U.S. NUCLEAR REGULATORY COMMISSION
CONSUMERS ENERGY COMPANY
DOCKET NO. 50-155
BIG ROCK POINT NUCLEAR POWER STATION
ENVIRONMENTAL ASSESSMENT AND FINDING OF
NO SIGNIFICANT IMPACT RELATED TO CONSIDERATION OF
A LICENSE TERMINATION PLAN

# 1. INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) is considering issuing an amendment to Facility Operating License No. DPR-6, issued to the Consumers Energy Company (CE) (licensee), that would authorize CE to implement the License Termination Plan (LTP) submitted for the Big Rock Point Power Station (BRP). The NRC prepared this environmental assessment (EA) to determine the environmental impacts (radiological and non-radiological) of approving the LTP and subsequently releasing the site for unrestricted use as defined in 10 CFR 20.1402. See Final Rule "Radiological Criteria for License Termination" (July 21, 1997, 62 FR 39058). This proposed action also is consistent with 10 CFR 50.82 that sets forth the criteria for license termination and the requirement for an LTP. See Final Rule, "Decommissioning of Nuclear Power Reactors (July 29, 1996, 61 FR 39278). The NRC is issuing this environmental assessment and finding of no significant impact pursuant to 10 CFR Part 51. As discussed in Section 1.3 below, the primary goal of this EA is the evaluation of the impacts of the radiation release criteria as presented in the LTP and subsequent termination of the license.

## 1.1 BACKGROUND

The BRP nuclear reactor is a deactivated boiling water nuclear reactor on a site fronting Lake Michigan in Charlevoix County, Michigan, about 7 kilometers (4.25 miles) northeast of the city of Charlevoix. CE owned the reactor that General Electric Company designed. BRP received a provisional operating license in 1962, and operated until 1997; NRC licensed the reactor to operate commercially at 240 megawatts thermal. The licensee submitted a certification of permanent cessation of operations on September 23, 1997. CE completed transfer of the fuel to an onsite Independent Spent Fuel Storage Installation (ISFSI) in March 2003. The spent fuel pool was subsequently drained.

In April 2003, the licensee submitted the LTP (CE, 2003) required by NRC regulations in 10 CFR 50.82, with a goal of completing decommissioning by 2005. CE submitted a subsequent LTP revision in July 2004 (CE, 2004), in response to an NRC request for additional information (RAI) dated February 13, 2004, (NRC, 2004). CE is proposing to decontaminate the BRP site to meet the unrestricted release criteria of 10 CFR 20.1402. CE will demolish all of the structures except those used to support the ISFSI. The resulting concrete demolition debris will be disposed of offsite at an appropriate disposal facility according to the authorization pursuant to 10 CFR 20.2002 (NRC, 2002a). The following structures will remain on the site after

decommissioning is complete: the ISFSI, the ISFSI security building and access road, the reactor cooling water intake pipe in Lake Michigan, portions of the dikes around the discharge canal, and possibly some administrative/office buildings.

## 1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

Licensees of nuclear facilities may apply to the NRC for authority to terminate a license voluntarily and to decommission a facility. CE submitted the LTP, as specified in 10 CFR 50.82. The NRC must determine whether the radiation release criteria and the final status survey planned for completing decommissioning appear sufficient and, if implemented according to the plan, would demonstrate that the site is suitable for release for unrestricted use.

## 1.3 SCOPE

To fulfill its obligations under the National Environmental Policy Act (NEPA), the NRC must evaluate the radiological and non-radiological impacts associated with approval of the LTP and subsequent license termination. As described in the Statements of Consideration accompanying the Final Rule on Decommissioning Nuclear Power Reactors (61 FR 39278, 39284), the NRC must consider the following in order to approve the LTP: (1) the licensee's plan for assuring sufficient funds will be available for final site release; (2) radiation release criteria for license termination; and (3) the adequacy of the final survey to verify that CE has met these release criteria. NRC has reviewed the decommissioning costs to ensure that adequate funds will be available for site decommissioning, and documented this review in the safety evaluation report (SER).

Issues Studied in Detail

The well-defined scope of license termination activities at BRP results in few resource areas expected to be affected. Consistent with NEPA regulations and guidance to focus on environmental issues of concern, land use, water resources, and human health resource areas were selected because of their potential to be affected by license termination. These resource areas are discussed in detail in this EA because of the potential for impacts from residual material left on the site.

### 1.1.1 Issues Eliminated from Detailed Study

For reasons cited above, impacts to air quality, ecological resources (including endangered and threatened species), socioeconomic factors, transportation, noise, visual and scenic quality, waste management, and accident analyses are not expected to be affected by approval of the proposed radiation release criteria and the final status survey. Also, we will not discuss financial assurance in this EA because it is not related to the environment; it is addressed in the SER.

Impacts from decommissioning activities at the BRP site are not evaluated in this document. The NRC assessed decommissioning impacts previously in programmatic NEPA documents. Specifically, the Generic Environmental Impact Statement for Decommissioning (NRC, 1988, 2002b) discussed the range of impacts expected from power plant decommissioning activities Further, the radiological impacts of releasing the site for unrestricted use are bounded by the impacts evaluated in NUREG-1496, "Generic Environmental Impact Statement in Support of

Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities." (NRC, 1997) Impacts from decommissioning activities were also evaluated in BRP's Post Shutdown Decommissioning Activities Report (PSDAR) (CE, 1997).

Additionally, the Commission made a generic determination that, if necessary, licensees can safely store spent fuel generated in any reactor without significant environmental impacts for at least 30 years beyond the licensed life for operation (64 FR 68005; 10 CFR 51.23). Therefore, this EA does not evaluate the environmental impacts of spent fuel storage on the ISFSI.

# 2. THE PROPOSED ACTION AND ALTERNATIVES

## 2.1 THE PROPOSED ACTION

The proposed action is for the NRC to review and approve the licensee's LTP. Before approving the LTP, the NRC staff will review it to ensure that: the radiation release criteria and final status surveys are in accordance with NRC regulations, the licensee protects public health and safety, and there will be no significant impact on the quality of the human environment. If NRC approves the LTP, the approval will be in the form of an amendment to the BRP license.

CE plans to complete decommissioning of BRP for unrestricted use, as described in NRC regulations at 10 CFR 20.1402. To meet the unrestricted release criteria, CE will divide the site into survey units and sample and survey them according to the LTP. This is to verify that the site meets the derived concentration guideline levels (DCGLs), and demonstrate compliance with the release criteria. We discuss the DCGLs below in Sections 3.4, "Human Health" and 4.3, "Human Health Impacts."

## 2.2 NO-ACTION ALTERNATIVE

The NRC considered no-action as an alternative to approval of the LTP. The no-action alternative is for the NRC not to review and approve the LTP, and therefore, not terminate the license, i.e., maintain the status quo. This alternative would result in no change to the current environmental impacts, which are larger than those resulting from the proposed action. This is because all residual contamination at the site could migrate into the environment and potentially contribute to radiological doses beyond the site boundary. Therefore, we eliminate the no action alternative from further consideration in this EA.

This alternative also conflicts with NRC regulations at 10 CFR 50.82, which require the NRC to approve the LTP, by license amendment, if: 1) the LTP shows that the licensee will perform the remainder of the decommissioning activities according to the regulations; 2) it will not be inimical to the common defense and security; and 3) it will not affect the quality of the environment. If the staff determines the LTP does not satisfy NRC regulations, the staff will not approve it. Because of these requirements and NRC's statutory mission to protect public health and safety, the NRC has determined the no-action alternative is not reasonable.

# 3. AFFECTED ENVIRONMENT

## 3.1 SITE DESCRIPTION

Consumers Energy Company owns the Big Rock Point Restoration Project (BRP site) in Charlevoix County, Michigan on 230 hectares (568 acres). It is approximately seven kilometers (4.25 miles) northeast of Charlevoix, Michigan, and approximately 18 kilometers (eleven miles) west of Petoskey, Michigan, on the northern shore of Michigan's lower peninsula. Figure 1 shows the BRP site and Figure 2 shows the industrial area surrounding the reactor. The site has the following general bounds: on the south by an upland area of cleared land used for residential and recreational purposes; on the east by highway U.S. 31 North; on the north by Lake Michigan; and on the west by privately owned land that is wooded and undeveloped. The main power station (industrial) area of the BRP site comprises 6.2 hectares (15.4 acres) of fill immediately adjacent to the lake. This fill surface, which has an elevation of 180.6 meters (592.5 feet) above mean sea level (msl), was placed along a slight embayment of the lake shore, approximately 305 meters (1000 feet) east of the nearest headland (Big Rock Point). The fill area encompasses all of the original operational facilities for the plant, including maintenance and administration buildings. Preconstruction photographs of the main power station portion of the site indicate that the original grade was similar to that found in nearby sections of the shoreline; these other areas are generally 0.6 to three meters (two to 10 feet) lower in elevation, depending on location. A paved road on the east side of the main power station area provides access from U.S. 31 North. The BRP site is within a zone of low topographic relief that parallels the modern Lake Michigan shoreline and locally extends approximately 1.6 kilometers (one mile) inland. This zone was formerly submerged beneath post-glacial Lake Michigan, and a series of recessional beach ridges characterizes the terrain separated by low swampy areas. Elevations within this zone gradually increase from 176 meters (577 feet) msl at the lake shore to a maximum of approximately 213 meters (700 feet) msl. The elevations rise markedly inland (i.e., south) of this zone to more than 274 meters (900 feet) msl eight kilometers (five miles) south of the site.

### 3.1.1 Radiological Contamination

CE characterized the site according to the guidelines of Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, 2000a), including a historical site assessment (HSA); hydrogeological investigation; and measurements, samples and analyses to define the radiological conditions of the site. Surveys and sampling conducted during site characterization are based on biased and judgmental measurements; Chapter 2 of the LTP provides radiological conditions of the site. The results of sample analyses, and the use of the results in identifying the significant radionuclides expected to be present after remediation, are described in LTP Chapter 2, Appendix 2-E.

**FIGURE 1.** BRP Site (ML042080221)

**FIGURE 2.** BRP Industrial Area (ML042080221)

#### 3.1.1.1 Historical Site Assessment

In support of characterization efforts, the licensee conducted a historical site assessment (HSA). The HSA used information from decommissioning records; employee interviews; Health Physics Logbook; corrective action records; previous decommissioning studies; and waste shipment records. The HSA process identified 63 events during the operational life of the plant with known or potential radiological impact on the environment. CE used the results of the HSA to guide remediation activities, and to confirm the appropriateness of the radiological source terms used for the dose model, as more site information is being collected.

#### 3.1.1.2 Scoping Survey

In anticipation of decommissioning, CE performed a radiological scoping survey in 1993 and early 1994. The initial scoping survey effort included the spectrographic analysis of grab samples taken in the Owner-Controlled Area, in-situ measurements of plant and background areas, and installation of nine groundwater monitoring wells. The licensee developed the scoping survey project following the guidance of NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination." (Berger, 1993). CE details survey design, methodology, and findings in the BRP Decommissioning Plan (CE 1995). Following this survey, CE defined Initial Derived Concentration Guideline Level (IDCGL) values to provide conservative guidance for estimating remediation requirements. IDCGLs were developed using the RESRAD version 5.05 computer code based on the resident farmer scenario and the site release criteria of 25 mrem/yr. The information resulting from the scoping survey contributed to development of the HSA. CE summarizes these data in Appendix 2-B of the LTP, Data Event 49; they also provide the current radiological status of these survey areas in Section 2.4.

The licensee conducted a series of sample analyses using site media it believes represents the distribution of radionuclide contaminants, and their decay-corrected distribution, over the operational history of the plant. Tables 2-11 and 2-13 of the LTP identify 24 radionuclides potentially present at the site, including: 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, and Cm-243/244. These radionuclides include fission and activation products, which are typical of those found in boiling water reactor plants and are similar to those radionuclides described in NUREG/CR-3474, "Long-Lived Activation Products in Reactor Materials," ( Evans et al., 1984), and NUREG/CR-4289, "Residual Radionuclide Contamination Within and Around Commercial Nuclear Power Plants," (Carrick and Leale, 1986). Based on dose model assumptions and expected time at which they expect to complete site remediation, the licensee has identified the following radionuclides that could contribute to the dose after license termination: H-3, Mn-54, Fe-55, Co-60, Sr-90, Cs-137, Eu-152, Eu-154, and Eu-155. Accordingly, these radionuclides will form the basis for planning and conducting all final status surveys (FSSs), and demonstrating compliance with the site release criteria. The LTP allows for the possibility of taking and analyzing additional samples as decommissioning activities warrant. If the results of such analyses reveal that radionuclide profiles have changed, BRP will inform NRC at least 30 days before using the new profiles.

#### 3.1.1.3 Area Classification

The Non-Impacted Area of the BRP site ranges from low wetlands with standing water to mature forested uplands. From the Lake Charlevoix watershed divide, groundwater and surface water flow to the north into the Non-Impacted Area and then drain from this higher elevation through the Impacted Area into Lake Michigan. The property is generally inaccessible to motorized traffic and in most locations challenges foot travel. Thick forest and uneven terrain mainly characterize the Non-Impacted Area. Dense vegetation is clearly visible in historical aerial photographs and shows that the present terrain has remained relatively unchanged since plant construction.

The Impacted Property extends approximately 1.6 kilometers (one mile) along the Lake Michigan shoreline and contains an area of 54 hectares (133.4 acres). Most of this property is remote from plant operational activities and has little probability to contain residual radioactivity. CE confines the locations of potential radiological concern to the Industrial Area, an area of less than 10 hectares(24.7 acres) that includes the Protected area, the Radwaste compound, and all material transportation routes and storage locations.

### 3.1.2 Non-Radiological Contamination

The Non-Radiological HSA reviewed the historical impact of site activities, including decommissioning waste management, involving hazardous and regulated materials that have the potential to affect the environment. The licensee developed this study following the data quality objectives (DQO) process. They used applicable guidelines for scoping and site characterization from the Environment Protection Agency's (EPA) Preliminary Assessment and Remedial Investigation/Feasibility Study (RI/FS) Processes and guidelines found in NUREG-1575 as resources in the development of this study.

The licensee did an evaluation to determine if any events required further investigation or action to allow final unrestricted release of the site. It stated that there is no environmental contamination at BRP from non-radiological activities involving hazardous and regulated substances because the response and cleanup to those events that did, or had the potential to, affect the site were completed per applicable regulatory requirements. In its review of the Draft EA, Michigan Department of Environmental Quality stated it did not agree with this assessment. NRC review determined that the licensee has now excavated all hazardous waste and is stockpiling it, pending authorization to ship it to a RCRA authorized landfill. That authorization was issued on January 11, 2005, and the licensee is proceeding with disposal. Therefore, these incidents do not need further investigation because the waste has been collected, and will be disposed in accordance with applicable regulations. MDEQ has reviewed the licensee actions to consolidate the waste and its plans to ship it to a licensed waste facility and determined that those measures resolve its concerns. As the decommissioning process continues and the licensee dismantles buildings, CE will consider the need for additional samples in the gravel and soil beneath structures that pose the highest non-radiological risk to the environment to confirm that no impact has occurred. These locations include the Screenhouse, Containment Building, Turbine Building, I & C Lab, Track Alley, and underground storage tank areas.

## 3.2 Land Use

Figure 8-3 of the LTP shows the general land use surrounding BRP. The lakeshore of Little Traverse Bay in Lake Michigan is highly developed for summer home and recreational uses; there currently are no Lake Michigan shoreline farms within 32 kilometers (20 miles) of Charlevoix. Only 10 percent of Charlevoix County land is used for agricultural purposes and the county has an established trend in declining land use for agricultural purposes. Also, lakeshore soils in the area are poorly suited for subsistence farming because the soil is gravelly-sandy loam containing low natural fertility and having a moderately low organic content. Finally, current high property values on the lakeshore would effectively preclude use of the site for subsistence farming. It is most likely that the future use of the site would be resort or recreational use.

Vegetation in this area consists largely of wooded areas and open fields. Few farms are in the area immediately surrounding the plant site. Commercial land use consists primarily of small businesses in or near the city of Charlevoix. Several small industrial sites exist within the 8 kilometer (5 mile) radius. Several medium-density residential developments are east of the plant. The remainder of the land comprises residential and vacation homes scattered throughout the area. Four schools and a hospital are within 8 kilometers (5 miles) of the plant. Also, there are a variety of public recreation areas, including parks and golf courses, and several large bodies of water with marinas within 8 kilometers (5 miles) of the plant.

US Route 31 connects the cities of Charlevoix and Petoskey and provides access to the plant. A small airport serving the area is south of Charlevoix along US Route 31.

## 3.3 Water Resources

We divide the discussion of water resources into surface water and groundwater. The sections that follow provide a summary overview of the characteristics of each at and near the BRP site.

### 3.3.1 Surface Water

#### 3.3.1.1 Major Bodies of Water

The primary body of water near the plant is Lake Michigan. Lake Michigan has a surface area of approximately 57,757 square kilometers (22,300 square miles) and a maximum recorded depth of 281 meters (923 feet). Lake Charlevoix, an inland extension of Lake Michigan, is about five and a half kilometers (three miles) south. Susan Creek, which flows north from Susan Lake into Lake Michigan, is just east of the plant. Lake Charlevoix has a surface area of 6880 hectares (17,000 acres), and Susan Lake has a surface area of about 52.6 hectares (130 acres).

#### 3.3.1.2 Drainage Ditch

The Drainage Ditch is a seasonal stream just west of the Protected Area; it is less than one meter wide and extends approximately 370 meters (1214 feet) from the northern boundary of the Non-Impacted Area to Lake Michigan. Surface waters from wetland elevations to the south concentrate in low areas along the railroad grade and flow north into the Industrial Area. The facility diverts stormwater runoff around the Protected Area to the Drainage Ditch that discharges into Lake Michigan. The Drainage Ditch also receives water from a series of catch

basins and corrugated metal piping that remove storm water from buildings and parking lots in the Industrial Area. Subsurface structures and components include storm water culverts and piping. Septic piping and electrical conduits traverse the stream in limited areas.

#### 3.3.1.3 Discharge Canal

The plant Discharge Canal enters Lake Michigan north of the Owner-Controlled Area and extends from the Screenhouse to the normal beach contour line. The Discharge Canal is the licensed release pathway for liquid effluents. This area is approximately 600 square meters (6460 square feet) in size and includes the submerged area from the Discharge Canal bottom to the water's edge. Normal water depths in the Discharge Canal range from 1.2 to 2.1 meters (4 to 7 feet); however, current near-record lows in Lake Michigan water levels have greatly reduced this depth. The licensee performs environmental monitoring of effluents, surface waters and sediment according to site procedures. Radioactivity originating from licensed liquid release is present in this area; characterization surveys identified elevated levels of radioactivity concentrated in the sediment below the water's surface.

CE has detected no radionuclides of plant origin in surface water at the plant site, other than those detected in samples taken at the discharge weir during permitted releases to the Discharge Canal. Consequently, surface waters do not require remediation. CE will remediate discharge canal sediments, the only place that radionuclides of plant origin remain from those permitted discharges, as discussed in LTP Section 4.2.2.1.

### 3.3.2 Groundwater

The licensee routinely monitors surface and subsurface waters following the BRP Radiological Environmental Monitoring Program (REMP). In addition, the Hydrogeological Assessment conducted in 2002 (CE, 2002) provided an evaluation of groundwater movement through the site subsurface geology. This evaluation identified migration pathways of potential contaminants in groundwater within the Industrial Area. The Hydrogeological Assessment and associated radiological measurements performed in this study provide sufficient information to define the range, concentration, and migration of contaminants in subsurface hydrology. They detail this evaluation in Sections 2.4.3, and 2.4.5.3. of the LTP.

#### 3.3.2.1 Description

As shown in Figure 2-5 of the LTP, the upper 4.5 meters (15 feet) of soil are fill material and native soils ranging from coarse gravel and cobble to fine clayey sands. A thick layer of sandy clay extends to bedrock from this upper soil stratum. Two shallow, groundwater bearing zones are typically encountered within 7.6 meters (25 feet) of grade elevation. The Hydrogeological Report identifies three groundwater bearing zones at the site: i) the lower portion of the near-surface sand and gravel layer (Units 6a, 6b; e.g., bottom one to 1.5 meters [3-5 feet]); ii) the intermediate depth sand layer (Unit 4); and iii) the underlying fractured limestone bedrock (Unit 1). The uppermost groundwater bearing zone is unconfined, while the other two zones are confined. South of the main power station, in the undeveloped portion of the BRP site, is the inferred entry point for the groundwater found in the uppermost zone. Much of this area is low, wetland terrain and a significant portion of the precipitation falling in this area likely infiltrates the soil and enters the shallow groundwater zone. Groundwater entry points for the other two units are further to the south, where the topography rises about 20 meters (65 feet), at varying

distances from the main power station area. The groundwater flow in all three units is northerly into Lake Michigan. The lowermost bedrock aquifer (Unit 1) consists of separate upper and lower flow zones. On the south side of the site it is about 26 meters (85 feet) below grade level (bgl) at piezometer well 1D and is characterized by primarily horizontal groundwater flow from the source area northward toward Lake Michigan. Because of the irregular bedrock topography, the upper bedrock zone is encountered only on the north side of the site. It is about 15 meters (50 feet) bgl at piezometer wells 2D and 3D, and is apparently isolated from the groundwater source to the south by low permeability, unconsolidated sediments. The licensee assumes it receives groundwater flow vertically upward from the lower bedrock zone.

The near-surface location of the two upper groundwater bearing units bans their use as sources of drinking water. The limited thickness, thus total flow capacity, of these same two units also inhibits their use as sources of non-potable water for irrigation or other purposes. The fractured bedrock zone is considered the main drinking water aquifer at the site, and a potential source of non-potable water.

#### 3.3.2.2 Groundwater Movement

Horizontal groundwater movement in all three water bearing zones moves generally northward though the main power station area and into Lake Michigan. Licensee analysis of hydraulic head contour maps provides additional quantitative information regarding horizontal groundwater flow. The shallow water bearing zone yields a horizontal flow direction of slightly east of north with a horizontal hydraulic gradient of 0.015. The intermediate water bearing zone flow direction is north-northwest with a horizontal gradient of 0.028. Constructing a contour map for the lower bedrock aquifer was not possible because of the different completion depths of the bedrock peizometers; however, horizontal hydraulic gradients for the upper and lower bedrock aquifer zones were estimated from the bedrock piezometer well data. Data suggests that the bedrock aquifer flows north into Lake Michigan with an estimated horizontal gradient of 0.019.

Vertical groundwater movement was evaluated by investigation of hydraulic head differences using nested piezometer well pairs installed at three locations across the site (PZ-1, PZ-2, and PZ-3; see Figure 3). Comparison of the hydraulic heads in the nested piezometer wells shows that vertical head differences occur at all three locations. At the locations south of the Containment Building (PZ-1 and PZ-2), the head differences from nested wells indicate upward directed vertical components of flow above the intermediate sand unit and downward vertical flow components below the intermediate sand unit. At the location north of the Containment Building (PZ-3 location), the head differences from nested wells indicate downward vertical flow components both above and below the intermediate sand unit. Vertical hydraulic gradient data vary in magnitude both above and below the intermediate sand layer. The overall downward vertical gradient in the area north of the containment sphere indicates the potential for downward migration of mobile constituents from the surface or shallow water bearing zones to the bedrock groundwater bearing zone.

#### 3.3.2.3 Effect of Building Foundations on Groundwater Flow

According to plant construction drawings, the foundations of several buildings extend far enough below grade to intersect one or more of the water bearing units. Likely penetrations of the water bearing units occur at the Containment Building, Screenhouse Building, Liquid Radwaste Processing Vault, and Turbine Building. The concrete foundations of these buildings

**FIGURE 3** BRP Ground Water Monitoring Wells (ML042080221)

represent impermeable barriers that impede the normal (south to north) groundwater flow within the respective water bearing units. The presence of such barriers is expected to cause localized changes in the horizontal flow directions within the individual layers, and may provide opportunities for vertical movement between the different layers. Preferential migration of groundwater, both vertically and horizontally, is also increased because of disturbance of the soils surrounding the building foundations by construction activities.

The containment structure is 41.76 meters (137 feet) in diameter and is set 11.3 meters (37 feet) below grade. Therefore, this building would likely have the greatest effect of the horizontal groundwater flow, particularly within the shallow groundwater unit. The presence of additional foundation structures at upgradient locations of the Turbine Building and the Liquid Radwaste Vault structure present a complicated flow regime, which could result in groundwater flow stagnation zones in the area south of the Containment Building. The Containment and Screenhouse Buildings intersect the upper shallow groundwater bearing zones. These penetrations, combined with the downward vertical gradients existing on the north side of the main power station, provide the potential for a vertical mixing of groundwater and a downward migration of mobile contaminants in this area. Dewatering activities using extraction wells and temporary barriers to groundwater flow -- an interceptor trench -- will be used before and during building demolition. Groundwater flow is not expected to be adversely influenced beyond the demolition interval.

#### 3.3.2.4 Ground Water Contamination

Sample analyses identified tritium as the only radionuclide present in groundwater at BRP. CE found tritium concentrations in all three groundwater zones north of the Turbine Building, in a corridor less than 100 meters (330 feet) wide. This corridor extends approximately 140 meters (460 feet) north to the site boundary at Lake Michigan. The location of highest contaminant concentration within these three zones is near the centerline of the Containment Building near the concrete base pad. Tritium concentrations decrease at the test well locations north of the Containment Building compared with shallow wells south of containment. The source of groundwater contamination is believed to be the condensate leak beneath the Turbine Building in 1984, described in LTP Section 2.2.5.3(c). Shallow groundwater below the Turbine Building is held in place above a dense layer of thick clay, and the deep foundation walls of this building provide a mechanism for confinement. CE postulated that contaminated water from this event has been contained in this area and is slowly migrating north, via pathways around Turbine and Containment Building foundations and footings. Further investigations of shallow groundwater contaminant migration are ongoing; additional information/data for groundwater survey results will be maintained according to Site Characterization Plan requirements. Groundwater discharge to Lake Michigan is allowed by the National Pollution Discharge Elimination System (NPDES) Permit.

At the current time, no tritium above the U. S. Environmental Protection Agency (EPA) drinking water guidelines has been detected in the aquifer suitable as a drinking water supply; the maximum detected concentration in the potential drinking water aquifer is 1560 picoCuries per liter (pCi/l), well below the EPA guideline of 20,000 pCi/l. Twenty monitoring wells are used to monitor for tritium and other potential radionuclides in groundwater. Three additional wells to monitor Units 3, 4 and 5 were installed in June, 2004 in response to NRC RAIs. No other radionuclides have been detected in groundwater at greater than environmental LLD levels.

CE performed a groundwater sampling event in November 2003 to evaluate potential plant-generated radionuclides in their industrial area. The NRC selected six of these wells to collect split samples, and NRC's independent laboratory, Oak Ridge Institute for Science and Education (ORISE), analyzed these water samples for the above radionuclides and gross alpha and gross beta. The only significant analytical results above either the minimum detection concentrations or background levels in the groundwater were three groundwater samples that were above the background levels of 200 to 400 pCi/L for tritium. The tritium in these four samples ranged from 770 to 2900 pCi/L. These concentrations of tritium are significantly below the EPA Primary Drinking Water Standard for tritium.

## 3.4 Human Health

CE's intent for decommissioning activities at BRP is to reduce radiological contamination at the site to meet NRC's unrestricted release criteria. Unrestricted use of the site is defined in 10 CFR 20.1402:

> A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE [total effective dose equivalent] to an average member of the critical group that does not exceed 25 mrem [millirem] (0.25 mSv) [milliSievert] per year, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). . . .

The licensee calculated the DCGLs for the BRP site using dose models based on guidance in NUREG-1727 "NMSS Decommissioning Standard Review Plan " (NRC, 2000b), and NUREG-1757, "Consolidated NMSS Decommissioning Guidance," Volume 2 (NRC, 2003), and the computer code RESRAD version 6.21. These dose models translate residual radioactivity into potential radiation doses to the public, based on select land-use scenarios, exposure pathways, and identified critical groups. A critical group is defined as the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity given the assumptions of a given scenario. To ensure a high level of conservatism, such scenarios and their associated modeling are designed to overestimate, rather than underestimate, the potential dose.

### 3.4.1 Dose Modeling Summary

Because all buildings, above and below-grade structures, and equipment within the industrial area will be demolished and removed from the site, CE selected a modified resident farmer scenario to develop site-specific soil DCGLs for BRP. Because of site-specific environmental parameters, the modified residential farmer scenario is considered a conservative dose model for the BRP site. Chapter 6 of the LTP, *Compliance with the Radiological Criteria for License Termination*, contains the basis and results of dose modeling that CE performed for BRP; it also describes modifications of the standard resident farmer scenario to exclude meat and milk pathways. Table 5-1 of the LTP, reproduced below, provides a list of all potential radionuclides that may be present in onsite soils and the corresponding DCGLs.

**Table 5-1. BRP Site-Specific Radionuclides and Soil DCGL Values**

| Radionuclide | 25 mrem/yr Limit Open Land Areas (Surface and Subsurface Soils) (pCi/g) |
|---|---|
| H-3 | 3.27 E+02 |
| Mn-54 | 1.37 E+01 |
| Fe-55 | 3.58 E+05 |
| Co-60 | 3.21 E+00 |
| Sr-90 | 2.48 E+00 |
| Cs-137 | 1.32 E+01 |
| Eu-152* | 7.35 E+00 |
| Eu-154* | 6.78 E+00 |
| Eu-155* | 2.87 E+02 |

* Europium is included due to the potential to contaminate soil from concrete demolition activities.

# 4. ENVIRONMENTAL IMPACTS

## 4.1 Land Use

Termination of the BRP license is not expected to result in any adverse impacts to onsite and adjacent land use. Land use on and directly adjacent to the BRP site is expected to remain diverse and continue to include residential, commercial, summerhouses, and idle farmland and forest. Offsite land uses around the towns of Charlevoix and Petosky will continue with fishing, hunting, shell fishing, tourism, and recreation.

## 4.2 Water Resources

No potentially significant, adverse impacts to either surface or groundwater are expected from remediation activities, and subsequent license termination, at the BRP site.

### 4.2.1 Surface Water

Land areas from which precipitation runs off to surface waters will be subject to further investigations and remediation if necessary. CE will conduct the Final Status Survey according to LTP Section 5 to verify that DCGLs have been met, thus demonstrating compliance with the release criteria.

Before license termination, CE will reduce the paved-over area by approximately 7 hectares (17 acres) primarily by revegetation of areas currently occupied by buildings, roads, and parking lots. Until decommissioning is complete, effluent discharges would continue to be monitored for

compliance with discharge standards. The current Pollutant Discharge Elimination System permit reflects the decommissioning activities. Storm water outfall discharges associated with the construction activity of decommissioning are authorized under the EPA's Storm Water Construction Permit. Both the existing water supply system and sewage system would remain in place.

#### 4.2.2 Ground Water

If the remediation and decontamination of this site and its structures increase the level of plant-generated radionuclides dissolved in the groundwater, the monitoring program at this facility should detect this change. During the remediation, the current monitoring plan of quarterly sampling will be in effect. Because several monitoring wells will be abandoned during the remediation activities, new monitoring wells were installed to characterize potential changes in the level of plant-generated radionuclides dissolved in the groundwater. Additional wells will be installed, if necessary, to maintain the current sampling capability.

### 4.3 Human Health Impacts

Compliance with 10 CFR Part 20.1402 for unrestricted release requires removal of contamination in soil and groundwater to residual concentrations that correspond to a total dose of 0.25 mSv/yr (25 mrem/yr) or less to an average member of the critical group. In addition, residual radioactivity must meet the ALARA requirements of the rule. The licensee has shown compliance by defining acceptable levels for various sources of residual radioactivity at the site. These acceptable levels are the Derived Concentration Guideline Levels (DCGLs). Structures, foundations, paved surfaces and buried piping and utilities will be removed before the final status survey for each specified survey area. Therefore, the scope of the analyses is limited to calculating annual dose resulting from surface and subsurface soil and groundwater contamination.

The DCGLs were derived using the radiation doses per unit activity. Each DCGL was selected at a fraction of the limit so that the total dose to the average member of the critical group from all sources would meet the limit. Because of the conservatism in both the modeling and the assumption that the entire source would have residual radioactivity at the DCGL, any actual doses would likely be much less than the limit. If the licensee demonstrates compliance with the limit through the results of the FSS, there will be no anticipated adverse impacts to human health from approval of the license termination plan and subsequent termination of the license.

CE's approach to deriving the DCGLs is documented in Chapter 6 of the LTP. Before approving the LTP, the NRC will ensure the adequacy of the DCGLs in providing protection for members of the public after the site is released for unrestricted use. The DCGLs were developed for each source, accounting for the expected abundance of each radionuclide. Soil sampling and analysis have demonstrated that direct measurements of Cs-137 and Co-60 can be used as surrogates for estimating levels of other contaminants that may be present, but hard to detect, in BRP soils. Use of this surrogate approach accounts for the dose from all relevant radionuclides, not just those measured.

The Historical Site Assessment (HSA) and the Site Characterization showed that most of the site area contains no residual radioactivity that is distinguishable from background radiation. Therefore, compliance with the unrestricted use criteria for these areas will be demonstrated by

comparison of the FSS results with published unrestricted release screening criteria in NUREG-1757, Volume 2, Appendix H. However, residual radioactivity has been identified in surface and subsurface soil and in groundwater within the Industrial Area of the site. Because these areas do not meet the criteria for using screening values, site-specific DCGLs were established as described above. CE performed an analysis to identify a suite of radionuclides that are potentially present in site soils and groundwater following completion of decommissioning activities and structure demolition. This analysis considered radionuclides identified in two different companion guides: NUREG/CR-3474, "Long-Lived Activation Products in Reactor Materials," and NUREG/CR-4289, "Residual Radionuclide Contamination Within and Around Commercial Nuclear Power Plants."

CE performed an evaluation of radionuclides that may be discounted at BRP. Based on this evaluation, individual radionuclides that contributed less than 0.1 percent of the total activity and those with half-lives less than 244 days were discounted from the list of identified radionuclides, if that dose contributed by the sum of these radionuclides does not exceed 1 percent of the total calculated dose. The total percentage of activity from radionuclides that meet these criteria is 0.065 percent.

The critical group for site-specific analysis of the Industrial Area is the modified resident farmer. This individual lives on the site and grows some of his or her diet in an adjacent garden and uses water tapped from the onsite bedrock (deep) aquifer. However, this resident would not consume animal products grown onsite.

This land use scenario accounts for exposure involving residual radioactivity that is initially in the surficial soil. The pathways for exposure are the following:

- External exposure to penetrating radiation from volume soil sources while outdoors,
- External exposure to penetrating radiation from volume sources while indoors,
- Inhalation exposure to resuspended soil while outdoors,
- Inhalation exposure to resuspended soil while indoors,
- Inhalation exposure to resuspended surface sources of soil tracked indoors,
- Direct ingestion of soil,
- Inadvertent ingestion of soil tracked indoors,
- Ingestion of drinking water from a contaminated groundwater source,
- Ingestion of plant products grown in contaminated soil,
- Ingestion of plant products irrigated with contaminated groundwater, and
- Ingestion of fish from a contaminated surface water source.

To compensate for tritium contamination in subsurface water in the three groundwater zones, CE subtracted the calculated dose of 0.782 mrem/yr from tritium from the unrestricted release limit of 25 mrem/yr. Therefore, for license termination the DCGL limit is 24.218 mrem/yr. The licensee used RESRAD version 6.21 in the deterministic mode to calculate the dose per unit concentration values using the site-specific input parameters. Although MARSSIM is directly applicable only to surface soil contamination ($\leq$15 centimeters (six inches)), CE demonstrated that applying surface soil DCGL values to subsurface soils down to depths of 10.7 meters (35 feet) is conservative. This calculation resulted in the surface soil DCGL values listed in Table 6-10 of the LTP, reproduced below.

Table 6-10. Site-Specific Surface Soil DCGL Values

| Radionuclide | DCGL Value (pCi/g) | Radionuclide | DCGL Value (pCi/g) |
|---|---|---|---|
| H-3 | 327 | Cs-137 | 13.2 |
| Mn-54 | 13.7 | Eu-152 | 7.36 |
| Fe-55 | 3.58E+05 | Eu-154 | 6.79 |
| Co-60 | 3.21 | Eu-155 | 287 |
| Sr-90 | 2.48 | | |

The NRC evaluated the appropriateness of the postulated exposure scenarios and the methodology used for deriving the DCGLs. The staff has concluded that the licensee has not underestimated any potential radiation exposures from residual radioactivity present after license termination and these protect public health. The NRC staff's Safety Evaluation Report will provide more details.

CE will use the FSS to demonstrate compliance with the radiological release criteria consistent with the MARSSIM. Planning for the FSS involves an iterative process that requires two steps: 1) appropriate site classification based on the potential residual radioactivity levels compared with the DCGLs, and 2) formal planning using the Data Quality Objective process. The licensee committed to an integrated design that will address the selection of appropriate survey and laboratory instrumentation and procedures; this includes a statistically-based measurement and sampling plan for collecting and evaluating the data needed for the FSS. The staff has determined that the sampling strategy and survey data evaluation methodology presented in the LTP are adequate.

### 4.4 Cumulative Impacts

The NRC approval of the BRP LTP, the proposed action, combined with known effects on resource areas at the site, is not anticipated to result in any cumulative impacts. The decommissioning and remediation of the BRP facility, and subsequent release of the site for unrestricted use, would reduce the opportunity for potential negative cumulative impacts.

## 5. AGENCIES AND PERSONS CONSULTED AND SOURCES USED

The draft Environmental Assessment was provided to the State of Michigan for comment. Both the Department of Environmental Quality (MDEQ) and the State Historic Preservation Office (SHPO) provided comments; these are discussed below. Staff also consulted with the U.S. Fish and Wildlife Service (U.S. FWS). Their comments are also discussed below.

In its letter dated October 18, 2004, the SHPO noted that the BRP facility was eligible for the National Register of Historic Places (NRHP), therefore demolition of the facility was an adverse effect. Further, the SHPO stated that, because demolition began before completion of the section 106 process required by the National Historic Preservation Act, a memorandum of agreement was necessary to resolve the issues. The SHPO also noted that there are two properties on the grounds of the Big Rock Point nuclear facility that meet the criteria for listing in the NRHP: 20CX170, a prehistoric Native American site near the sanitary sewer drainfield; and

20CX177, a Traditional Cultural Property represented by the Big Rock and the surrounding area, which is a traditional seasonal gathering place for Odawa Indian people.

The SHPO and BRP have reached agreement on all the SHPO's concerns related to direct decommissioning activities and agree that BRP may proceed with dismantlement of the facility. However, the issues of Native American access to the Big Rock and potential existence of relics near the drain field will be the subject of a memorandum of agreement (MOA), as specified in 36 CFR 800.6, Resolution of Adverse Effects, that states, in part: "A memorandum of agreement executed and implemented pursuant to this section evidences the agency official's compliance with section 106 ...." This MOA must be executed before implementing any actions that alter the definition of the site in the NRC license. The SHPO also seeks early notification to the SHPO of any licensee actions that will include site demolition. NRC will review its procedures for notifying stakeholders of licensee actions, including SHPOs.

The Michigan Department of Environmental Quality provided input related to remediation of non-radioactive, hazardous waste. Based on material found by the licensee in the powerline corridor, MDEQ did not agree with the statement in Section 3.1.2 that no hazardous waste at the site required remediation. MDEQ has reviewed the licensee actions to consolidate the waste and its plans to ship it to a licensed waste facility and determined that those measures resolve its concerns. That section of the EA has been revised to respond to this comment.

The U.S. FWS indicated that, on the basis of current information, there are no endangered, threatened, proposed, or candidate species, or critical habitat occurring within the proposed project areas. Therefore, there is no need for further action on this project under Section 7 of the Endangered Species Act (ESA) at this time. It also notes however, that should new information become available before the project is complete that indicates listed or proposed species may be present and/or affected, consultation should be reinitiated.

The NRC staff has determined, based on the scope of this action and U.S. FWS review, that the proposed action will not affect listed species or critical habitat. Therefore, it is unlikely that further consultation under Section 7 of the ESA will be necessary prior to completion of this action.

## 6. CONCLUSION

The NRC has prepared this EA (ADAMS Accession No: ML042890054) related to issuing a license amendment to Facility Operating License No. 50-155, approving the LTP. On the basis of this EA, the NRC has concluded that there are no significant environmental impacts and the license amendment does not warrant the preparation of an Environmental Impact Statement. Accordingly, it has been determined that a Finding of No Significant Impact is appropriate.

## 7. LIST OF PREPARERS

J. Shepherd, Project Engineer, Division of Waste Management and Environmental Protection.

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## 8. LIST OF ACRONYMS

| | |
|---|---|
| ALARA | As Low As is Reasonably Achievable |
| bgl | below ground level |
| BRP | Big Rock Point (reactor site) |
| CE | Consumers Energy |
| CFR | Code of Federal Regulations |
| DCGL | Derived Concentration Guideline Limit |
| dpm/100cm$^2$ | disintegrations per minute per 100 square centimeters |
| DQO | Data Quality Objective |
| EA | Environmental Assessment |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| FR | Federal Register |
| FSS | Final Status Survey |
| FWS | U.S. Fish and Wildlife Service |
| HSA | Historical Site Assessment |
| IDCGL | Initial Derived Concentration Guideline Limit |
| ISFSI | Independent Spent Fuel Storage Installation |
| LLD | Lower Limit of Detection |
| LTP | License Termination Plan |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| MDEQ | Michigan Department of Environmental Quality |
| MOA | memorandum of agreement |
| mrem/y | millirem per year |
| mSv/yr | milliSievert per year |
| NEPA | National Environmental Policy Act |
| NPDES | National Pollution Discharge Elimination System |
| NRC | Nuclear Regulatory Commission |
| NRHP | National Register of Historic Places |
| ORISE | Oak Ridge Institute for Science and Education |
| pCi/L | picocurie per Liter |
| PSDAR | Post Shutdown Decommissioning Activities Report |
| RAI | request for additional information |
| RCRA | Resource Conservation and Recovery Act |
| SHPO | State Historic Preservation Officer |
| TEDE | Total Effective Dose Equivalent |

## 9. REFERENCES


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10 CFR 51. Code of Federal Regulations, Title 10, Energy, Part 51, “Environmental protection regulations for domestic licensing and related regulatory functions.”

36 CFR 800. Code of Federal Regulations, Title 36, Interior, Part 800, “Protection of Historic Properties.”

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