha and beta particle emitters, they set up permanently next to the marrow of your bones, in your reproductive organs or elsewhere.

The effects of ionizing radiation are not necessarily immediate. Exposure to radiation can cause cancer many years later, after a prolonged latency period. Chronic exposure to even very low levels of radiation can be dangerous over time.

[Sources: Cindy Folkers, NIRS, email to author, 11/20/2006; “Ionizing Radiation” wall poster, based on a drawing by Susanna Natti and Candace Kaihlanen, on page 8 of “The Nuclear Fix: A Guide to Nuclear Activities in the Third World,” by Thijs de la Court, Deborah Pick, and Daniel Nordquist, World Information Service on Energy (WISE), Amsterdam, the Netherlands, 1982. An earlier version is also available in “No Nukes,” by Anna Gyorgy & Friends, South End Press, 1976, 1979. Also see “No Immediate Danger: Prognosis for a Radioactive Earth,” by Dr. Rosalie Bertell, The Women’s Press Ltd., London, 1985, particularly Part One, “The Problem: Nuclear Radiation and its Biological Effects.”]

Given that Plutonium-239, the stuff of thermonuclear bombs, is probably the most-infamous of those very long lasting radioactive poisons listed above, opponents to Consumers Energy’s proposed recreational area at Big Rock have dubbed it: “Plutonium State Park.” Pu-239 will remain deadly, in even microscopic amounts, for hundreds of thousands of years. It is worth noting that Big Rock experimented with MOX fuel (mixed-oxide uranium/plutonium). From 1969 to 1977, Big Rock was licensed to use mixed-oxide fuel through a cooperative R&D program that included GE, Exxon, and Consumers Power and was sponsored by the Edison Electric Institute. Use of experimental fuels worsened Big Rock’s radiation emissions, as documented above. Plutonium is also amongst the most hazardous of radioactive poisons when released into the environment, calling into question its use in experiments at Big Rock in the first place. [<http://www.ans.org/pubs/magazines/nn/docs/2006-11-3.pdf> ]

Was Big Rock and its surrounding area regarded by nuclear establishment decision makers in industry and government as a “low use segment of the population”? This term was used by atomic weapons testing decision makers in the Atomic Energy Commission – forerunner to NRC -- for the Mormons, Native Americans, and ranchers of southwestern Utah, immediately

downwind of the Nevada Test Site, when it was decided to begin atmospheric weapons testing in 1951. Perhaps so, given the following remarks from NRC:

“Charlevoix is the closest urban center and does not currently nor foreseeably fall within the population center definition in 10 CFR Part 100 [this despite Charlevoix being less than four miles away from Big Rock!] The topic of Population Distribution was evaluated by the NRC as part of the Systematic Evaluation Program [SEP]... This review resulted in an assessment and evaluation... which found that based upon an examination of present and projected population data and on observations made during a visit to the site in July 1979, that neither Charlevoix nor any other city within 30 miles of the plant is now, or is likely to become in the foreseeable future, a population center, (more than 25,000 residents), as defined in 10 CFR Part 100. Further, the NRC concluded that the low population zone and population center distances specified for the Big Rock Point site remain valid and the site is in conformance with the distance requirements of 10 CFR Part 100 in that the population center distance is more than one and one third times the distance from the reactor to the outer boundary of the low population zone... This completed the evaluation of this SEP Topic. Since the plant conforms to current licensing criteria, no additional SEP review is required.” [Part I of Rev. 10 to Big Rock Point Plant Updated Final Hazards Summary Report, Sept. 17, 2002]

23 years of population growth seem to have been disregarded by the above document – as if small rural populations are less deserving of protection from radioactivity than are large urban populations. Such an attitude on NRC’s part amounts to environmental injustice.

[ <http://www.nirs.org/ejustice/ejustice.htm> ]

Tritium also has lessons to teach about radio-toxicity at Big Rock. Tritium is harmful to human DNA and cells, carcinogenic, mutagenic, etc. Water is in every cell of the human body. Therefore, water contaminated with radioactive hydrogen (tritium) can enter, contaminate, and bombard any cell in the body. A beta particle from a tritium atom travels at faster than the speed of a jet airplane, and can do tremendous damage to any cell that it contacts. [Kay Drey, NIRS Board Secretary, St. Louis, MO, telephone interview with author, 11/29/06; see also <http://www.nirs.org/radiation/tritium/tritiumhome.htm> ]

It is scientifically established that every exposure to radiation increases the risk of damage to tissues, cells, DNA and other vital molecules. Each exposure potentially can cause cell death, genetic mutations, cancers, leukemia, birth defects, and reproductive, immune and endocrine system disorders. [[http://www.nirs.org/factsheets/drey\\_usa\\_pamphlet.pdf](http://www.nirs.org/factsheets/drey_usa_pamphlet.pdf), especially point #14]

In 2005, in its Seventh “Biological Effects of Ionizing Radiation” (BEIR) report, the National Academies of Science reported that any radiation dose, no matter how small, carries a health risk. In fact, low doses of radiation may carry a disproportionate risk, unit for unit, when compared to high doses of radioactivity. There is no such thing as a safe dose of radiation, despite NRC’s assurance that radioactive contaminants at Big Rock are below “permissible” levels. “Permissible” or “allowable” radiation doses are not “safe,” despite nuclear establishment assurances to the contrary.

[ [http://dels.nas.edu/dels/rpt\\_briefs/beir\\_vii\\_final.pdf](http://dels.nas.edu/dels/rpt_briefs/beir_vii_final.pdf) ; “U.S. Radiation Panel: No Radiation Dose Safe,” WISE/NIRS Nuclear Monitor, July 15, 2005; <http://www.nirs.org/factsheets/nosafedose.pdf> ]

## Liability

A 351-acre tract (of the 563-acre property), with more than a mile of “undeveloped” -- but likely radiologically-impacted -- Lake Michigan shoreline, has been offered for sale by Consumers to the State of Michigan, in order to establish a public park or recreation area. Consumers is asking the state to pay it \$20 million for the property that the company contaminated; ironically, this might shift future legal liability onto the state.

Given the ambiguity over transfer of liability, state taxpayers might assume the legal burden for contamination or problems discovered at this site in the future. Trust Fund board members should not agree to saddle residents with such a potential very long-lasting radioactive burden on the beaches and shores of a state park.

Among the most troublesome questions is the wisdom of the state’s taxpayers potentially assuming legal liability for land with a history of radioactive releases and dangerous nuclear waste that will be there indefinitely. Despite these long-term risks, state and federal officials have declined to conduct an environmental impact statement, settling instead for a lower level “environmental assessment.”

On November 30, 2006 the Associated Press reported that “ [Tim] Petrosky [Consumers Energy’s spokesman at Big Rock] would not comment on liability issues, saying they were a subject of negotiations with the state.” The article went on to report that:

Petrosky said Big Rock Point emitted less than 1 percent of the radiation allowed under its federal permit during its 35 years of operation. "These releases were short-lived radioactivity that naturally dissipated," he said.

The plant's decommissioning included extensive testing for residual contamination that showed the area was safe, he said. Recent groundwater tests turned up no detectable levels of tritium, he said.

"Overwhelming scientific data proves that there would be no risk to anyone using the Big Rock Point property," Petrosky said.

[<http://www.mlive.com/newsflash/michigan/index.ssf?/base/business-10/1164842989300200.xml&storylist=newsmichigan> ; John Flesher, “Environmentalists debate recreation area at former nuclear site,” A.P. 11/29/2006.]

Petrosky's assurances beg the question, then, why would Consumers object to retaining liability, if the site is so clean and safe? What is there to negotiate with the state, unless Consumers is trying to offload the legal liability for the radioactive contamination it caused at Big Rock onto the backs of state taxpayers?

Petrosky claims that "Big Rock Point emitted less than 1 percent of the radiation allowed under its federal permit," yet NRC documents, based on company records and analyses, reveal that up until the year 2000, the tritium contamination in Big Rock's groundwater violated the Safe Drinking Water Act maximum contamination level of 20,000 picocuries per liter (in nature, tritium is present in water in concentrations of 25 picocuries per liter or less, due to cosmic radiation; see <http://www.nirs.org/radiation/tritium/tritiumhome.htm> .)

It must also be emphasized that "permissible" or "allowable" radiation doses, as Petrosky seems to be referring to above, are not necessarily "safe" doses. In fact, as discussed just above concerning the National Academies of Science BEIR VII report, no dose of radiation is "safe."

Petrosky also claimed that "Recent groundwater tests turned up no detectable levels of tritium..." But NRC documents admit that contamination up to 2,900 picocuries per liter of tritium was being detected in site groundwater. [[NRC "Environmental Assessment," 3/11/2005, page 14] Even 2,900 picocuries per liter is more than a hundred times higher than natural background, certainly detectable – and detected, recently.

Petrosky is also quoted in the A.P. article saying "These releases were short-lived radioactivity that naturally dissipated..." The vast amount of artificial radioactivity generated at Big Rock for forty years was not natural. In fact, certain radioactive poisons, such as plutonium, existed only in the most trace amounts in nature on Earth before the Atomic Age artificially generated them in large quantities. One percent or more of the 64 tons of high-level radioactive waste at Big Rock is plutonium – 1,280 pounds of plutonium. [percentage figure from Dr. Arjun Makhijani, Institute for Energy and Environmental Research, Takoma Park, MD] And certain radioactive poisons that both company and NRC documents admit are still present at Big Rock are anything but "short-lived." Tritium, for example, remains hazardous for 120 years. Cesium-137 and Strontium-90 remain hazardous for around 300 years, at a minimum. Plutonium-237 is deadly for 240,000 years; Iodine-129 for 160 million years. Hazardous lives are listed in the table above, on page 27.

A nuclear industry analyst warned that "a third party using more sensitive instrumentation" could identify "residual radioactivity on or in materials" at decommissioning sites such as Big Rock. Thus, better radiation detection tools and monitors could uncover presently unknown or undetected radioactive contamination in the soil, groundwater, plants and animals, Lake Michigan, and its sediments surrounding the Big Rock site. [Jas S. Devgun, Ph.D., Senior Project Engineer/Project Manager, Sargent & Lundy LLC, Chicago, IL, presentation entitled "Impact of Lack of Consistent Free Release Standards on Decommissioning Projects and Costs," at the Waste Management '02 Conference, Feb. 24-28, 2002, Tucson, AZ]

In short, the risks are too high, and the unknowns too great, for the State of Michigan to assume legal liability for the Big Rock site.

# Opportunity Costs: Other Potential Park Sites

The bulk of the \$20 million purchase price for the Big Rock site would come from the state's Natural Resources Trust Fund. This fund contains public money earned from oil and gas revenues and earmarked to enhance public recreational opportunities. Since this proposal competes for limited Trust Fund dollars with many other worthy projects, none of which have such a toxic legacy or security concerns, it requires a careful analysis of the drawbacks and risks.

There are more than 160 applicants for trust fund dollars, many for spectacular lands including sand dunes, wetlands, riverfront and lakefront property and forests – none of which have nuclear waste and radioactive contamination issues. The Trust Fund board members should not shortchange these applicants to invest in a site that will have dangerous radioactive waste for the foreseeable future, and that has a dubious environmental legacy of contamination.

The 351-acre tract would cost the state \$3 million this year, and an additional \$16.3 million in future years. The parkland at Big Rock would exclude a 100-acre “buffer zone” forbidden to the public because of its proximity to 64 tons of highly radioactive nuclear fuel rods patrolled by armed guards.

All told, the request is among \$63 million worth of projects under consideration for the \$35 million available.

Although Big Rock has been declared clean and open for “unrestricted use” by contractors for its owner, Consumers Energy Co., as well as the NRC, questions remain as to the residual contamination and radiation, and the thoroughness of the environmental assessment.

## Conclusion

The many concerns and questions raised above remain unaddressed. The establishment of a state park (or residential development) at Big Rock is not prudent, in terms of public health, safety, and security. With many other applicants offering potential park sites without such complications, the state should not choose to favor this one. We urge the State of Michigan to reject this proposal.