Appendix E

Applicant's Environmental Report
Operating License Renewal Stage

Davis-Besse Nuclear Power Station

August 2010

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Acronyms and Abbreviations

Acronym	Definition
AADT	annual average daily traffic
AEC	Atomic Energy Commission
BSBO	Black Swamp Bird Observatory
BVPS	Beaver Valley Power Station
Btu	British thermal unit
°C	degrees Celsius
CDF	core damage frequency
CEQ	Council on Environmental Quality
CET	containment event tree
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CO_2	carbon dioxide
CWA	Clean Water Act
CWS	Circulating Water System
Davis-Besse	Davis-Besse Nuclear Power Station
DSM	demand-side management
EFH	Essential Fish Habitat
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
ER	environmental report
ESA	Endangered Species Act
°F	degrees Fahrenheit
FBC	Fluidized-bed-combustion
FE	FirstEnergy Corporation
FENGenCo	FirstEnergy Nuclear Generation Corp.
FENOC	FirstEnergy Nuclear Operating Company
FERC	Federal Energy Regulatory Commission

Acronyms and Abbreviations
(continued)

Acronym	Definition
FES	Final Environmental Statement
fps	feet per second
ft^3	cubic feet
gal	gallon
GEIS	Generic Environmental Impact Statement
gpd	gallons per day
gpm	gallons per minute
IGCC	integrated gasification combined cycle
IPA	Integrated Plant Assessment
kWh	kilowatt-hour
kV	kilovolt
lb	pound
lb/MMBtu	pounds per million British thermal units
LOS	level of service
m^3	cubic meters
mA	milliampere
MAAP	Modular Accident Analysis Program
MACCS2	MELCOR Accident Consequence Code System
MDC	Minimum Detection Concentration
mg/l	milligrams per liter
mgd	million gallons per day
MM	million
MSW	municipal solid waste
MW	megawatt
MWd/MTU	megawatt-days per metric ton uranium
MMBtu	million British thermal unit
MWe	megawatts-electric
MWh	megawatt-hour

Acronyms and Abbreviations
(continued)

Acronym	Definition
MWt	megawatts-thermal
NAAQS	National Ambient Air Quality Standards
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRR	Office of Nuclear Reactor Regulation
OAC	Ohio Administrative Code
OCMP	Ohio Coastal Management Program
ODCM	Off-site Dose Calculation Manual
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
ONWR	Ottawa National Wildlife Refuge
OPSB	Ohio Power Siting Board
pCi/L	picoCuries per liter
PDS	plant damage state
PEIS	programmatic environment impact statement
PCBs	polychlorinated byphenyls
PM	particulate matter
PM_{10}	particulates with diameters less than 10 microns
$PM_{2.5}$	particulates with diameters less than 2.5 microns
ppb	parts per billion

Acronyms and Abbreviations
(continued)

Acronym	Definition
ppm	parts per million
ppt	parts per thousand
PRA	probabilistic risk assessment
psig	pounds per square inch gauge
rms	root mean square
RC	release category
RCS	Reactor Coolant System
ROW	Right of Way
SAMA	Severe Accident Mitigation Alternatives
scf	standard cubic feet
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SO_x	sulfur oxides
SU	standard units
SWS	Service Water System
USACE	U.S. Army Corps of Engineers
USAR	Updated Safety Analysis Report
USCB	U.S. Census Bureau
USDOD	U.S. Department of Defense
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USOSHA	U.S. Occupational Safety and Health Administration
wt%	percent by weight
yr	year

1.0 INTRODUCTION

1.1 PURPOSE OF AND NEED FOR ACTION

FirstEnergy Nuclear Operating Company (FENOC) prepared this Environmental Report (ER) to support renewal of the Class 103 facility operating license for Davis-Besse Nuclear Power Station, Unit 1 (Davis-Besse) (facility operating license NPF-3) for a period of 20 years beyond the expiration of the current license term. License renewal would extend the facility operating license from midnight on April 22, 2017, to midnight on April 22, 2037. Davis-Besse Operating License NPF-3 was issued on April 22, 1977, and the plant began commercial operation on July 31, 1978 (**FENOC 2010**, Section 1.1). Per 10 CFR 50.51, the license allows the plant to operate up to 40 years, and may be renewed for a period of up to an additional 20 years (10 CFR 54.31).

For license renewal, the U.S. Nuclear Regulatory Commission (NRC) has defined (**NRC 1996a**, Page 28,472) the purpose and need for the proposed action as follows:

> *The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decision makers.*

The proposed action would provide FENOC the option to operate Davis-Besse for an additional 20 years beyond the current licensed operating period.

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1.2 ENVIRONMENTAL REPORT SCOPE AND METHODOLOGY

NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled *Applicant's Environmental Report - Operating License Renewal Stage*. This report fulfills that requirement and is an appendix to the Davis-Besse license renewal application.

The requirements regarding information to be included in the environmental report (ER) are codified in 10 CFR 51.45 and 51.53(c). Table 1.2-1 lists the regulatory requirements and identifies the ER sections that respond to the requirements. In addition, affected ER sections are prefaced by a boxed quote of the relevant regulatory language.

The ER has been developed to meet the format and content of Supplement 1 to Regulatory Guide 4.2 (**NRC 2000**). Additional insight regarding content was garnered from the NRC's Generic Environmental Impact Statement (GEIS) for license renewal (**NRC 1996b**) and standard review plans for environmental reviews (**NRC 1999**), and supplements to the GEIS.

Table 1.2-1: Environmental Report Responses to License Renewal Environmental Regulatory Requirements

Regulatory Requirement	Description	ER Section(s)
10 CFR 51.53(c)(1)	Operating license renewal stage ER.	Entire Document
10 CFR 51.53(c)(2)	Proposed action description.	3.0
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(3)	Environmental impacts and comparison of alternatives.	7.3, 8.0
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(1)	Proposed action impact on the environment.	4.0
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2)	Unavoidable adverse environmental impacts.	6.3
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(4)	Local short-term uses vs. long-term productivity of the environment.	6.5
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(5)	Irreversible and irretrievable commitments of resources.	6.4
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	Environmental analysis of the proposed action and mitigating actions,	4.0, 6.2
	environmental impacts of alternatives, and	7.3
	alternatives available for reducing or avoiding adverse environmental effects.	8.0
10 CFR 51.53(c)(2) and 10 CFR 51.45(d)	Status of compliance.	9.0
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2) and (e)	Proposed action impact on the environment and unavoidable adverse impacts.	4.0, 6.3
10 CFR 51.53(c)(3)(ii)(A)	Water use conflicts (plants using cooling towers or ponds and withdrawing from a small river).	4.1, 4.6
10 CFR 51.53(c)(3)(ii)(B)	Entrainment, impingement, and heat shock assessment (plants using once-through cooling or cooling ponds).	4.2, 4.3, 4.4
10 CFR 51.53(c)(3)(ii)(C)	Groundwater use conflicts (plants using Ranney wells or >100 gpm groundwater).	4.5, 4.7

Table 1.2-1: Environmental Report Responses to License Renewal Environmental Regulatory Requirements
(continued)

Regulatory Requirement	Description	ER Section(s)
10 CFR 51.53(c)(3)(ii)(D)	Groundwater quality degradation.	4.8
10 CFR 51.53(c)(3)(ii)(E)	Impact of refurbishment on terrestrial resources, and	4.9
	threatened or endangered species.	4.10
10 CFR 51.53(c)(3)(ii)(F)	Assessment of air quality during refurbishment (nonattainment areas).	4.11
10 CFR 51.53(c)(3)(ii)(G)	Impact on public health from thermophilic organisms.	4.12
10 CFR 51.53(c)(3)(ii)(H)	Potential shock hazard from transmission lines.	4.13
10 CFR 51.53(c)(3)(ii)(I)	Assessment of refurbishment on housing,	4.14
	public water supply,	4.15
	public schools, and	4.16
	land use.	4.17
10 CFR 51.53(c)(3)(ii)(J)	Assessment of local highway traffic during refurbishment.	4.18
10 CFR 51.53(c)(3)(ii)(K)	Assessment of historic or archaeological properties.	4.19
10 CFR 51.53(c)(3)(ii)(L)	Alternatives to mitigate severe accidents.	4.20
10 CFR 51.53(c)(3)(iii)	Reducing adverse impacts.	6.2
10 CFR 51.53(c)(3)(iv)	New and significant information.	5.0
10 CFR Part 51, Appendix B, Table B-1, Footnote 6	Environmental Justice.	2.6.2, 4.21

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1.3 DAVIS-BESSE NUCLEAR POWER STATION LICENSEE AND OWNERSHIP

Davis-Besse is owned by FirstEnergy Nuclear Generation Corp. (FENGenCo). Both FENGenCo and FENOC are the licensees. FENOC is the applicant and, acting on behalf of FENGenCo, is also the operator with exclusive responsibility and control over the operation and maintenance of Davis-Besse. (**FENOC 2010**, Section 1.4.1)

FENOC is a wholly owned direct subsidiary of FirstEnergy Corp., a public utility holding company.

FirstEnergy Nuclear Generation Corp. is a wholly owned direct subsidiary of FirstEnergy Solutions Corp., and a wholly owned second-tier subsidiary of FirstEnergy Corp (FE).

FirstEnergy Solutions Corp. is a wholly owned direct subsidiary of FirstEnergy Corp.

References to a previous owner, the Toledo Edison Company, have been retained, where appropriate, for historical purposes. (**FENOC 2010**, Section 1.4.1)

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1.4 REFERENCES

FENOC 2010. Updated Safety Analysis Report (USAR) Davis-Besse Nuclear Power Station No. 1 Docket No: 50-346 License No: NPF-3, FirstEnergy Nuclear Operating Company (FENOC), Revision 27, June 2010.

NRC 1996a. Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, Federal Register, Vol. 61, No. 109, June 5, 1996.

NRC 1996b. Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), NUREG-1437, Volumes 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1996.

NRC 1999. Standard Review Plans for Environmental Reviews for Nuclear Power Plants, NUREG-1555, Supplement 1, Operating License Renewal, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, October 1999.

NRC 2000. Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses; Supplement 1 to Regulatory Guide 4.2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, September 2000.

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2.0 SITE AND ENVIRONMENTAL INTERFACES

This chapter describes the overall character of the Davis-Besse site and local environment. Its purpose is to portray the plant's setting and the environment affected, with particular attention to information required to address the environmental issues designated by the GEIS (**NRC 1996**) as Category 2.

2.1 LOCATION AND FEATURES

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio, in Section 12 of Township 8 North, Range 15 East. Nearby communities include Oak Harbor approximately 8 miles southeast, Fremont 16 miles south, and Toledo 25 miles west northwest. Prominent features of the surrounding area out to 50 miles are shown in Figure 2.1-1. The area within six miles is shown on Figure 2.1-2.

The station structures are located approximately in the center of the site 3,000 feet from the shoreline, which provides a minimum exclusion distance of 2,400 feet from any point on the site boundary. The reactor is located at 41° 35' 49" north Latitude and 83° 05' 16" west Longitude. The approximate Universal Transverse Mercator coordinates are 4,607,000 meters north and 326,100 meters east (**FENOC 2010**, Section 2.1.1).

The low population zone is an area outside the site boundary within a radius of two miles from the center of the containment structures (**FENOC 2010**, Section 2.1.3.3). Figure 2.1-3 shows the site boundaries and exclusion area. Section 3.1 describes key features of Davis-Besse, including reactor and containment systems, cooling water system, and transmission system.

The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge (**FENOC 2010**, Section 2.1.2). To the west is the main unit of the Ottawa National Wildlife Refuge and the state of Ohio Magee Marsh Wildlife Area. On the southern boundary is the Toussaint River, which empties into Lake Erie 700 feet from the lake shoreline site boundary (Figure 2.1-3). The land area surrounding the site is generally agricultural with no major industry in the vicinity.

The topography of the site and vicinity is flat with marsh areas bordering the lake and the upland area rising to only 10 to 15 feet above the lake low water datum level in the general surrounding area. The site itself varies in elevation from marsh bottom, below lake level, to approximately six feet above lake level (**FENOC 2010**, Section 1.2.1.1).

Motor vehicle access to the site is by a two-lane road off State Highway 2, which is a two-lane artery located west of the station (**FENOC 2010**, Section 2.2.2.1). U.S. Highway 80 is about 14 miles south of the site (Figure 2.1-1). The nearest scheduled passenger air service is located 38 miles west, in Toledo (**FENOC 2010**, Section 2.2.2.3). Section 2.9.5 describes local and regional transportation in more detail.

2.1.1 References

FENOC 2010. Updated Safety Analysis Report (USAR) Davis-Besse Nuclear Power Station No. 1 Docket No: 50-346 License No: NPF-3, FirstEnergy Nuclear Operating Company (FENOC), Revision 27, June 2010.

NRC 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), NUREG-1437, Volumes 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1996.

Figure 2.1-1: Project Area Map, 50-Mile Radius

Figure 2.1-2: Project Area Map, 6-Mile Radius

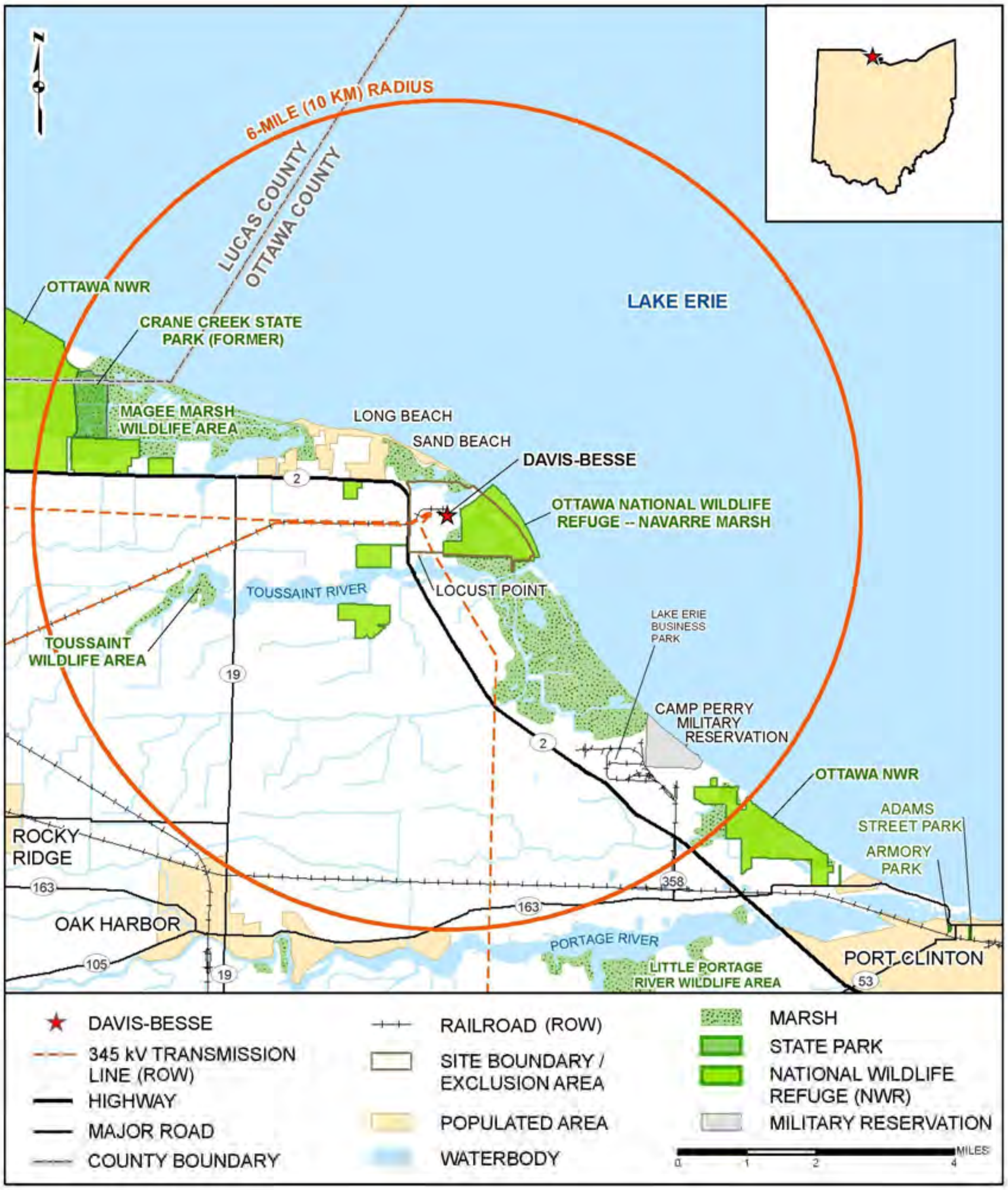
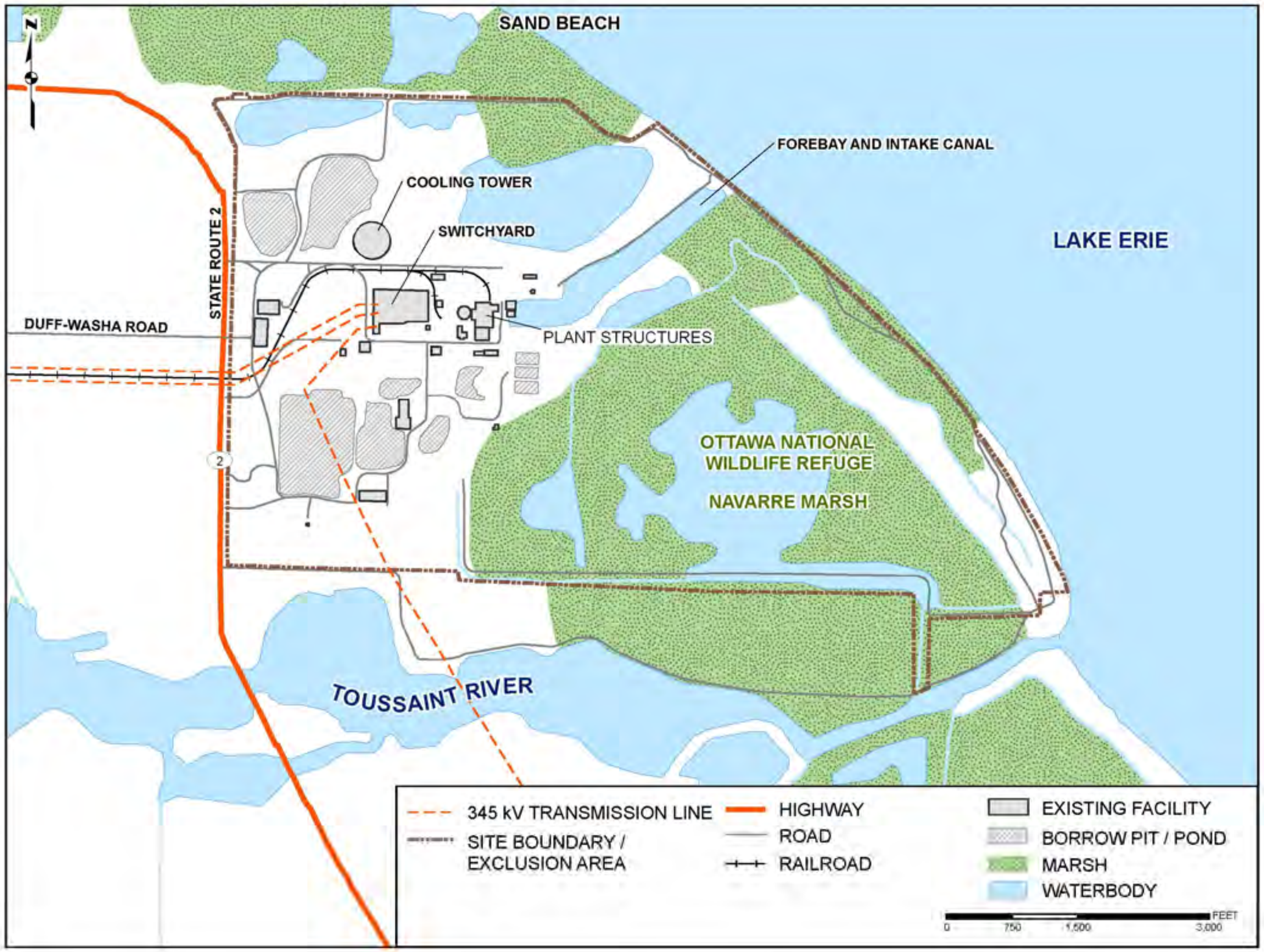


Figure 2.1-3: Site Area Map



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2.2 AQUATIC AND RIPARIAN ECOLOGICAL COMMUNITIES

Davis-Besse is located on the south shore of western Lake Erie. Hydrologic features of the site include Lake Erie surface waters, 733 acres of associated site wetlands, and the nearby Toussaint River and the Cedar-Portage Watershed (**NRC 1975** Section 2.5.1; **ODNR 2007**, Chapter 3; **LELamp 2008**, Section 6.1). Lake Erie and its associated watersheds, like that of the Great Lakes System, represent a vitally important economic and natural resource that supports recreation, fisheries, agriculture, transportation, and industrial processes. The lake also represents an important source of potable water. However, rapid industrial and population growth surrounding the lake have contributed to water quality degradation and eutrophication. As a result, numerous state, federal, and international partnerships have been established to develop resource management goals and to perform long-term ecological monitoring (**GLFC 2007**; **LELamp 2008**; **USEPA 2004**; **OHLEC 2008**; **NRCS 2005**; **IJC 2005**). Together, these partnerships provide critical information to assess ecosystem health. This environmental report section summarizes aquatic resources associated with western Lake Erie and the Davis-Besse site.

2.2.1 HYDROLOGY AND WATER QUALITY

2.2.1.1 Hydrology

Lake Erie is the smallest of the Great Lakes by volume and second smallest by surface area. The southernmost and most-shallow of the Great Lakes, Lake Erie extends west to east approximately 240 miles and averages about 57 miles wide. Water surface area is approximately 9,906 square miles and its volume is about 116 cubic miles. Average depth is about 60 feet. The lake's surface area represents about 44% of the total land-water area of the Lake Erie Basin which includes 22,720 square miles and parts of New York, Pennsylvania, Ohio, Michigan and Ontario (**Downhower 1988**, Chapter 4; **USEPA 1984**, Pages 3-10; **LELamp 2008**, Section 2.1; **Bolsenga and Herdendorf 1993**, Pages 11-26).

Lake Erie is divided into three distinct topographic basins: the western basin bounded on the east by a series of islands near Port Clinton; the central basin extending approximately 124 miles to the east; and the eastern basin bounded on the west by a shallow sand and gravel bar near Erie, PA (**Herdendorf and Monaco 1988**, Page 30). Average depths in the basins are 24 feet, 60 feet, and 80 feet for the western, central and eastern basins, respectively. Maximum water depth in the western basin is 62 feet (**Bolsenga and Herdendorf 1993**, Pages 11-19).

The hydrologic budget in Lake Erie is determined largely by inflow from the Detroit River, and to a lesser extent by direct precipitation and basin drainage (runoff). The estimated contributions are about 80% from the Detroit River inflow, about 11% from precipitation, and about 9% from basin runoff (**Bolsenga and Herdendorf 1993**, Pages 173-180; **LELamp 2008**, Section 2.1; **Herdendorf and Monaco 1988**, Pages 30-38). Annual precipitation in the Lake Erie region is approximately 34 inches. Within the western basin, the Maumee River is the largest contributor of runoff; approximately 25% of the runoff to the lake is attributed to this river. The Toussaint River enters Lake Erie about 1.75 miles southeast of the station. Outflow from the lake is primarily through the Niagara River.

Current patterns in Lake Erie are influenced by the inflow of water from the Detroit River and gyres created by prevailing winds. In the western basin, flows from the Detroit River predominate and pass along the north shore through the Pelee Passage with some recirculation along the south shore attributed to the islands extending northward from Port Clinton toward Pelee Point in Ontario, Canada. Currents in the central and eastern basins generally occur as gyres circulating either clockwise or counterclockwise depending on the prevailing wind direction. Water levels fluctuate due to seasonal changes in inflow but also due to the prevailing winds that run along the axis of the lake. The average annual water level fluctuation is about 1.2 feet. Changes in lake level have been recorded to increase up to 9.8 feet at Toledo due to northeasterly storms and decrease up to 6.6 feet due to southwesterly winds. Differences in water level between Toledo and Buffalo have been recorded as high as 14 feet due to extreme wind driven seiches (**Bolsenga and Herdendorf 1993**, Page 188-194 and **LELamp 2008**, Section 2.1). At the same time, Lake Erie can experience large wind driven waves. Herdendorf and Monaco suggest that, based on U.S. Army Corps of Engineers (USACE) estimates, waves as high as 12 feet can be obtained in the area of Marblehead Peninsula, reaching up to 3.6 feet along the shoreline (**Herdendorf and Monaco 1988**, Page 38).

2.2.1.2 Water Quality

Water quality in Lake Erie and its western basin reflects the demographics of the surrounding watersheds. About one-third of the total population of the Great Lakes Basin, about 11.6 million people, resides within the Lake Erie watershed. As a result, Lake Erie has been disproportionately affected by urbanization, industrialization, and agriculture (**LELamp 2008**, Section 2.1; **OHLEC 2008**, Introduction). Eutrophication of the lake was first identified as an emerging ecological and human health concern in the 1950s, with the occurrence of noxious algal blooms and oxygen depletion. The increasing discharge of phosphorous and its recycling in sediments were considered to be the main contributors. The accumulation of persistent toxic chemicals, attributed to increased industrialization, was also being observed in water, sediment, fish and wildlife. Subsequent ecological concerns have focused on invasive species such as the zebra mussel that have altered food web dynamics.

Addressing these ecological and human health issues in the Great Lakes led to the formation of an international partnership and the development of a long term strategy expressed in the Great Lakes Water Quality Agreement of 1978 (**IJC 2005**; **LELamp 2008**). Lakewide Management Plans, envisioned for each of the Great Lakes, include a set of performance measures tied to beneficial use criteria. Complementary plans were established by the Ohio Lake Erie Commission and the U.S. Department of Agriculture. Various research institutions and scientific forums were also developed to carry out the required water quality and ecological monitoring and to provide data analyses that allow for continued management oversight and refinement of lake management goals. The current status of the Lake Erie Management Plan (Plan) is found in the Lake Erie Lake Management Report for 2008 (**LELamp 2008**).

While results of these international efforts have demonstrated some progress, water quality impairments still exist for most of the performance criteria established in the Plan. Areas of continued concern include the occurrence of chemical contaminants in biota and sediments, elevated levels of bacteria, invasive species (and impact on biodiversity), habitat loss, degradation of fish populations (and supporting food web) and continued eutrophication. Similar trends have been observed in the terrestrial environment associated with Lake Erie and its basins (**LELamp 2008**).

Despite the legacy issues and ongoing concerns with respect to water quality and ecosystem health, drinking water taken from the lake following treatment meets the primary maximum contaminant levels for finished drinking water (**OHLEC 2004**, Page 14).

Lake Erie monthly average water temperatures recorded at Cleveland between 1961 and 1990 varied between 33º F in February to 74ºF in July and August (**NOAA 2009**). At Hatchery Bay, near South Bass Island, water temperatures were reported for various years between 1984 and 1995. Minimum winter water temperature reached 32ºF in January and February and 80.6ºF in late July and early August (**Beeton et al. 1996**). Comparable water temperature ranges were also reported for long time series recorded at Put-in-Bay and Sandusky Bay (**McCormick 1996a, b**).

Lake Erie water quality data spanning the period 1974 to 2001 were collected in the vicinity of Davis-Besse by various investigators. Following is a summary of the results, demonstrating the seasonal and temporal range of values for the different parameters.

Water quality data were collected in the vicinity of Davis-Besse between 1974 and 1979 as part of a preoperational and operational study (**Reutter et al. 1980**, Pages 49 and 72). Parameters were measured monthly at three stations during ice-out periods.

Parameters were reported as averages for the intake and discharge station for the preoperational and operational periods. Annual average water temperature over the study period varied between 60.8 and 61.5ºF. Average dissolved oxygen ranged between 9.1 and 10.0 parts per million (ppm), although variations between 3.0 ppm and 14.1 ppm were reported. Water pH averaged 8.3 standard units (SU) across all stations and varied seasonally between 7.2 and 8.9 SU. Alkalinity ranged between 94 ppm and 96.2 ppm. Transparency (clarity) was low and varied between 1.6 and 1.8 feet. Phosphorus concentrations were relatively high but decreased over time from an average of about 70 parts per billion (ppb) to 40 ppb between the preoperational and operational periods, respectively.

Additional water quality data are found in U.S. Environmental Protection Agency (USEPA) (**USEPA 1984**), Herdendorf and Monaco (**Herdendorf and Monaco 1988**), Bolsenga and Herdendorf (**Bolsenga and Herdendorf 1993**) and OHLEC (**OHLEC 2004**). Bolsenga and Herdendorf (**Bolsenga and Herdendorf 1993**, Pages 251-270) report selected parameters for the period 1967-1982 drawing on data provided by USEPA (Table 2.2-1). Similar to the results reported by Reutter (**Reutter et al. 1980**), Bolsenga and Herdendorf indicate that Lake Erie tends to be alkaline with an average alkalinity of 95 milligrams per liter (mg/l) as $CaCO_3$, ranging from 82.3 ppm in the western basin to 103.9 ppm in the eastern basin (**Reutter et al. 1980**; **Bolsenga and Herdendorf 1993**). Average pH ranged from 8.23 to 8.42 SU across the three basins. Average annual water temperatures in the three basins varied from 63 ºF to 58.5 ºF. Secchi depth readings showed that water clarity was greater in the central and eastern basins and averaged only 2.6 feet in the western basin which was the most turbid of the three basins, this attributed to the Maumee River inflow. Annual average dissolved oxygen varied between 9.4 and 9.9 ppm in the basins.

Average annual total phosphorous concentrations were 29.1 and 20.7 ppb for the central and eastern basins. No value was reported for the western basin although the concentration of dissolved phosphorus was between two to three times higher than that of the central and eastern basins. Total phosphorus loadings during this study period showed a dramatic decrease of up to 50% due to improvements in sanitary sewage treatment. Despite these improvements, periods of anoxia in the central basin continued to exist. Average chlorophyll a concentrations were greatest (13.5 ppb) in the western basin, reflecting the inputs from the Maumee River, and lowest in the eastern basin (3.1 ppb) (**Bolsenga and Herdendorf 1993**).

OHLEC provides corresponding data for the period 1983-2001 (**OHLEC 2004,** Pages 4-8). During this study period, the concentration of total phosphorus in the western basin ranged between just over 25 ppb to just over 10 ppb and showed a general decrease over time. The 5-year average concentration as of 2001 was 16.2 ppb, just above the 15 ppb target for the western basin. During this same period, average phosphorus concentration in the central basin was 6 ppb. Despite these past improvements, phosphorus loadings have been increasing since the early 1990s attributed largely to agricultural practices (**LELamp 2008**; **OHLEC 2004**). Corresponding increases in loadings have been observed for nitrate-nitrite.

Water clarity improved during the period 1970 through 1996 in the western basin increasing from approximately two to three feet to between 6 and 7 feet. The improvement resulted in part from the infestation of zebra mussels in 1988. A comparison of water clarity and phytoplankton diatom densities pre- and post-zebra mussel occurrence showed a 100% increase in water clarity, and a corresponding decrease of 86% in diatoms (**Holland 1993**). However, water clarity decreased through 2001 due to increased sediment loads and algal concentrations, and continues to be impaired in certain parts of the lake (**LELamp 2008**, Section 4.2). Increasing sediment loads contributing to this trend appear to be linked to increased drainage basin flows in the major tributaries and the corresponding increases in nutrient loadings.

Bathymetry of western Lake Erie and sediment composition near Davis-Besse were reported by Herdendorf in anticipation of station construction near Locust Point (**Herdendorf 1972 a**, **b**, **c**). Depth profiles taken from the shoreline out to about 4,000 feet show the depth increasing gradually to approximately 11 feet at 3,000 feet from shore, the location of the intake crib (**AEC 1973**, Section 3.3.2). Sediment composition was variable but generally had a higher percentage of sand near shore, and tending toward gravel further offshore.

2.2.2 AQUATIC COMMUNITIES

Information describing the ecological characteristics of western Lake Erie in the vicinity of Davis-Besse is available from preoperational and operational studies (**Reutter et al. 1980**) and from research conducted subsequently by various state, federal and international organizations, some for the purpose of monitoring and assessing ecological conditions relative to lake management plans (**Herdendorf and Monaco 1985**; **Bolsenga and Herdendorf 1993**; **LELamp 2008**; **OHLEC 2008**; **NRCS 2005**; and **GLFC 2007**).

2.2.2.1 General

Lake Erie aquatic community data dating from as early as 1930 were collected in the general vicinity of Davis-Besse by various investigators. Following is a summary of the results, demonstrating the abundance and diversity of the aquatic communities.

The abundance and diversity of aquatic organisms in Lake Erie has been influenced historically by altered habitat conditions. As discussed above, key factors that have impacted the lake's ecological balance include eutrophication, hypoxia, toxics, habitat loss and invasive species. Phytoplankton, as an example, respond to excess concentrations of phosphorus and other nutrients in Lake Erie and form algal blooms. The algae die, settle to the bottom and decompose consuming oxygen in the process. The effect is exacerbated when a hypolimnion occurs separating oxygen rich surface waters from anoxic bottom waters. This problem was most acute in the 1960s and provided the impetus for coordinated efforts to improve water quality and protect ecosystem health (**LELamp 2008**, Section 2.1).

Phytoplankton species composition and abundance were studied from 1974 through 1979 as part of the Davis-Besse preoperational and operational monitoring programs (**Reutter et al. 1980,** Page 31, 57). Among the three groups of phytoplankton, diatoms were most numerous and typically peaked in spring. Mean densities during the preoperational and operational periods were 127,669 cells/gallon (gal) and 521,415 cells/gal, respectively. Monthly densities ranged from 346 cells/gal in June to 1,572,684 cells/gal in May. The dominant species typically included *Melosira, Fragillaria, Asterionella, Stephanodiscus and Synedra* (**Herdendorf and Monaco 1985**, Page 17; **Reutter et al. 1980**).

Green algae were least abundant. Mean densities ranged between 16,758 cells/gal and 58,665 cells/gal during the preoperational and operational study periods. Mean monthly densities varied between 392 cells/gal in April and 452,177 cells/gal in November. The dominant species were *Mugeotia, Pediastrum and Scenedesmus*. Blue-green algae mean densities ranged from 62,919 cells/gal to 223,180 cells/gal in the two study periods and were most abundant in summer (**Reutter et al.1980**). Blue-green algal blooms observed during the mid 1960s, consisting of *Microcystis, Aphanizomenon and Anabena*, were less common in the 1970s (**Herdendorf and Monaco 1985**).

Algae that adhere to substrates, periphyton, are also common in Lake Erie and are most abundant in the littoral zone. A discussion of these algal species is provided by Herdendorf and Monaco (**Herdendorf and Monaco 1985**) who studied the limnology of the island region near Port Clinton. The benthic alga, *Cladophora glomerata*, is known for its formation of massive algal mats in late spring and summer that create noxious odors and foul submerged structures. Excess growth of this species has been linked to increased phosphorus concentrations and hypoxia (**Lorenz and Monaco 1988**, Page 65). Benthic algal species also include diatoms, and green and blue-green algae.

Zooplankton in the western basin of Lake Erie include both herbivores and carnivores from three basic groups: protozoans, rotifers and microcrustaceans (cladocerans and copepods) (**Herdendorf and Monaco 1985**, Page 18; **Reutter et al. 1980**, Pages 36 and 57). Mean densities of rotifers reported by Reutter (**Reutter et al. 1980**) ranged between 858/gal and 442/gal during the Davis-Besse preoperational and operational study periods. Monthly mean densities ranged between 58/gal in November (operational) and 2,619/gal in October (preoperational). The dominant species included *Brachionus, Keratella, Polyarthra and Synchaeta*. Copepods were most abundant in spring and fall during this same study. Mean densities during the preoperational and operational periods ranged between 515/gal and 550/gal, respectively. Mean monthly densities ranged between 92/gal in April and 3,273/gal in May. Calanoid and cyclopoid forms were most common, including their nauplii. Cladoceran mean densities ranged between 254/gal and 296/gal during the two study periods. Mean monthly densities were comparable to those reported by Herdendorf and Monaco (**Herdendorf and Monaco 1985**).

A composite description of the Lake Erie benthic community in the vicinity of Davis-Besse is also provided by Herdendorf and Monaco, (**Herdendorf and Monaco 1985,** Page 25), and Reutter (**Reutter et al. 1980**, Page 64). Typical of benthic macroinvertebrate communities, species composition was determined by the substrate type and included attached and borrowing forms: coelenterates, annelids, arthropods, mollusks and crustaceans were all represented. The burrowing forms were dominated by oligochaetes and chironomid midge larvae. Gastropod snails were found mostly on submerged vegetation. Among the mollusks, the freshwater mussels and fingernail clams were the dominant forms. Crustaceans included the amphipod, *Gammarus fasciatus,* and various forms of water fleas, isopods, ostracods (seed shrimp) and decapods (crayfish). Insects typically included dipterans (true flies) and mayflies. Densities of the four major groups were provided by Reutter (**Reutter et al. 1980**) as part of the Davis-Besse monitoring programs.

A historical perspective on the benthic fauna of western Lake Erie including the invasion by zebra mussels was provided by Manny and Schloesser and Austen (**Manny and Schloesser 1999**; **Austen et al. 2002**). From 1930 to 1961, the average densities of most benthic macroinvertebrates increased dramatically while the mayflies decreased. However, from 1961 through 1982, there were large decreases in gastropods, fingernail clams, and chironomids (midge larvae) and the disappearance of mayflies. As of 1982, the benthic infauna was dominated by oligochaete and polychaete worms, suggesting continued water quality impairment. In 1993, burrowing mayflies began to recover, yet the native unionid freshwater mussel died throughout most of western Lake Erie as a result of competition from the zebra mussel. Recent evidence suggests, however, that the abundance of mayflies in the western basin is increasing (**GLFC 2003**). Information on historical changes in benthic communities of the nearby island region is provided by Fink and Wood (**Fink and Wood 1988**). Similar to the findings of Manny and Schloesser, Fink and Wood report the demise of the mayfly, decreasing numbers of caddisfly species and the dominance of *Gammarus* in the littoral zone (**Manny and Schloesser 1999**; **Fink and Wood 1988**). Monitoring of zebra and quagga mussel densities continues as part of the Lake Erie Management Plan activities (**LELamp 2008**, Section 10.2). Results during 2004 suggest that while the density and mass of zebra mussels has changed little from 1992 to the present, they are now distributed mostly within the western basin. In general, quagga mussels were more abundant than zebra mussels. Mean density of quagga mussels was 235 individuals/square foot compared to 22.4 individuals/square foot for zebra mussels. A detailed discussion of the affects of invasive mussels on energy flow and biodiversity within the Lake Erie benthic community is provided by Austen (**Austen et al. 2002**).

Because most benthic infauna are relatively immobile, they have been used as bioindicators of toxic contaminants in sediments and related impairments. Of particular concern are metals and organic chemicals. Based on the USEPA Lamp study programs, portions of western Lake Erie remain impaired based on sediment contaminant concentrations and indicator species abundance. While concentrations of key contaminants such as polychlorinated byphenyls (PCBs), dioxin, chlordane, mercury and poly aromatic hydrocarbons (PAHs) have been steadily declining over the past two decades, most remain above their probable effect concentrations near industrial-urban areas (**LELamp 2008**, Section 5.0).

2.2.2.2 Fisheries

Changes in the species composition and abundance of Lake Erie fishes over the last century have been attributed to a number of stresses, including exploitation, habitat deterioration, contaminants and invasive species (**LELamp 2008**; **GLFC 2003**; **Reutter and Hartman 1988**, Page 163). The perturbation of trophic structure led to corresponding impacts on standing fish stocks. Several native species such as the lake trout, lake sturgeon, lake herring and whitefish have been nearly extirpated. The abundance of key recreational and commercial species such as walleye and yellow perch had declined significantly. Despite these historical impacts, Lake Erie maintains a substantial fishery, and long-term management goals have been established by the Great Lakes Fishery Commission to restore and maintain stability of the standing fish stocks (**GLFC 2003**).

The Lake Erie basin supports an estimated 143 fish species; 95 species are present in the lake. Thirty-four species (24%) of fish in Lake Erie proper are nonindigenous (**Austen et al. 2002**). Thirty-five species have been harvested and 19 are considered commercially significant (**Reutter and Hartman 1988**; **Van Meter and Trautman 1970**). Key commercial and recreational species include yellow perch, walleye, smallmouth bass, steelhead trout, lake whitefish and white bass. The abundance of these and other species is monitored by the Ohio Department of Natural Resources (**ODNR 2008**). Trawl surveys have been conducted in the western basin during summer and fall since 1990. Up to 38 locations are sampled at four depths. Gill nets were also deployed at seven historic sites. Corresponding samples were collected in the central basin.

Information on growth and diet are also collected. Hydroacoustic surveys are conducted to assess forage fish abundance.

Walleye abundance (mean catch/acre of age-1 and older fish in the western basin) in summer trawls ranged between 0.04 in 1996 and 2007 and 7.5 in 2004. Except for 2004, catches in the last 5 years were below the long-term average of 1.6 fish/acre. Walleye catches in fall trawls ranged between 0.0 in 2007 and 4.1 in 2004. The long term mean was 0.85 fish/acre. Yellow perch abundance ranged between 1.6 fish/acre in 2003 and 85.3 fish/acre in 2004. The long-term average catch was 22.2 fish/acre. Catches during 2005-2007 were well below the long term average. Similar trends were found in Fall catches of yellow perch. The long term catch of white bass in summer trawls was 33.8 fish/acre and was lowest in 2007 at 3.3 fish/acre. Fall abundance of white bass averaged 2.2 fish/acre and was highly variable in recent years. The abundance of freshwater drum was comparatively high and averaged 53.3 fish/acre over the study period, and was consistently higher between 2000 and 2004. The fall average abundance of drum was 32.5 fish/acre (**ODNR 2008**, Section 6).

Monitoring performed as part of the Davis-Besse monitoring programs through 1979 yielded a total of fifty-one fish species in the Locust Point area (**Reutter et al. 1980**, Page 44, 66). Gillnet, trawl and seine samples were typically dominated by seven species: alewife, emerald shiner, freshwater drum, gizzard shad, spottail shiner, white bass and yellow perch. Together these species contributed over 90% of the catch. Walleye were not commonly found. Yellow perch, gizzard shad, white perch, carp and spottail shiner were the most common fish species caught in gill nets set at Locust Point. Yellow perch were consistently the most abundant. A total of 20 species of fish were captured in trawls and included several benthic species such as bullheads and channel catfish. Species composition in seines was similar to that found in gill net catches.

Records of sport catch in Ohio waters by private and charter boats are available for the period 1975-2007 (Table 2.2-2). Some of the earlier catches represent averages over two or more years but are generally recorded as annual catches between 1995 and 2007. Total annual catch (x1000) of walleye during this period ranged between 374 in 2005 and 1,790 fish in 1998. Catches in 2006 and 2007 were 1,195 and 1,414, respectively. Catch rates in 2006 and 2007 averaged 0.68 fish per angler hour and were the highest harvest rates for the period of record (**ODNR 2008**, Section 4).

Lake-wide commercial and sport harvest of walleye during 1975 through 2007 is shown in Figure 2.2-1. Total lake-wide harvest of walleye peaked during the late 1980s at about 10,000,000 individuals and declined thereafter, although increases were observed in 2005-2007. The total estimated lake-wide harvest was 4.67 million fish in 2007. Harvest per-unit effort also increased during these later years to levels last seen during the 1980s. The lake-wide population estimates of walleye in Lake Erie show similar trends over the period 1978-2008 (Figure 2.2-2).

Yellow perch sport catch in Ohio waters varied between 248 (x1000) fish average per year in 1990 - 1994 and 4,174 (x1000) fish in 2003 (Table 2.2-2). Catches in recent years appeared to be consistent with the long-term average. Long-term trends in western Lake Erie yellow perch population size are shown in Figure 2.2-3. Trends across the various basins of the lake show similar results with decreasing population size during the early 1990s and increases in recent years, but not surpassing levels seen historically. Sport catch of smallmouth bass appears to have declined in recent years. Total private and charter boat catch varied between 2.7 (x1000) fish in 2007 to a high of 77.4 (x1000) fish in 1995. Catches between 2004 and 2007 were less than 7.6 (x1000) fish. Corresponding harvest rates were also low. (**LEC 2008b**)

Commercial harvests of fish taken from Lake Erie are available through the National Marine Fisheries Service (**NMFS 2009**). Over the period 1971 through 2005, annual walleye catches varied between a low of 33 fish in 2002 and a high of 153,595 fish in 1973 (Table 2.2-3). Harvests of yellow perch taken in Lake Erie varied from a peak 3,157,417 fish in 1980 to 235,078 fish in 1984. Catches were greatest during the 1970s, declined during the 1980s and more recently have increased reaching 1,586,154 fish in 2005. White bass commercial harvests for Lake Erie varied from 3,249,763 fish in 1980 and 95,466 fish in 1995. Catches were highest during the 1970s and have been consistently lower since, although harvests in Ohio consistently exceeded 300,000 fish from 2004 through 2007. Freshwater drum harvests were also higher during the 1970s and have consistently decreased since. Only 253,086 fish were harvested in 2002 compared to a peak of 1,332,971 in 1979. Similar trends were observed in other commercial catches of fish landed in Ohio, as listed in Table 2.2-4.

Affecting the quality of the sport and commercial fisheries are consumption health advisories attributed to toxic contaminants. Studies of toxic chemical concentrations in sport fish from the Canadian waters of Lake Erie from 1976-2000 continue to show elevated levels of mercury, PCBs and other contaminants although concentrations continue to decline. Mean mercury concentrations in 12 in. white bass decreased from 0.22 ppm in 1976-80 to 0.13 ppm in 1996-2000. Similarly, mean mercury concentrations in 18 in. walleye have decreased from 0.30 ppm to 0.12 ppm over the same time period. Only fish larger than 16 in. exceeded the 0.45 ppm consumption advisory. PCB concentrations in channel catfish have also decreased over the same study periods. PCB concentrations (3,225 ppb) in 1981-1985 had decreased to 1143 ppb in 1996-2000. However, PCB concentrations in benthic feeding species such as carp and catfish continue to exceed the consumption guideline of 500 ppb (**LELamp 2008**, Section 10.4).

Another factor affecting fish species composition and abundance in Lake Erie has been the invasion of nonindigenous fish species. As stated above, it is estimated that the resident fish community now includes approximately thirty-four nonindigenous species. Approximately 40% of the commercial catches in Ontario in the late 1990s were nonindigenous fish species (**Austen et al. 2002**). Changes have occurred within the various trophic levels. Historically, lake herring, sculpins and shiners dominated the forage fish community. Many of the sculpin species are no longer found. Alewife, rainbow smelt, gizzard shad and round gobies now dominate.

A review of the U.S. Fish and Wildlife Service Critical Habitat portal indicated that the Locust Point area of Lake Erie near Davis-Besse does not contain critical habitat for any threatened or endangered fish species (**USFWS 2009a**). Notwithstanding the historical impacts to Lake Erie and its fisheries described above, none are related to Davis-Besse operation and the lake continues to maintain a substantial fishery, both in the species composition and abundance.

2.2.2.3 Entrainment and Impingement.

Year class strength of most fish species is determined within the egg and larval stage. As a result, the abundance and distribution of ichthyoplankton relative to the location and amount of water withdrawal by cooling water intakes can influence the potential impact of entrainment on fish populations. Studies of entrainment and the abundance of ichthyoplankton relative to the Davis-Besse Station and other steam-electric stations located on Lake Erie were performed by the Ohio State University Center for Lake Erie Area Research from 1974 through the first few years of Davis-Besse operation , as requested by the Ohio Department of Natural Resources (**Reutter et al. 1980**) by the U.S. Environmental Protection Agency (**Cooper et al. 1981**), and by the Toledo Edison Company (**Reutter 1981a**).

In general, emerald shiner, common shiner, freshwater drum, gizzard shad, white bass and yellow perch were the majority of the larval fish species collected in the Davis-Besse intake area, although gizzard shad were clearly the most abundant. Larval densities were highest in late May and June. The relative abundance of yellow perch and walleye was highly variable from year to year. During the period 1976-1980, the percent composition of larval yellow perch ranged between 2% in 1978 to 70% in 1975. Walleye percent composition varied from 0.2% in 1976 and 1979 to 22% in 1980. In 1980, mean densities (number/3531 cubic feet (ft^3)) of the abundant species, freshwater drum, gizzard shad, white bass and yellow perch, were 130.67, 189.18, 23.8 and 91.0, respectively. Peak density estimates in 1979 based on a composite of stations off Locust Point were as follows: gizzard shad, 200.4/3531 ft^3; yellow perch, 66.1/3531 ft^3; emerald shiner, 7.6/3531 ft^3. Estimates of equivalent female adult losses due to entrainment in 1980, based on mean adult fecundity, were very low, i.e., 71 gizzard shad, one (1) walleye, and 153 yellow perch (**Reutter 1981a**). Reutter concluded that there was no indication that the Davis-Besse intake location was a significant spawning area that could be detrimentally impacted by the operation of the facility, and there was no indication that the activities of the plant, including the thermal discharge, have significantly altered the populations of the local larval fish species (**Reutter et al. 1980**, Page 72). Reutter also states that the research and other research performed by the authors has indicated that the design features at Davis-Besse, i.e., cooling tower, off-shore intake, closed intake canal, bottom intake, and a high velocity discharge nozzle, may be the optimal design features to minimize aquatic environmental impacts due to cooling water intakes and thermal discharges (**Reutter et al. 1980**, Page 79).

An assessment of entrainment impacts from power plants distributed throughout Lake Erie was performed by Cooper (**Cooper et al. 1981**). Data included samples collected in 1975-1977 in the western basin and 1978 in the central basin. A total of 22 larval fish taxa was collected in the western basin. Dominant species included gizzard shad (87% of the catch) followed by rainbow smelt, whitefish, carp, white bass, yellow perch, sauger, walleye and freshwater drum. The data shows that the percentage of fish entrained by the Davis-Besse cooling water intake as compared to three other Lake Erie western basis generating stations is a small fraction (i.e., 6% or less by fish type) of total fish entrainment (**Cooper et al. 1981**, Page 108).

More recently, McKenna (**McKenna et al. 2008**) studied the relationship between larval fish assemblages in West-Central Lake Erie and habitat type. Ichthyoplankton species composition, abundance and distribution were examined in the vicinity of the major river mouths. Samples were collected in 2000-2002 from April through September. A total of 26 fish species was recorded. Fourteen were found in each year of the study. Species composition and seasonal occurrence were similar to that found in earlier studies. White bass larvae were most common in April, percids in May and June, and cyprinids (shiners) in summer.

Each of the studies discussed here demonstrates that the occurrence of fish larvae and their vulnerability to entrainment is limited to a very short period. While walleye are known to spawn over the offshore reefs near Locust Point (**ODNR 2007**, Page 131), the relative abundance of larval walleye in entrainment samples was low (**Cooper et al. 1981**).

Samples of fish impinged on the Davis-Besse traveling screens were collected at the request of Toledo Edison during 1980 (**Reutter 1981b**). Estimates of total impingement were extrapolated from periodic sampling by normalizing impingement counts to fish impinged/hour. Total 1980 estimated impingement was 9,056 fish. Goldfish and gizzard shad dominated the impingement samples and were most commonly impinged during winter. Over half (51%) of the annual impingement occurred during January, and this January total (4,626) was composed primarily of goldfish (53.5%) and gizzard shad (37.0%). Other species that occurred but at much lower numbers included yellow perch, shiners and freshwater drum. The number of yellow perch estimated to have been impinged was 750 fish, compared to the yellow perch sport and commercial harvest from Ohio waters of 22,248,000 fish. During this same period, 45 white bass were impinged compared to the white bass sport and commercial harvest of 3,909,000 fish. When compared to the sport and commercial harvest of the key species from Ohio waters during the study period, impingement of fish in the Davis-Besse cooling water intake was judged to be insignificant.

Low entrainment and impingement at Davis-Besse are attributable to the use of closed cycle cooling (average intake flow of 21,000 gallons per minute (gpm)) and low intake velocities (< 0.25 fps) (**AEC 1973**, Pages 3-6).

2.2.2.4 Riparian zone

The Lake Erie riparian zone at the Davis-Besse site is one of transition from shoreline beach, to a beach ridge community, a hardwood swamp zone, extensive wetlands and then to upland. The shoreline beach consists of a sand-shell mixture and is considered to be stable “non-critical erosion area, not protected” (**AEC 1973**, Section 2.5.1). The beach ridge plant community consists of several grass species, willow, and sumac. Dominant plants of the hardwood swamp include cottonwood, black willow, hackberry, sycamore, sumac and river-bank grape. The largest freshwater marsh on site (about 733 acres) is the Navarre Marsh which is part of the larger Ottawa National Wildlife Refuge. A series of dikes and pumps are employed to maintain adequate water levels and to manage vegetation and species composition. The marsh is typical of palustrine systems that are flooded seasonally. Vegetation consists mostly of rooted herbaceous hydrophytes (**USFWS 2009b**). The Navarre marsh vegetation includes cattail, soft-stem bulrush, white water lily, milfoil, sago pondweed and curly-leafed pondweed (**AEC 1973**, Pages 2-6, 2-28, 2-40, 4-6).

2.2.3 References

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

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Table 2.2-1: Mean Chemical Composition of Lake Erie and Connecting Waterways (1967-1982)

Parameter Units		St. Clair River	Lake St. Clair	Detroit River	Western Lake Erie	Central Lake Erie	Eastern Lake Erie	Niagara River
Water Temperature	°F	53.2	65.9	58.2	63.1	58.7	58.5	59.7
Secchi depth	ft	1.3	4.9	3.3	2.6	9.8	14.1	---
Dissolved oxygen (D.O.) ppm		10.4	9.5	9.3	9.8	9.4	9.9	9.7
D.O. percent saturation	%	97.4	102.0	91.9	98.1	90.6	96.6	98.4
Conductivity @ 25 °C	μmhos/cm	329	224	256	282	298	304	330
Dissolved solids	ppm	142.7	134.6	140.3	193.7	211.2	197.6	169.4
Suspended solids	ppm	21.62	12.14	15.42	19.86	6.63	5.32	17.92
Alkalinity, total	ppm	91.6	81.6	83.4	82.3	89.8	103.9	95.9
Alkalinity, phenolphthalein pH	ppm	---	---	---	4.2	3.7	---	7.3
pH SU		8.09	8.27	8.03	8.42	8.23	8.26	7.83
Calcium, total	ppm	51.2	29.1	29.8	34.4	39.7	31.3	43.6
Magnesium, total	ppm	18.2	7.6	7.5	7.6	9.5	8.8	9.9
Potassium, total	ppm	3.2	1.0	1.0	1.2	1.4	1.3	1.7
Sodium, total	ppm	47.4	4.9	6.1	8.9	10.1	9.2	13.3
Chlorides, total	ppm	20.1	8.1	17.2	---	24.4	21.6	27.7
Sulfates, total	ppm	16.6	16.7	16.1	32.7	25.7	25.5	30.1
Fluoride, total	ppm	0.12	0.12	0.11	0.24	0.16	0.20	0.25
Silica, dissolved	ppb	1.11	0.72	0.83	---	---	0.32	0.19
Ammonia, dissolved	ppb	0.018	---	0.047	0.061	0.023	0.017	---
Nitrate + nitrite, dissolved	ppb	0.290	---	0.300	0.325	0.165	0.263	---
Phosphorus, total	ppb	---	44.5	---	---	29.1	20.7	---
Phosphorus, dissolved	ppb	11.9	8.1	33.8	29.3	11.8	8.1	---
Phosphorus, ortho	ppb	12.2	---	12.1	9.2	5.8	3.4	---
Chlorophyll a ppb		11.9	4.7	3.4	13.5	5.6	3.1	---

Source: **Bolsenga and Herdendorf 1993**, Pages 251-270

Table 2.2-2: Sport Harvest of Selected Fish Species in Western Lake Erie, 1975-2007 (thousands of fish)

Year	Species			
	Walleye	White Bass	Yellow Perch	Smallmouth Bass
1975-77	937	173	6,567	21.2
1978-79	2,424	--	--	--
1980-84	2,520	312	7,982	33.8
1985-89	3,496	166	4,906	20.5
1990-94	1,378	28	1,242	25.6
1995	1,161	19	2,838	77.4
1996	1,442	31	4,020	30.7
1997	929	36	3,464	32.8
1998	1,790	49	3,708	55.7
1999	812	45	3,262	67.8
2000	674	71	3,062	28.0
2001	941	83	2,642	25.1
2002	516	72	3,290	22.4
2003	715	23	4,174	35.0
2004	515	26	2,603	5.9
2005	374	79	2,593	5.2
2006	1,195	93	3,173	7.6
2007	1,414	89	2,817	2.7

Source: **ODNR 2008**

Table 2.2-3: Commercial Harvest, in Numbers of Fish, for Selected Fish Species Taken from Lake Erie during 1971 through 2005

Year	Species					
	Walleye	Yellow Perch	Whitefish	White Bass	White Perch	Freshwater Drum
1971	55,525	2,641,392	114	996,333	--	838,863
1972	91,215	1,917,615	554	770,503	--	917,371
1973	153,595	1,887,321	2,390	2,424,667	--	999,754
1974	113,136	2,376,685	758	2,912,884	--	694,038
1975	127,053	1,914,326	681	1,691,852	--	853,832
1976	69,032	1,885,272	28	1,523,579	25	1,034,677
1977	72,487	2,868,959	28	1,121,201	--	833,458
1978	69,493	2,580,025	1,077	1,732,218	2	1,214,939
1979	101,873	3,147,031	99	1,968,538	53	1,332,971
1980	80,505	3,157,417	2,396	3,249,763	186	1,063,793
1981	66,158	2,422,699	2,274	1,134,536	3,882	1,281,724
1982	68,072	57,314	347	726,804	28,404	1,064,553
1983	79,380	387,748	2,617	864,901	120,682	1,006,962
1984	84,851	235,078	481	980,896	206,367	735,968
1985	131,322	349,963	953	1,350,486	300,358	669,290
1986	14,617	270,390	2,252	729,930	346,724	798,790
1987	14,618	588,442	16,274	474,523	422,039	976,647
1988	12,223	996,187	15,424	144,706	593,992	710,775
1989	9,542	1,926,620	42,013	558,100	607,863	508,929
1990	10,190	1,765,886	123,707	398,226	851,228	658,225
1991	10,532	858,049	336,049	446,122	1,021,149	514,470
1992	9,779	396,635	228,405	383,002	865,402	621,922
1993	29,567	381,441	373,185	227,080	354,901	809,934
1994	28,163	670,282	404,844	366,698	419,395	761,460
1995	41,145	473,245	225,233	95,466	412,702	750,996
1996	81	632,641	51,416	103,603	188,029	600,211
1997	193	774,729	29,028	358,196	259,511	714,839
1998	417	586,754	45,459	236,230	119,647	578,764
1999	229	700,936	48,292	221,562	131,519	359,659
2000	186	959,368	41,475	319,455	182,583	429,227
2001	73	1,042,006	47,639	227,199	155,982	288,199
2002	33	1,413,030	6,564	165,496	270,422	253,086
2003	129	1,501,939	13,337	318,413	312,638	262,004
2004	300	1,588,901	10,620	360,635	387,617	297,708
2005	830	1,586,154	5,176	349,152	432,647	441,975

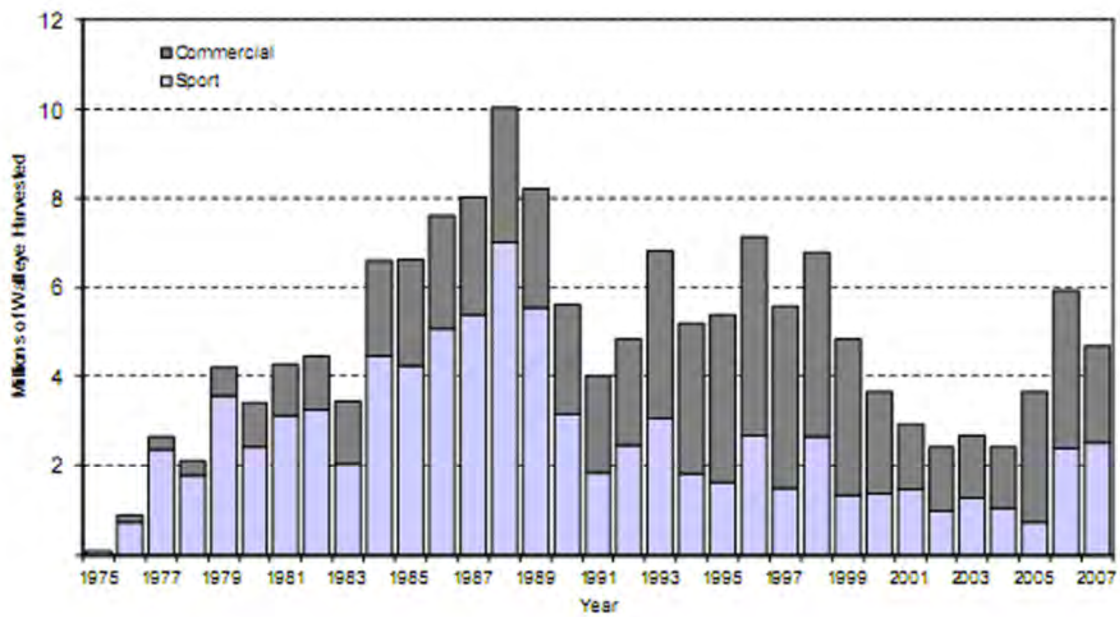
Source: **NMFS 2009**

Table 2.2-4: Annual Commercial Harvest (pounds) from Ohio Waters of Lake Erie, by species, 1998 - 2007

Year	Buffalo	Bullhead	Burbot	Carp	Channel Catfish	Freshwater Drum	Gizzard Shad	Goldfish	Quillback	Suckers	White Bass	White Perch	Whitefish	Yellow Perch
1998	295,904	17,897	1,458	1,336,450	302,056	553,659	172,425	7,992	226,603	50,785	234,791	118,946	41,990	580,151
1999	258,160	24,502	1,145	1,111,504	317,642	358,714	105,068	20,726	170,988	32,415	221,443	131,308	47,622	697,332
2000	162,477	41,695	78	956,218	260,512	428,660	2,809	19,473	140,183	30,195	317,336	182,254	41,472	962,841
2001	257,621	24,106	47	857,694	322,488	284,883	1,970	18,837	149,549	41,040	226,664	155,555	47,639	1,089,247
2002	281,955	23,409	59	523,539	311,824	248,567	545,151	10,625	170,096	32,641	161,664	269,512	6,539	1,438,215
2003	278,544	21,815	192	582,035	319,378	261,068	45	31,406	227,195	15,469	318,327	312,240	13,244	1,505,840
2004	234,673	11,005	857	469,059	271,627	298,336	85,540	23,834	195,931	30,836	358,810	386,800	10,529	1,577,113
2005	230,426	17,012	363	340,399	310,115	438,589	219,800	35,396	363,818	41,763	347,657	428,822	4,613	1,563,200
2006	263,396	25,118	305	271,190	385,134	411,840	195	58,812	250,052	33,233	483,314	655,551	29,795	1,050,614
2007	268,884	25,790	47	322,323	341,843	320,747	55,259	29,148	211,208	17,165	334,721	573,996	41,554	1,950,661
Mean	253,204	23,235	455	677,041	314,262	360,506	118,826	25,625	200,562	32,554	300,473	321,498	28,500	1,241,521

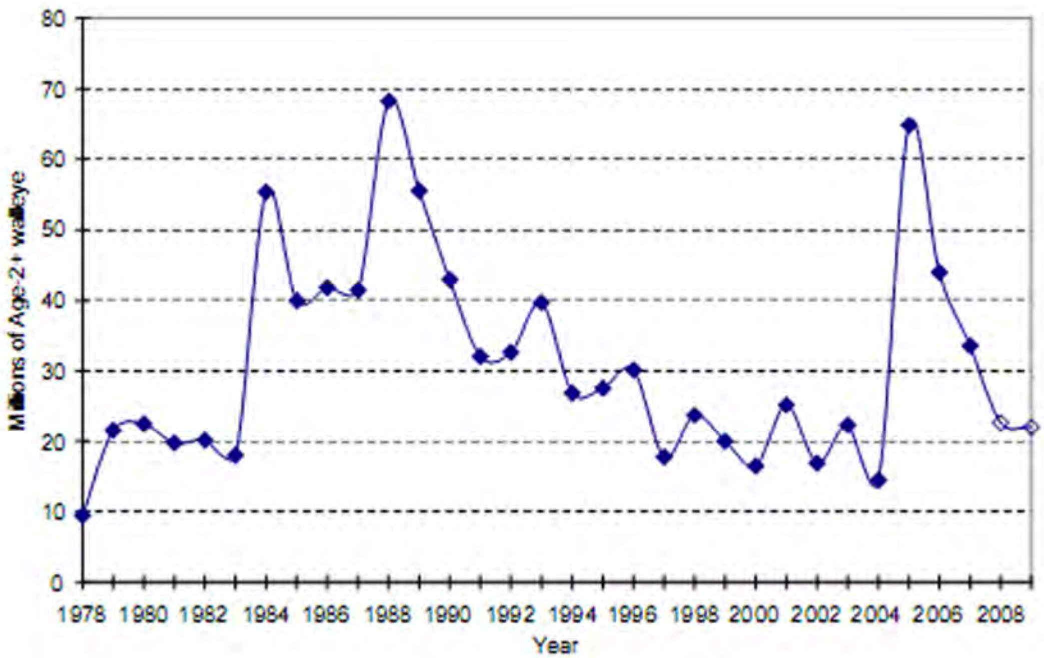
Source: **ODNR 2008**

Figure 2.2-1: Lake-wide Harvest of Lake Erie Walleye by Sport and Commercial Fisheries, 1975-2007



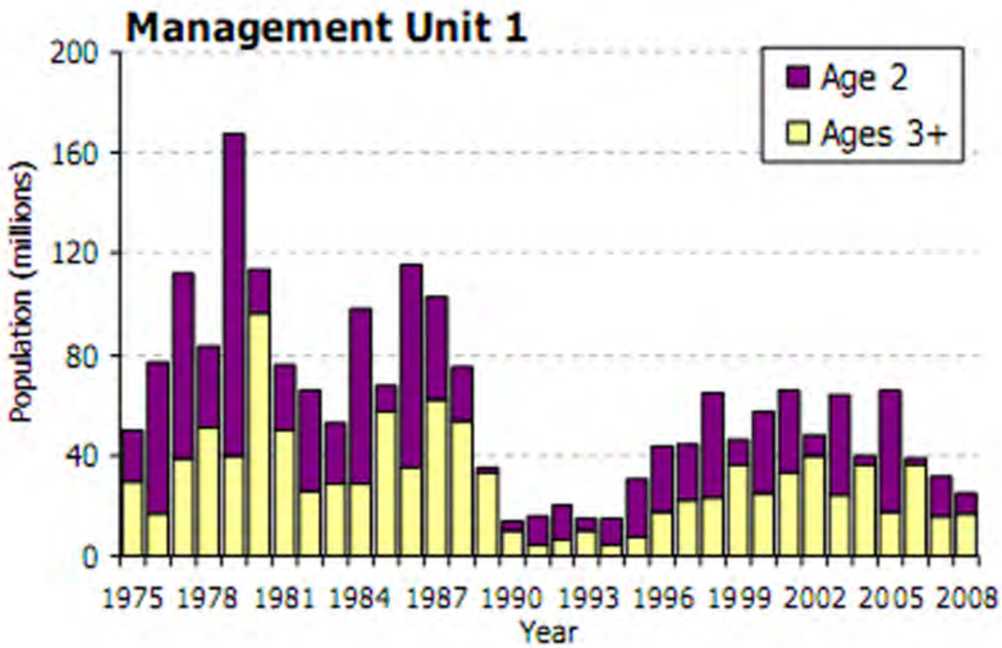
Source: LEC 2008a

Figure 2.2-2: Abundance of Lake Erie Walleye from 1978-2007 (Two Additional Years are Forecasted)



Source: LEC 2008a

**Figure 2.2-3: Western Lake Erie (Great Lakes Fishery Commission Management Unit 1) Yellow Perch Population Estimates, 1975-2007
The Estimate for 2008 is Projected**



Source: **LEC 2008b**

2.3 GROUNDWATER RESOURCES

The Davis-Besse site is underlain by glaciolacustrine and glacial till deposits, which overlie sedimentary bedrock. The surficial deposits, which are dominantly silty clay, have very low permeability. Site bedrock consists of the Tymochtee formation underlain by the Greenfield formation. These formations consist of nearly horizontal beds of argillaceous dolomite with interbeds of shale, gypsum and anhydrite to a depth of at least 200 feet below ground surface. (**FENOC 2010**, Section 2.4.1.2.3)

The presence of the low permeability surficial deposits has produced an artesian groundwater condition in the site vicinity bedrock. This effect is the result of the surficial deposits acting as an aquiclude to the underlying water-bearing carbonate bedrock, and the influence of Lake Erie's water table producing a potentiometric surface above the water-bearing zone. The potentiometric surface of the confined water-bearing zone is generally a few feet above the level of Lake Erie, indicating that groundwater flow at the site is generally east to northeast, towards the lake and adjacent marshes, with a gradient of approximately 2 feet per mile, which is similar to the surface water gradient in the area. Groundwater elevation fluctuations historically correlate to lake level fluctuations. (**FENOC 2010**, Section 2.4.13.2.3) Assuming heterogeneous hydraulic conductivity of 1×10^{-2} centimeters per second for the bedrock, the maximum value obtained in field tests, the groundwater flow in the Davis-Besse site vicinity is calculated to be approximately 83 feet/year (**FENOC 2010**, Section 2.4.13.3). The groundwater at the site discharges primarily into Lake Erie and the adjacent marshes to the east/northeast (**ERM 2008**, Section 5.0).

Davis-Besse does not use groundwater at the site for plant operations (**FENOC 2010** Section 2.4.13.1.5). Groundwater use in the site vicinity is limited due to the naturally poor water quality exhibited by the carbonate water-bearing zones. There are no identified drinking water wells within 5 miles of the site (**ERM 2007**, Section 3.4). Local residents obtain drinking water from the Carroll Township Water Treatment Plant, which uses surface waters from Lake Erie (**ERM 2007**, Section 3.4). The intake for this water treatment facility is located approximately three miles northwest of the Davis-Besse site. Privately owned wells within 2 to 3 miles of the site are used for farm irrigation and sanitary purposes, and not used as drinking water sources (**ERM 2007** Section 3.4).

The groundwater at the plant site is characterized by strong hydrogen sulfide odors resulting from naturally occurring interaction with local deposits of gypsum and anhydrite. Naturally high levels of carbonate and total dissolved solids cause this aquifer to be unsuitable for use as drinking water (**ERM 2007**, Section 3.4). The Ohio Environmental Protection Agency (OEPA) indicated the absence of any sole-source aquifer in the plant region (**OEPA 2005**).

The historic groundwater monitoring network at the Davis-Besse site consisted of 78 monitoring wells, of which 54 (27 couplets) remain functional (**ERM 2008**, Section 5.0).

The couplets are nested wells screened in bedrock units designated for the site as the upper dolomite and the lower dolomite. These wells were installed during plant construction to monitor groundwater conditions.

In June 2007, Davis-Besse implemented a plan to conform with the voluntary policy of the Nuclear Energy Institute (NEI) Groundwater Protection Initiative (**NEI 2007**). Selected existing monitoring wells were sampled to determine the necessity and location of additional monitoring wells as needed to characterize and monitor the groundwater conditions at the site. In August 2007, 16 new monitoring wells were installed in six distinct locations (**ERM 2008**, Section 3.3). Five of the locations provide nested monitoring wells screened in three distinct zones: the base of the glacial till, the upper dolomite, and the lower dolomite. One of these nested locations is located as a background well up-gradient of the plant power block on the southwest side of the site. The other four nested locations are in the northeast portion of the site, down-gradient from plant structures. Three of these down-gradient wells are located near the extreme northeast corner of the site, allowing for determination of down-gradient offsite contaminant migration. The sixth location is a monitoring well screened only in the glaciolacustrine/glacial till and is located to the northeast and down-gradient from the power block. Historical and 2007-installed well locations are shown in Figure 2.3-1.

Concentrations of gamma-producing radionuclides were below the minimum detection concentration (MDC) in all groundwater samples analyzed between 2007 and 2009. In early 2010, five of seven historic wells showed tritium levels slightly greater than the plant action level of 2,000 pCi/l. Another well, MW-105A, which has been on a slow increasing trend since the spring of 2009, had a tritium level of 4,158 pCi/l. As a result, FENOC is pursuing a root cause approach to identify the source of the tritium in the wells. No tritium concentrations have been detected at or above the USEPA drinking water limit of 20,000 pCi/l (40 CFR 141.66).

Analysis results from three periods of groundwater sampling performed in 2007 revealed the following (**ERM 2008**, Section 5.0). July tritium concentrations above the plant action level of 2,000 picoCuries per liter (pCi/l) occurred in three historical down-gradient wells screened in the upper dolomite. The highest concentration from this sampling period was 7,535 pCi/l in the upper dolomite at a down-gradient well. September groundwater samples from the wells screened in the soil had a range from below the MDC, under about 200 pCi/l to 1,832 pCi/l, with three wells displaying tritium concentrations above background levels. Background tritium levels have been statistically determined by up-gradient groundwater sampling and sampling of Lake Erie waters to be between 178 and 348 pCi/l. Samples in the upper dolomite had a range from the MDC to 3,149 pCi/l, with none of the new monitoring wells having tritium concentrations outside the range of background levels. Samples from the lower dolomite included three wells with tritium concentrations above background levels, but none of these were the new down-gradient monitoring wells. September sampling showed a decrease in tritium concentrations from the June and July samplings.

Sampling in 2008 showed no wells with tritium concentrations above the plant action level. Sampling in 2009 resulted in one well above the plant action level with a tritium concentration of 2,352 pCi/l. During the same 2009 sampling period, six well locations had tritium values below the MDC, with the remainder showing tritium levels below the plant action level.

Concentrations of gamma-producing radionuclides were below the MDC in all groundwater samples analyzed between 2007 and 2009. No tritium concentrations have been detected at or above the USEPA drinking water limit of 20,000 pCi/l (40 CFR 141.66).

2.3.1 References

Note to reader: This list of references identifies a web page and associated URL where reference data were obtained. This web page may likely no longer be available or its URL address may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web page.

FENOC 2010. Updated Safety Analysis Report (USAR) Davis-Besse Nuclear Power Station No. 1, Docket No: 50-346, License No: NPF-3, FirstEnergy Nuclear Operating Company (FENOC), Revision 27, June 2010.

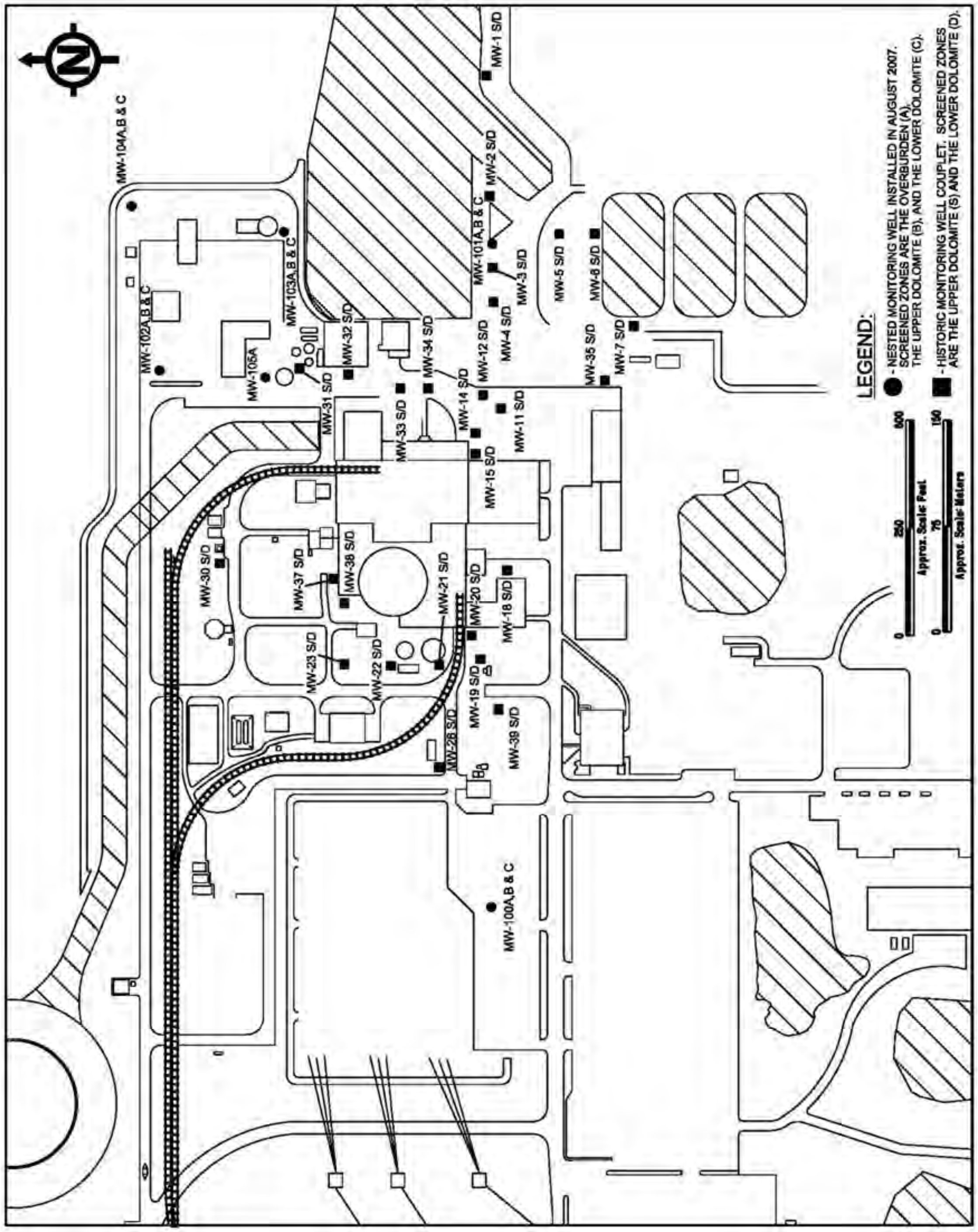
ERM 2007. Groundwater Flow Characteristics Report Davis-Besse Nuclear Power Station, Oak Harbor, Ohio, Environmental Resources Management (ERM) Reference 55194, FirstEnergy Service Company, January 2007.

ERM 2008. Groundwater Monitoring Well Installation & Monitoring Report Davis-Besse Nuclear Power Station, Environmental Resources Management (ERM) Reference 0065992.2, FirstEnergy Nuclear Operating Company, March 2008.

OEPA 2005. Sole Source Aquifers in Ohio, Ohio Environmental Protection Agency, Division of Drinking and Ground Waters, http://www.epa.state.oh.us/ddagw/pdu/swap_ssa.html, accessed March 3, 2009.

NEI 2007. Industry Ground Water Protection Initiative – Final Guidance Document, NEI-07-07 (Final), Nuclear Energy Institute, August 2007.

Figure 2.3-1: Groundwater Well Monitoring Locations



Source: ERM 2007

2.4 CRITICAL AND IMPORTANT TERRESTRIAL HABITAT

Various state and federal conservation agencies, along with the Nature Conservancy have adopted ecoregions for landscape-level planning. Ecoregions provide an ecological basis for portioning the state into coherent units with common habitat types, wildlife species, and landforms. The Ohio Department of Natural Resources (ODNR) has developed a comprehensive conservation program for the state including detailed accountings of plant and animal species of concern within various ecoregions (**ODNAP 2009a**).

2.4.1 ECOREGIONS

The Davis-Besse Nuclear Plant lies in the Huron/Erie Lake Plains (HELP) Ecoregion. This area, in northwestern Ohio, northeastern Indiana and southwestern Michigan, is bounded by Lake Erie and glacial moraines. Approximately one sixth of Ohio is within this ecoregion. The Environmental Protection Agency and the Indiana Biological Survey describe this ecoregion as follows (**BSC 2009**; **IBS 2009**; **USEPA 2009**):

> *This ecoregion is a discontinuous, broad, fertile, nearly flat plain punctuated by relict sand dunes, beach ridges, and end moraines. Originally, soil drainage was typically poor and black swamp elm-ash swamp and beech forests were dominant. Many wetlands are still present, but many have been drained and cleared for agriculture. Streams within the moraine hills and valleys are often intermittent becoming perennial when they reach the valley floor. The majority of streams drain less than 100 square miles. Precipitation is evenly distributed throughout the year and region and averages from 31 – 35 inches annually. The ecoregion has few lakes and reservoirs with those present usually being less than a quarter mile square.*

Oak savanna, and more specifically mesic oak savanna, was characteristic in this region. Mesic oak savanna typically occurs on bluffs and ridges or morainal deposits. Dominant species are white oak, bur oak, northern red oak, and black oak. This Biome was typically restricted to sandy, well-drained dunes and beach ridges. Nearly all savannas on mesic sites have been destroyed by land-use changes or altered by successional change and invasion of exotic species (**USEPA 1993**). Today, the natural climax vegetation of the area includes American elm, red maple, and black ash. Most of the area has been cleared and artificially drained and contains highly productive farms producing corn, winter wheat, soybeans, livestock, and vegetables; urban and industrial areas are also extensive. Stream habitat and quality have been degraded by channelization, ditching, and agricultural activities.

Within the HELP ecoregion, the Davis-Besse Nuclear Power Station is more specifically located in the Marblehead Drift/Limestone Plain ecoregion, which has been described by the USEPA as follows (**USEPA 2009**):

> *This ecoregion has areas of thin glacial drift and limestone-dolomite ridges and islands. Streams often flow on carbonate bedrock; originally, beech forests and, especially, elm-ash swamp forests were common. Scattered carbonate ridges supported distinctive mixed oak forests and prairies, marl plains had prairies, and the Lake Erie and Sandusky Bay shoreline often supported fens. Many geographically isolated plant species occurred in this ecoregion. Today, corn, small grains, soybeans, and hay are grown on artificially drained land. Vegetable and fruit farming is well adapted to the relatively mild climate near the shoreline.*

Since the designation of ecoregions, states have made efforts to divide ecoregions into subecoregions by using information with greater resolution, specifically concentrating on differences in patterns of environmental characteristics of particular ecoregions. The regional subdivision is based on the vegetative differences of an ecoregion along with climate, physiography, land use, soils, and surface-water quality (**ACWI 1995**). Ohio recognizes five distinct physiographic regions within the state. The Davis-Besse site can be found within the Lake Plains physiographic region (Figure 2.4-1). The ODNR describes this region as being at one time, the bottom of a much larger ancient lake known as Lake Maumee. This region is an extremely flat plain that consists of a narrow strip of land along the Lake Erie coast in northeastern Ohio that widens significantly west of Cleveland. Historically, as water levels rose and fell, sandy beach ridges and dunes formed along the shore. The northwestern area of the physiographic region, where the Davis-Besse site is more specifically located, was called the Great Black Swamp that was distinguished by rich, black soils and poor drainage (**ODNAP 2009c**).

Remnants of this habitat are preserved in the Ottawa National Wildlife Refuge (ONWR) which consists of three refuges, Ottawa, Cedar Point, and West Sister Island and two divisions, the Navarre and Darby Marshes. In total, the ONWR network of marshes encompasses more than 9,000 acres along the western shore of Lake Erie (**ONWRA 2009**). The Ohio Department of Natural Resources Division of Natural Areas and Preserves has identified several areas within and around the ONWR complex that are of importance for some threatened or endangered species as well as locations worth noting as they are deserving of priority for conservation efforts. These locations deserve priority due to their identification as being a rare or outstanding example of a particular community. Examples in and around the complex area include a bank swallow colony, a breeding amphibian site, a great blue heron rookery, a mussel bed, Piping Plover critical habitat and a waterfowl rest area. These areas are likely to harbor rare, threatened or endangered species (**ODNAP 2009a**).

2.4.2 Davis-Besse Site

The Davis-Besse site is typical of the HELP ecoregion. It is generally flat, with predominantly hydric or wetland soils. Approximately 700 acres (**FirstEnergy 2008**) of the site is marshland, with the remaining areas being classified as woodlands, low grasslands and poorly drained marginal agricultural lands (**AEC 1973**, Section 3.3.2). The Davis-Besse site contains some of the best and arguably least disturbed examples of a marsh habitat in northwest Ohio (**Campbell 1995**, Page 138). The on-site Navarre Marsh is a small remnant of what was once the Great Black Swamp. The original area and location of the Swamp lie completely within this ecoregion. Since settlement, much of the region has been converted into farms and urban centers. The protected status of the Navarre Marsh on the Davis-Besse site has resulted in its becoming a refuge for native plants, animals and biological communities that were once more common in the surrounding landscape.

National Wetland Inventory Maps indicate that 15 different classifications of wetlands exist on or near the Davis-Besse property. Southeast of the intake channel there is a prominent area identified as being a Palustrine, emergent, persistant, semipermanently flooded area otherwise known as the Navarre Marsh. The Navarre Marsh is located on the southeast end of the Davis-Besse Site, on the southern edge of Lake Erie. It is owned by Davis-Besse, and leased to the U. S. Fish and Wildlife Service (USFWS) which operates it as a division of the Ottawa National Wildlife Refuge (ONWR) located about five miles east of the Davis-Besse plant. The ONWR network has been recognized as an area of high biodiversity by the Ohio Department of Natural Resources, Natural Heritage Department, as well as an outstanding example of a waterfowl rest area. Due to its ecological importance, the Navarre Marsh is protected habitat that is managed cooperatively by the utility environmental personnel and ONWR staff (**FirstEnergy 2008**). Navarre Marsh wetland characteristics can be viewed on the USFWS National Wetlands Inventory, Wetlands Mapper portal (**USFWS 2009a**).

The majority of the area at Navarre is covered by freshwater marsh and contains nearly all the habitats associated with a marsh complex including freshwater marsh, swamp forest, wet meadow, and patches of buttonbush and deciduous forest which serve as a shelter and important refuge for migrating birds (**FirstEnergy 2008**; **Campbell 1995**, Page 138). There have been more than 325 species of birds recorded in or around units of the ONWR complex. The refuge complex is especially important to certain groups of birds, including waterfowl, neotropical migrant song birds, raptors, bald eagles, shorebirds and colonial-nesting wading birds such as herons (**USFWS 2009c**). Approximately nine miles off shore is the 77-acre West Sister Island NWR. It is home to the largest colonial nesting bird rookery in the Great Lakes chain with approximately 3,500 nests. West Sister Island is the only designated national wilderness area in Ohio (**GORP 2009**). Additionally, during normal migration, waterfowl use of the ONWR

Complex averages 3 million duck-use days and 800,000 individuals. Mallards, black ducks, American wigeon, pintail, lesser scaup, redhead and canvasback are the predominant duck species during migration and surveys indicate that approximately 70 percent of the black ducks in the Mississippi flyway use these wetlands during the fall migration (**USFWS 2009c**).

The Black Swamp Bird Observatory (BSBO), an independent, non-profit organization has worked in the Navarre Marsh and surrounding areas for the past 20 years collecting daily bird data throughout the spring and fall migrations. Due to the observatory's efforts, they provide the most up-to-date data for this area. The 10 most common passerine bird species banded by the BSBO during the spring 2008 migration on the Navarre Marsh alone were Myrtle warbler (1082), White-throated sparrow (758), Gray catbird (460), Yellow warbler (393), Traill's flycatcher (339), Magnolia warbler (414), Nashville warbler (299), Western palm warbler (296), Red-winged blackbird (211) and the American redstart (250). In total, 140 different bird species had been banded, totaling 7,805 individuals. During the same 2008 spring time period, raptors were also surveyed throughout the entire ONWR wetland complex. The survey lists 18 different raptor species totaling 8,760 individuals (**BSBO 2009a, b**).

The marshes along the southwestern shore of Lake Erie provide much of the feeding areas for both migratory and nesting birds that utilize this region of Lake Erie. The variety of insect prey available in the marshes permits these birds to refuel for their continued migration. The nesting birds of West Sister Island, such as Herons and egrets, have been documented as flying several times a day to the mainland refuges for food (**GORP 2009**). Ensuring that a variety of high quality food as well as cover are available to the high diversity of species utilizing the marsh, the Navarre Marsh is heavily managed through the use of earthen dikes, which surround and transect the marsh, to control water levels to promote plant succession to meet seasonal wildlife's food and habitat needs (**FirstEnergy 2008**; **AEC 1973**).

About 35 species of mammals can be found within or around the ONWR wetland complex due to the abundance and variety of food and cover available in these habitats. Common species include deer, coyotes, fox, rabbits, squirrels, muskrats, mink, skunks, shrews, mice and weasels (**USFWS 2009c**; **Herdendorf 1987**, Page 12).

Reptiles and amphibians are also present on the ONWR complex. Sixteen different species of turtles and snakes can be found in the area. Common reptiles and amphibians include garter snakes, fox snakes, northern watersnakes, Blanding's turtles, Midland painted turtles, snapping turtles, bullfrogs and leopard frogs. The Five-lined skink is the only lizard species found in the region and is common in the Navarre Marsh (**Campbell 1995**, Page 184; **Herdendorf 1987**, Pages. 102-104; **USFWS 2009c**).

Over 370 terrestrial vertebrates have been reported on or near the Navarre Marsh area, including 325 bird species (174 of these bird species were identified in the Navarre Marsh), 35 species of mammals, 5 species of amphibians and 11 species of reptiles (**BSBO 2009a, b** and **USFWS 2009c**).

Approximately 800 species of vascular plants are found in the low-lying marsh communities of the Lake Erie Region, of which, less than 100 species are trees and shrubs (**Bolsenga and Herdendorf 1993**, Page 372). Throughout this lowland area, common wetland species include cattail, bur reed, grasses, spatterdock, water lily and smartweed. A stable beach ridge separates the Navarre Marsh from Lake Erie. Common plants growing on the beach ridge include sandbar willow, staghorn sumac and elderberry. Behind the beach ridge there is a hardwood swamp zone. Here, cottonwood, hackberry, sycamore, river-bank grape, black willow and staghorn sumac are commonly found. The plant communities that grow on the earthen dikes that surround the marsh likely change as the marsh is managed and dikes are repaired. Common species found on earthen dikes are similar to those found in wet meadows and include common greenbrier, swamp thistle, cone flower, common milkweed, asters, river-bank grape and common burdock (**AEC 1973**;Section 2.7.2; **Campbell 1995**, Pages 189-192; **Bolsenga and Herdendorf 1993**, Pages 372, 380).

2.4.3 Habitat Management

The USFWS completed the Ottawa National Wildlife Refuge Comprehensive Conservation Plan in 2000. The plan was created to outline how the Refuge will fulfill its legal purpose and contribute to the National Wildlife Refuge System's wildlife, habitat and public use goals. The Conservation Plan is intended to be updated every 5 to 10 years based on information gathered through monitoring the site (**USFWS 2009c**).

Within the Navarre Marsh, habitat is managed through the use of electric pumps. The pumps are used to lower marsh pools during spring migrations, exposing knolls thereby creating nesting habitat as well as promoting vegetation growth throughout the summer. In early fall, the water levels are increased to accommodate southward migrations (**FirstEnergy 2008**; **AEC 1973**).

The biodiversity of this ecoregion is being challenged by invasive species. These species are of focus for study and control by the ODNR, USFWS and ONWR staffs. Invasive species that are of concern and are considered a priority for management include purple loosestrife, reed canary grass, phragmites and flowering rush (**USFWS 2009c**).

Purple loosestrife, reed canary grass and phragmites all grow in a variety of wetland habitats, primarily in northern Ohio. All three species invade both natural and disturbed wetlands, replacing native vegetation with nearly homogeneous stands of each. These three species are classified as “targeted species” by the ODNR as they are the most invasive and difficult to control. Management techniques used to eradicate loosestrife include hand-pulling or digging up small stands. Currently, biological controls using insects are being researched. Reed canary grass management techniques include burning and mowing and phragmites is best controlled by cutting. In all three species herbicides are used to treat larger stands (**ODNAP 2009d**; **TNC 2009**).

Flowering rush is not considered to be a targeted species by the ODNR, but is a species that is on the state’s “well-established invasive species” list. Species put on this list have a distribution that is state-wide or regional in Ohio and pose moderate to serious threats to natural areas. Flowering rush can grow as an emergent plant along shorelines and as a submersed plant in lakes and rivers. This species is best managed by cutting the stalk of the plant below the water or digging it up taking care to remove all root fragments. Mechanical methods of harvesting are not recommended as root fragments of the plant are able to form new plants. Herbicides are effective, but not selective and can spread easily to native plants through the water (**MIPN 2009**; **TNC 2009**).

Within the marsh, there is a large lacustrine area which contains both permanently flooded and semipermanently flooded sections; the latter of the two contains some aquatic beds. There are sections of the marsh that are seasonally flooded, comprised of broad-leaved deciduous species as well as containing aquatic beds. The section of the Navarre Marsh that adjoins the intake channel is classified as being a mix between a broad-leaf deciduous scrub – shrub marsh and an emergent marsh, both of which are semipermanently flooded. To the northeast of and adjoining the intake channel there is a marsh area classified as having sections that are forested, containing broad-leaved deciduous species as well as sections that contain emergent species and that are persistent. Both areas are classified as being seasonally flooded. Notably, nearly all wetlands and lake-like areas located on the Davis-Besse site are classified as Palustrine aquatic bed, semipermanently flooded diked/impounded (PABFh) or Palustrine forested broad-leaf deciduous, seasonally flooded (PFO1C) (**USFWS 2009a**).

2.4.4 References

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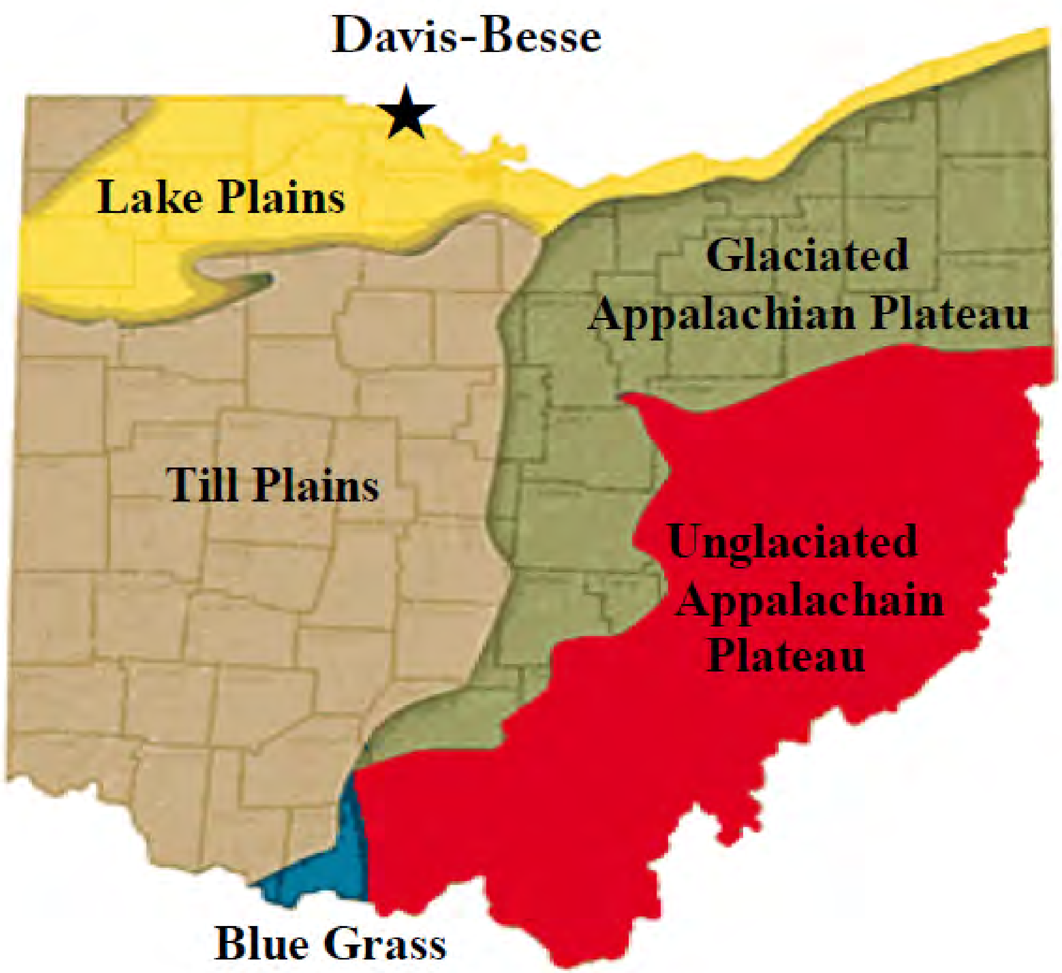
USFWS 2009c. Ottawa National Wildlife Refuge Complex Comprehensive Conservation Plan, U.S. Fish and Wildlife Service, http://www.fws.gov/midwest/Planning/ottawa/index.html, accessed March 23, 2009.

Figure 2.4-1: Ohio's Five Physiographic Regions



Source: **ODNAP 2009c**

2.5 THREATENED OR ENDANGERED SPECIES

2.5.1 OVERVIEW

The USFWS has listed several species with ranges that include the Navarre Marsh area as threatened or endangered at the federal level or candidates for such listing. Similarly, threatened, endangered and candidate species have been designated at the state level under programs administered by the Ohio Department of Natural Resources, Division of Wildlife and Division of Natural Areas and Preserves. The state resource agencies also use several additional classifications to guide conservation and management of wildlife resources. The total number of species according to taxa that are classified as endangered, threatened, species of concern, special interest, extirpated, or extinct for the state of Ohio is provided in Table 2.5-1. Table 2.5-2 lists those federally listed and candidate species that have been identified as being in, around or potentially occurring on the Davis-Besse site. Table 2.5-2 also lists state-listed, candidate and additional status given species that are considered to have a potential for occurring on or near the Davis-Besse site.

Federal and state-listed terrestrial species closely associated with the habitats found in the HELP ecoregion include the, star-nosed mole, Indiana bat, piping plover, Karner Blue butterfly, Virginia rail, sora, yellow-bellied sapsucker, least flycatcher, loggerhead shrike, Golden-winged warbler, magnolia warbler, Kirtland warbler, mourning warbler, Canada warbler, hermit thrush, sharp-shinned hawk, peregrine falcon, bald eagle, osprey, northern harrier, sandhill crane, American bittern, least bittern, king rail and black tern. Species and state and federal classification can be found in Table 2.5-2.

Federal and state-listed reptiles and amphibians that can be found in this ecoregion include the Lake Erie water snake, eastern massasauga rattlesnake, copperbelly water snake, spotted turtle, Blanding's turtle, box turtle and Kirtland's water snake (**USFWS 2009c**, **d**, **e**, **f**, **g**; **ODNAP 2009a, b, c, d**; **ODNR 2009**). The Lake Erie water snake is a federally-listed threatened species. They live on the cliffs and rocky shorelines of limestone islands and feed on fish and amphibians. Some of the Lake Erie water snakes are protected under the Endangered Species Act and some are not. The distinction is made on the basis of where the snakes are found. The snakes that live on a group of limestone islands in western Lake Erie that are located more than one mile from the Ohio and Canada mainlands are protected under the Endangered Species Act. Water snakes on the Ohio mainland, Mouse Island, and Johnson's Island are not protected under the Endangered Species Act. The primary reason for the snakes decline is habitat destruction (**USFWS 2008**).

Aquatic species that have been given a state or federal status that can be found in the HELP ecoregion include lake sturgeon, spotted gar, cisco, lake whitefish, burbot, eastern sand darter, channel darter, purple wartyback, snuffbox, wavy-rayed lampmussel, eastern pondmussel, black sandshell, threehorn wartyback, fawnsfoot, deertoe, and rayed bean (**USFWS 2009c**, **d**, **e**, **f**, **g**; **ODNAP 2009a, b, c, d**; **ODNR 2009**).

2.5.2 DAVIS-BESSE SITE

As discussed in Sections 2.2 and 2.4, the Davis-Besse site and associated wetlands provide habitat for numerous wildlife and plant species. Included are remnant habitats for terrestrial and aquatic organisms that were wide-spread before much of the region was converted to agricultural and urban lands. For example, Navarre marsh and similar surrounding wetlands were once part of a much larger wetland complex known as the Great Black Swamp that covered 300,000 acres. Today, only about 10% of this original wetland habitat remains (**USFWS 2009c**).

Federal and state-listed species occurring onsite or in the immediate vicinity of Davis-Besse are described by the USFWS and the ODNR. Several state, federal and independent agencies have reported listed species which include 1 mammal, 22 bird, 6 reptile, 7 fish, 9 mussel and 11 invertebrate species that are or potentially could be on the Davis-Besse site (**USFWS 2009c**, **d**, **e**, **f**, **g**; **ODNAP 2009a, b, c, d**; **ODNR 2009**; **BSBO 2010a**, **b**). Plant data is not as complete as animal data, so the rare plant list from Ottawa County, prepared by the Ohio Division of Natural Areas and Preserves, has been used to determine which species are associated with habitats similar to those found on the Davis-Besse site. Of the 69 state-listed rare plant species that occur in Ottawa County, 36 species grow in habitats that can be found within the Davis-Besse site and therefore could potentially be present. Of these, two species, the eastern prairie fringed orchid and the lakeside daisy are federally threatened (**ODNAP 2009b**).

In 2008, the BSBO banded several designated state-listed birds within the Navarre Marsh. These include Virginia rail, sora, yellow-bellied sapsucker, least flycatcher, loggerhead shrike, golden-winged warbler, magnolia warbler, Kirtland warbler, mourning warbler, Canada warbler, hermit thrush, sharp-shinned hawk, peregrine falcon, bald eagle, osprey, northern harrier, sandhill crane. Additional species not banded by the BSBO, but that could potentially utilize the Navarre Marsh include the American bittern, least bittern, king rail, and black tern. Of these species, only Kirtland's warbler is listed as federally endangered (**ODNR 2009**). Table 2.5-3 lists the passerine species for the spring and fall migrations for 2007 and 2008 along with total number of each species banded during each migration on the Navarre Marsh. Table 2.5-3 also lists the raptor species surveyed during spring of 2008 throughout the Navarre Marsh and ONWR complex as well as total number for each species sighted during that time period.

Review of the USFWS website revealed that the only designated critical habitat in the area was for the piping plover. Although the piping plover is not listed as being found on or potentially near the Davis-Besse site, it has a federal and state listing as endangered. The USFWS has designated two sites as piping plover critical habitat in northwest Ohio. The first site is located in Erie County around the Sheldon MarshState Nature Preserve, and the other site is in Lake County near the Headlands Dunes State Nature Preserve, approximately 30 miles and 115 miles east of the Navarre Marsh, respectively (**USFWS 2009h**,**i**).

All of the nine listed species of mussels were found in the western Lake Erie region by the Ohio State University Center for Lake Erie Area Research (**Herdendorf 1983**, Pages 121-122). Current data provided by the ODNR Natural Heritage Program indicates that these same species can still be found in this region of the lake, and therefore have the potential for occurring on or near the Davis-Besse Site (**ODNAP 2009a**). The only mussel given a federal status is the rayed bean, which is listed as a species of concern. There are seven fish species that can be found in this region of western Lake Erie that are also variously state-designated as being endangered, threatened, a species of concern or candidate species, none of which have been given a federal status (**ODNR 2009**, **USFWS 2009d**).

2.5.3 References

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Table 2.5-1: Number of Species in Major Taxa Classified as Endangered, Threatened, Species of Concern, Special Interest, Extirpated, or Extinct in Ohio, January 2009

Taxon	Endangered	Threatened	Concern	Special Interest	Extirpated	Extinct
Mammals	5	0	8	0	9	0
Birds	16	11	13	31	4	2
Reptiles	5	2	13	0	0	0
Amphibians	5	1	2	0	0	0
Fishes	23	13	11	0	5	2
Mollusks	24	4	9	0	13	5
Crayfishes	0	2	3	0	0	0
Isopods	0	0	2	0	0	0
Pseudo-scorpions	0	0	1	0	0	0
Dragonflies	13	6	1	0	0	0
Damselflies	3	0	0	0	0	0
Caddisflies	3	6	3	00	0	0
Mayflies	2	0	1	0	0	0
Midges	1	3	1	0	0	0
Crickets	0	0	1	0	0	0
Butterflies	8	1	2	1	1	0
Moths	14	4	22	10	0	0
Beetles	3	2	6	0	0	0
Total	125	55	99	42	32	9

Source: **ODNR 2009**

Table 2.5-2: Federal and State Listed Species of Known Occurrences or Potentially Occurring on the Davis-Besse Site

Common Name	Scientific Name	State Status	Federal Status
Plants			
alpine rush	*Juncus alpinus*	P	
American beach grass	*Ammophila breviligulata*	T	
American sweet flag	*Acorus americanus*	P	
American water milfoil	*Myriophyllum sibiricum*	T	
balsam poplar	*Populus balsamifera*	E	
baltic rush	*Juncus balticus*	P	
bearded wheat grass	*Elymus trachycaulus*	T	
Bebb's sedge	*Carex bebbii*	P	
bullhead-lily	*Nuphar variegata*	E	
bushy cinquefoil	*Potentilla paradoxa*	T	
Canada milk-vetch	*Astragalus canadensis*	T	
Caribbean spike-rush	*Eleocharis geniculata*	E	
deer's-tongue arrowhead	*Sagittaria rigida*	P	
Drummond's rock cress	*Arabis drummondii*	E	
prairie fringed orchid	*Platanthera leucophaea*	T	T
flat-stemmed pondweed	*Potamogeton zosteriformis*	P	
floating pondweed	*Potamogeton natans*	P	
Garber's sedge	*Carex garberi*	E	
golden fruited sedge	*Carex aurea*	T	
lakeside daisy	*Tetraneuris herbacea*	E	T
little green sedge	*Carex viridula*	P	
low umbrella sedge	*Cyperus diandrus*	P	
narrow-leaved blue-eyed grass	*Sisyrinchium mucronatum*	E	
ovate spike-rush	*Eleocharis ovata*	E	
Philadelphia panic grass	*Panicum philadelphicum*	E	
Pursh's bulrush	*Schoenoplectus purshianus*	P	
Richardson's pondweed	*Potamogeton richardsonii*	P	
rock elm	*Ulmus thomasii*	P	
Smith's bulrush	*Schoenoplectus smithii*	E	

Table 2.5-2: Federal and State Listed Species of Known Occurrences or Potentially Occurring on the Davis-Besse Site
(continued)

Common Name	Scientific Name	State Status	Federal Status
Smith's bulrush	*Scirpus smithii*	E	
southern wapato	*Lophotocarpus (=Sagittaria) calycinus*	P	
Sprengel's sedge	*Carex sprengelii*	T	
variegated scouring-rush	*Equisetum variegatum*	E	
wapato	*Sagittaria cuneata*	T	
wheat sedge	*Carex atherodes*	P	
wild rice	*Zizania aquatica*	T	
Invertebrates			
Insects			
Canada darner	*Aeshna canadensis*	E	
elfin skimmer	*Nannothemis bella*	E	
frosted elfin	*Incisalia irus*	E	
Karner blue	*Lycaeides melissa samuelis*	E	E
marsh bluet	*Enallagma ebrium*	T	
persius dusky wing	*Erynnis persius*	E	
plains clubtail	*Gomphus externus*	E	
purplish copper	*Lycaena helloides*	E	
silver-bordered fritillary	*Boloria selene*	T	
tiger beetle	*Cicindela hirticollis*	T	
unexpected cycnia	*Cycnia inopinatus*	E	
Mussels			
black sandshell	*Ligumia recta*	T	
deertoe	*Truncilla truncata*	SC	
eastern pondmussel	*Ligumia nasuta*	E	
fawnsfoot	*Truncilla donaciformis*	T	
purple wartyback	*Cyclonaias tuberculata*	SC	
rayed bean	*Villosa fabalis*	E	C
snuffbox	*Epioblasma triquetra*	E	
threehorn wartyback	*Obliquaria reflexa*	T	
wavy-rayed lampmussel	*Lampsilis fasciola*	SC	

Table 2.5-2: Federal and State Listed Species of Known Occurrences or Potentially Occurring on the Davis-Besse Site
(continued)

Common Name	Scientific Name	State Status	Federal Status
Fish			
burbot	*Lota lota*	SC	
channel darter	*Percina copelandi*	T	
cisco	*Coregonus artedii*	E	
eastern sand darter	*Ammocrypta pellucida*	SC	
lake sturgeon	*Acipensar fulvescens*	E	
lake whitefish	*Coregonus clupeaformis*	SC	
spotted gar	*Lepisosteus oculatus*	E	
Reptiles			
Blanding's turtle	*Emydoidea blandingi*	SC	
box turtle	*Terrapene Carolina*	SC	
eastern massasauga swamp rattler	*Sistrurus catenatus catenatus*	E	C
Kirtland's water snake	*Natrix kirtlandii*	T	
Lake Erie water snake	*Natrix sipedon insularium*	E	T
spotted turtle	*Clemmys guttata*	T	
Birds			
American bittern	*Botaurus lentiginosus*	E	
bald eagle	*Haliaeetus leucocephalus*	T	
black tern	*Chlidonias niger*	E	
Canada warbler	*Wilsonia canadensis*	SI	
golden-winged warbler	*Vermivora chrysoptera*	E	
hermit thrush	*Catharus guttatus*	T	
king rail	*Rallus elegans*	E	
Kirtland's warbler	*Dendroica kirtlandii*	E	E
least bittern	*Ixobrychus exilis*	T	
least flycatcher	*Empidonax minimus*	T	
loggerhead shrike	*Lanius ludovicianus*	E	
magnolia warbler	*Dendroica magnolia*	SI	
mourning warbler	*Oporornis philadelphia*	SI	
northern harrier	*Circus cyaneus*	E	

Table 2.5-2: Federal and State Listed Species of Known Occurrences or Potentially Occurring on the Davis-Besse Site
(continued)

Common Name	Scientific Name	State Status	Federal Status
osprey	*Pandion haliaetus*	T	
peregrine falcon	*Falco peregrinus*	T	
sandhill crane	*Grus canadensis*	E	
sharp-shinned hawk	*Accipiter striatus*	SC	
sora rail	*Porzana carolina*	SC	
Virginia rail	*Rallus limicola*	SC	
yellow-bellied sapsucker	*Sphyrapicus varius*	E	
Mammals			
star-nosed mole	*Condylura cristata*	SC	

Sources: **BSBO 2010a**, **b**; **ODNR 2009**; **USFWS 2009c**, **d**, **e**; **CFR 2008a**, **b**

Table Captions:

State Status

E: ENDANGERED - A native species or subspecies threatened with extirpation from the state.

T: THREATENED - A species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists.

SC: SPECIES OF CONCERN - A species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern but for which information is insufficient to permit an adequate status evaluation.

SI: SPECIAL INTEREST - A species that occurs periodically and is capable of breeding in Ohio. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance Ohio's wildlife diversity.

P: POTENTIALLY THREATENED - A native Ohio plant species may be designated potentially threatened if one or more of the following criteria apply:

1. The species is extant in Ohio and does not qualify as a state endangered or threatened species, but it is a proposed federal endangered or threatened species or a species listed in the Federal Register as under review for such proposal.

Table 2.5-2: Federal and State Listed Species of Known Occurrences or Potentially Occurring on the Davis-Besse Site
(continued)

2. The natural populations of the species are imperiled to the extent that the species could conceivably become a threatened species in Ohio within the foreseeable future.

3. The natural populations of the species, even though they are not threatened in Ohio at the time of designation, are believed to be declining in abundance or vitality at a significant rate throughout all or large portions of the state.

Federal Status

E: ENDANGERED - An animal or plant species in danger of extinction throughout all or a significant part of its range.

T: THREATENED - Likely to become endangered within the foreseeable future throughout all or a significant part of its range.

C: CANDIDATE - Sufficient information exists to support listing as endangered or threatened.

Table 2.5-3: Species and Total Numbers of Birds Banded and or Sighted at the Navarre Marsh or Throughout the ONWR Complex during Spring and Fall Migrations, 2007- 2008

Number of Birds Banded at the Navarre Marsh					
Passerine					
Common Name	**Scientific Name**	**2008**		**2007**	
		Spring	**Fall**	**Spring**	**Fall**
Canada warbler	*Oporornis philadelphia*	105	9	182	8
golden-winged warbler	*Lanius ludovicianus*	1	0	2	1
hermit thrush	*Wilsonia canadensis*	95	183	98	262
Kirtland warbler	*Dendroica magnolia*	0	N/A	0	N/A
least flycatcher	*Sphyrapicus varius*	56	1	96	6
loggerhead shrike	*Empidonax minimus*	0	N/A	1	N/A
magnolia warbler	*Vermivora chrysoptera*	414	101	1,282	113
mourning warbler	*Dendroica kirtlandii*	88	6	134	20
sharp-shinned hawk	*Accipiter striatus*	12	0	4	1
sora	*Porzana Carolina*	0	N/A	0	N/A
Virginia rail	*Rallus limicola*	0	N/A	0	N/A
yellow-bellied sapsucker	*Botaurus lentiginosus*	2	5	3	5

Raptors*			
Common Name	**Scientific Name**	**2008 Total Count**	**2007**
bald eagle	*Haliaeetus leucocephalus*	371	181
northern harrier	*Circus cyaneus*	167	122
osprey	*Pandion haliaetus*	29	14
peregrine falcon	*Falco peregrinus*	3	8
sandhill crane	*Grus canadensis*	13	43
sharp-shinned hawk	*Accipiter striatus*	389	492

Source: **BSBO 2009; BSBO 2010a, b**

* Raptors are only surveyed in the spring.

2.6 DEMOGRAPHY

2.6.1 GENERAL DEMOGRAPHIC CHARACTERISTICS

The study area is defined by a 50-mile radius around Davis-Besse and includes all or parts of 15 counties in Ohio, four counties in Michigan, and 10 Canadian census subdivisions in Ontario. Toledo, Ohio, is the nearest major city to Davis-Besse; its center is approximately 30 miles to the west-northwest of Davis-Besse. The 2000 U.S. Census Bureau decennial census indicated that the urban area of Toledo has a population of 502,146. A portion of Detroit, Michigan, lies to the north of Davis-Besse. This urban area's 2000 population is 3,900,539. To the north, most of the Canadian City of Windsor lies approximately 50 miles from Davis-Besse. The 2001 Canada Census estimated the population at 208,402. The urbanized area of Lorain-Elyria, Ohio, is approximately 50 miles east of Davis-Besse. The 2000 census population estimate for this urbanized area is 188,818. Cleveland, Ohio, is another major city in the vicinity; its center is approximately 70 miles (113 km) east of Davis-Besse. The urbanized population figure for the 2000 census for Cleveland is 1,785,038 (**ESRI 2007**). The study area is shown in Figure 2.6-1.

Table 2.6-1 through Table 2.6-7 present general demographic information for the jurisdictions around Davis-Besse. These include the population of U.S. Census Bureau (USCB) block-groups within a 50 mile radius of the plant. The Ohio counties of Lucas, Ottawa, Sandusky, and Wood are included in the general demographic information because most of the Davis-Besse work force resides within these areas (Section 3.4). Background data presented includes the total population of the 19 U.S. counties and 10 Canadian census subdivisions that fall entirely or partly within 50 miles of the plant. Population projections are included for the states of Michigan and Ohio, as well as the Canadian province of Ontario.

2.6.1.1 Current Demographic Characteristics

The population of persons residing within 20 and 50 miles of the Davis-Besse site was determined from the 2000 census block group data. Census block group population data were included if the block fell partly or entirely within an area. Most of the census blocks that fell partly within a zone were low density and, as a result, were not thought to significantly bias population size upward if included. Population density of the two zones was calculated using the total area circumscribed by their respective radii. This calculation provides a conservatively higher estimate of density than using an area defined by census blocks including those that may fall partly outside the 20 or 50 mile radii.

Using the methodology described above, an estimated 2,375,624 people lived within 50 miles of Davis-Besse in 2000, with a population density of 316 people per square mile (Table 2.6-1). This density is higher than the density for the state of Ohio (253 people per square mile), Michigan (103 people per square mile), and Ontario (27 people per square mile). Within the 20 mile area there were an estimated 129,411 persons, at a density of 169 persons per square mile (**ESRI 2007**).

Applying the GEIS population sparseness criterion to Table 2.6-1, Davis-Besse is sparseness Category 4, "least sparse" (≥ 120 persons per square mile within 20 miles), as shown in Table 2.6-1. Applying the GEIS proximity criterion using Table 2.6-1 again, Davis-Besse falls into Category 4, "in close proximity" (>190 persons per square mile within 50 miles). Per the GEIS sparseness-proximity matrix, Davis-Besse is located in a high population area (**NRC 1996**, Section C.1.4).

2.6.1.2 Population Projections

As shown in Table 2.6-1, a population increase of 3.1% for 2000 - 2005 was expected for the combined U.S. block groups and Canadian census subdivisions within a 50 mile radius of Davis-Besse (**ESRI 2006, ESRI 2007, StatCan 2006b**). A slight decline (-0.4%) from the present population of 129,411 was expected for U.S. block groups within 20 miles of Davis-Besse (**ESRI 2006, ESRI 2007**). The expected change in population (2000 – 2005) for Ohio and Michigan are similar, 1.0% and 1.6%, respectively (**USCB 2006**). Counties near Davis-Besse expected to have a declining population were Lucas, Ottawa, and Sandusky. Lucas County's population was expected to increase by 2.4% in the time period 2000 – 2005 (**MHAL 1996**; **ODD 2004**).

Population projections by county to 2040 indicate that five Ohio counties will experience a population decline: Crawford, Lucas, Ottawa, Sandusky, and Seneca. One Michigan county, Wayne, will also have a population decline over the same time period (Table 2.6-2 and Table 2.6-4). Canadian population projections were derived from estimates of the entire Province of Ontario's growth over the time period of 2006 – 2040 (**StatCan 2006a, b**). The growth rate for this area is higher for the period 2006 – 2010, but declines thereafter (Table 2.6-3 and Table 2.6-5).

2.6.2 Minority and Low Income Populations

Minority and low-income populations in the 50-mile geographic area were analyzed based on 2000 decennial census block data. The results were compiled and maps were produced showing the geographic location of minority and low-income populations in relation to the site. Information for both groups was then reviewed with respect to the NRC Office of Nuclear Reactor Regulation guidance (**NRC 2004**).

2.6.2.1 Minority Populations

Minority populations are defined as American Indian or Alaskan Native, Asian, Black, Native Hawaiian or Pacific Islander, Multi-Racial, and Hispanic ethnicity. Other races are analyzed as one group (Other). The relative sizes of minority populations in jurisdictions surrounding Davis-Besse are included in Table 2.6-6 and Table 2.6-7.

The NRC determined that a minority population exists in a specific census block if either of two criteria is met:

- The minority population percentage of the census block exceeds 50%.
- The minority population percentage of the census block is significantly greater (more than 20%) than the minority population percentage in the geographic region chosen for comparison.

The comparison area selected for this analysis consists of the 19 counties surrounding Davis-Besse that are entirely or partly within 50 miles of the station. This area contains 4,002 census block-groups. The study area is defined as a 50 mile radius around Davis-Besse and is a subset of the comparison area, consisting of all or parts of the counties that fall within the 50 mile radius; 1,747 census block groups are within 50 miles of Davis-Besse (Figure 2.6-1). Figure 2.6-2 through Figure 2.6-7 locate the minority block groups with the 50-mile radius.

Within the Canadian census subdivisions, minority groups make up less than 14% of the population. Windsor has the most diversity with a white population of 79%, Asian population of 11%, and 5% other ethnic groups. Pelee's population of 256, has a relatively large Latin American population (13%) (Table 2.6-5 and Table 2.6-7).

2.6.2.2 Low Income Populations

Low-income populations are defined by assessing household income according to a poverty income threshold determined by the U.S. Census Bureau (USCB). The Canadian census provides the percentage of persons in low income after tax for census subdivisions. Figure 2.6-8 shows the low-income population block groups within a 50-Mile radius of the Davis-Besse site.

The NRC determined that a low-income population exists in a specific census block if either of two criteria is met:

- The low income population percentage of the census block group exceeds 50%.

- The low income population percentage of the census block group is significantly greater (more than 20%) than the low income population percentage in the geographic region chosen for comparison.

The number of census block groups within a 50 mile radius of Davis-Besse meeting the above criteria for low-income households are included in Table 2.6-8 (50% criterion) and Table 2.6-9 (20% criterion). Thirteen block groups met the 50% criterion: eight are in Lucas County, two are in Wood County, and three are in Wayne County. One hundred twenty block groups met the 20% criterion, including block groups in Erie, Huron, Lorain, Lucas, Wood, Monroe, and Wayne counties. Lucas County, which contains Toledo, has 62 low income block groups. Wayne County, Michigan, which contains a portion of Detroit, has 36 low income block groups.

2.6.2.3 Migrant Populations

Migrant population totals by state, county, farms, and workers are summarized in Table 2.6-10. Data on migrant populations for the 19 counties in Ohio and Michigan within the 50 miles of Davis-Besse were obtained from the US Department of Agriculture 2002 Census of Agriculture.

Migrant laborers were defined as any worker whose employment required travel that prevented the migrant worker from returning to his/her permanent place of residence the same day and worked on a farm less than 150 days. The 2007 Census of Agriculture-County Data (**USDA 2007a, b**) estimates that there were 1,827 farms in the 15 Ohio counties surrounding Davis-Besse, with a total of 8,166 farm workers that worked less than 150 days. The four counties in Michigan surrounding Davis-Besse had 669 farms with a total of 3,379 farm workers that worked less than 150 days.

2.6.2.4 Seasonal and Transient Populations

As described in Section 2.9.6, the area in the vicinity of Davis-Besse comprises a significant percentage of all recreation in the four-county area. Ottawa County, in particular, has the most facilities and acreage devoted to state parks, forests, natural preserves, and wildlife. Its location along Lake Erie and its islands provide a wide variety of opportunities for water-based recreational activities.

As a result, there are significant seasonal and transient population groups within a 10-mile radius of Davis-Besse. Table 2.6-11 lists the estimated population of these groups, along with the permanent population within the 10-mile area. The seasonal population group comprises those people who reside in the area during warmer months, principally May through October. The transient population group comprises those people who enter the area for a specific purpose (e.g., recreation) and who leave on the same day or stay overnight at motels and hotels.

As shown in Table 2.6-11, the total combined seasonal and transient population is equivalent to the total permanent population.

2.6.3 REFERENCES

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

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Table 2.6-1: Population Density and Recent Change in Major Jurisdictions Near Davis-Besse

Location	2000	2005	Percent Change	2000 Density (people/ sq. mi)	2005 Density (people/ sq. mi)
Ohio	11,353,140	11,470,685	1.0%	277	280
Michigan	9,938,444	10,100,833	1.6%	175	178
Ontario, Canada [1]	11,410,046	12,541,400	9.9%	33	36
Lucas County, OH	455,050	449,290	-1.3%	1337	1320
Ottawa County, OH	40,990	40,850	-0.3%	161	160
Sandusky County, OH	61,790	61,060	-1.2%	151	149
Wood County, OH	121,070	123,960	2.4%	196	201
Within 50 Miles of Davis-Besse	2,375,624	2,448,608	3.1%	316	326
Within 20 Miles of Davis-Besse	129,411	128,878	-0.4%	169	168

Sources: **ESRI 2007**; **StatCan 2001**; **StatCan 2006a**; **USCB 2000a**; **MHAL 1996**[1]; **ODD 2004**

Note:

(1) Population Figure for Ontario is from the 2001 Canadian census

Table 2.6-2: Population Projections for Counties Surrounding Davis-Besse

State	County	2000 Census	2005 Estimate	Projections						
				2010	2015	2020	2025	2030	2035	2040
Ohio	Ashland	52,520	54,300	56,160	57,540	59,010	60,010	61,050	62063	63083
Ohio	Crawford	46,970	46,250	45,450	44,800	44,250	43,850	43,390	42970	42540
Ohio	Erie	79,550	81,020	81,420	82,260	82,400	83,180	83,060	83540	83870
Ohio	Fulton	42,080	43,270	44,610	45,830	47,210	48,190	49,110	50070	51020
Ohio	Hancock	71,300	73,030	74,180	75,740	76,910	78,250	79,040	80197	81262
Ohio	Henry	29,210	29,440	29,540	29,850	29,990	30,200	30,110	30220	30280
Ohio	Huron	59,490	60,830	62,040	62,610	63,430	63,690	64,020	64303	64598
Ohio	Lorain	284,660	288,400	290,840	295,660	299,630	306,720	312,540	319207	325662
Ohio	Lucas	455,050	449,290	444,870	439,370	434,650	426,860	417,870	409680	401290
Ohio	Ottawa	40,990	40,850	40,790	40,450	40,270	39,400	38,520	37647	36772
Ohio	Richland	128,850	128,190	128,900	128,770	130,050	130,460	132,180	133027	134092
Ohio	Sandusky	61,790	61,060	59,940	58,910	57,900	57,130	56,420	55670	54930
Ohio	Seneca	58,680	57,560	56,750	55,420	54,260	52,620	50,920	49260	47590
Ohio	Wood	121,070	123,960	127,020	129,500	133,330	136,480	141,880	145780	150055
Ohio	Wyandot	22,910	22,870	23,090	23,180	23,400	23,360	23,240	23173	23093
Michigan	Lenawee	98,890	100939	100286	102299	104025	105502	106704	107620	108242
Michigan	Monroe	145,945	152234	153140	154592	155525	155845	155566	154690	153224
Michigan	Washtenaw	322,895	343858	350008	361477	372946	384050	394823	405217	415186
Michigan	Wayne	2,061,162	2025145	1914940	1864929	1822219	1785118	1753609	1727407	1706277

Sources: **USCB 2000a**; **MHAL 1996**(1); **ODD 2004**

Note: (1) Michigan county projections report estimated 2000 population; this table presents 2000 census.

Table 2.6-3: Population Projections for Canadian Census Subdivisions near Davis-Besse

Location	2001 Census	2005 Estimate	Projections						
			2010	2015	2020	2025	2030	2035	2040
Amherstburg	20,339	21,466	22,537	23,322	24,048	24,732	25,335	25,822	26,187
Chatham-Kent	107,341	108,010	112,099	116,008	119,616	123,021	126,018	128,443	130,259
Essex	20,085	20,043	20,758	21,482	22,150	22,781	23,336	23,785	24,121
Kingsville	19,619	20,650	21,666	22,421	23,119	23,777	24,356	24,825	25,176
Lakeshore	28,746	32,345	34,450	35,651	36,761	37,807	38,728	39,473	40,031
Lasalle	25,285	27,179	28,655	29,654	30,576	31,446	32,213	32,832	33,297
Leamington	27,138	28,494	29,878	30,920	31,882	32,789	33,588	34,235	34,719
Pelee	256	281	297	308	317	326	334	341	346
Tecumseh	25,105	24,237	25,102	25,977	26,786	27,548	28,219	28,762	29,169
Windsor	208,402	215,022	224,322	232,143	239,365	246,176	252,176	257,028	260,661

Sources: **StatCan 2001**; **StatCan 2006b**

Notes:

(1) Estimates and projections based on growth rates for the entire Province of Ontario under scenario 1 (StatCan 2006b, Page 72).

Table 2.6-4: Annual Projected Population Percentage Change for Counties Surrounding Davis-Besse

State	County	2000 Census	2005 Estimate	Projections						
				2010	2015	2020	2025	2030	2035	2040
Ohio	Ashland	52,520	3.4%	3.4%	2.5%	2.6%	1.7%	1.7%	1.7%	1.6%
Ohio	Crawford	46,970	-1.5%	-1.7%	-1.4%	-1.2%	-0.9%	-1.0%	-1.0%	-1.0%
Ohio	Erie	79,550	1.8%	0.5%	1.0%	0.2%	0.9%	-0.1%	0.6%	0.4%
Ohio	Fulton	42,080	2.8%	3.1%	2.7%	3.0%	2.1%	1.9%	2.0%	1.9%
Ohio	Hancock	71,300	2.4%	1.6%	2.1%	1.5%	1.7%	1.0%	1.5%	1.3%
Ohio	Henry	29,210	0.8%	0.3%	1.0%	0.5%	0.7%	-0.3%	0.4%	0.2%
Ohio	Huron	59,490	2.3%	2.0%	0.9%	1.3%	0.4%	0.5%	0.4%	0.5%
Ohio	Lorain	284,660	1.3%	0.8%	1.7%	1.3%	2.4%	1.9%	2.1%	2.0%
Ohio	Lucas	455,050	-1.3%	-1.0%	-1.2%	-1.1%	-1.8%	-2.1%	-2.0%	-2.0%
Ohio	Ottawa	40,990	-0.3%	-0.1%	-0.8%	-0.4%	-2.2%	-2.2%	-2.3%	-2.3%
Ohio	Richland	128,850	-0.5%	0.6%	-0.1%	1.0%	0.3%	1.3%	0.6%	0.8%
Ohio	Sandusky	61,790	-1.2%	-1.8%	-1.7%	-1.7%	-1.3%	-1.2%	-1.3%	-1.3%
Ohio	Seneca	58,680	-1.9%	-1.4%	-2.3%	-2.1%	-3.0%	-3.2%	-3.3%	-3.4%
Ohio	Wood	121,070	2.4%	2.5%	2.0%	3.0%	2.4%	4.0%	2.7%	2.9%
Ohio	Wyandot	22,910	-0.2%	1.0%	0.4%	0.9%	-0.2%	-0.5%	-0.3%	-0.3%
Michigan	Lenawee	98,890	2.1%	-0.6%	2.0%	1.7%	1.4%	1.1%	0.9%	0.6%
Michigan	Monroe	145,945	4.3%	0.6%	0.9%	0.6%	0.2%	-0.2%	-0.6%	-0.9%
Michigan	Washtenaw	322,895	6.5%	1.8%	3.3%	3.2%	3.0%	2.8%	2.6%	2.5%
Michigan	Wayne	2,061,162	-1.7%	-5.4%	-2.6%	-2.3%	-2.0%	-1.8%	-1.5%	-1.2%

Sources: **ESRI 2007**; **MHAL 1996**; **ODD 2004**; **USCB 2000a**

Note: (1) 2005 estimate and 2010-2040 projections indicate percentage increase from prior interval; i.e., population in 2010 is 3.9% higher than estimated population in 2005.

Table 2.6-5: Projected Population Change for Canadian Census Subdivisions Near Davis-Besse

Location	2006 Census	2010 Projection (4 year)	Projection					
			2015	2020	2025	2030	2035	2040
Amherstburg	21,748	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Chatham-Kent	108,177	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Essex	20,032	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Kingsville	20,908	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Lakeshore	33,245	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Lasalle	27,652	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Leamington	28,833	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Pelee	287	3.5%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Tecumseh	24,224	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%
Windsor	216,473	3.6%	3.5%	3.2%	2.9%	2.4%	1.9%	1.4%

Source: **StatCan 2006b**

Notes:

(1) Estimates and projections based on growth rates for the entire Province of Ontario under scenario 1 (StatCan 2006b, Page 72).

(2) 2005 estimate and 2010-2020 projections indicate percentage increase from prior interval; i.e., population in 2010 is 3.9% higher than estimated population in 2005.

Table 2.6-6: General Demography for American Jurisdictions Near Davis-Besse

Location	Sex	Age				Racial/Ethnic Makeup							
	Female	Median age	Under 5	18+	65+	White	Black	American or Alaska Native	Asian	Native Hawaiian or Pacific Islander	Other	Multi-Racial	Hispanic
U.S.Block groups within 50 miles of Davis-Besse	51%	36.4	7%	74%	13%	85%	10%	0.4%	1%	< 1%	2%	2%	5%
Surrounding U.S. Counties	51%	36.6	7%	74%	13%	88%	8%	0.3%	1%	< 1%	2%	2%	4%
Lucas County, OH	52%	35.2	7%	74%	13%	78%	17%	< 1%	1%	< 1%	2%	2%	5%
Ottawa County, OH	51%	41.0	5%	77%	16%	97%	1%	< 1%	< 1%	< 1%	1%	1%	4%
Sandusky County, OH	51%	37.3	6%	74%	14%	92%	3%	< 1%	< 1%	< 1%	3%	2%	7%
Wood County, OH	52%	32.6	6%	76%	11%	95%	1%	0.2%	1%	< 1%	1%	1%	3%

Sources: **ESRI 2007**; **USCB 2000a**

Table 2.6-7: General Demography in the Major Canadian Jurisdictions Near Davis-Besse

Location	Sex	Age				Racial / Ethnic Makeup					
	Female	Median age	Under 5	20+	65+	White	Black	Asian	Other	Multi-Racial	Latin American
Amherstburg	51%	38.6	6%	73%	12%	97%	2%	1%	< 1%	< 1%	< 1%
Chatham-Kent	51%	41.2	5%	75%	16%	96%	2%	2%	< 1%	< 1%	< 1%
Essex	50%	40.8	5%	74%	14%	98%	1%	< 1%	< 1%	< 1%	< 1%
Kingsville	50%	39.9	5%	75%	15%	96%	1%	< 1%	< 1%	< 1%	2%
Lakeshore	49%	37.5	6%	71%	10%	95%	1%	3%	< 1%	< 1%	< 1%
Lasalle	51%	37.3	6%	71%	10%	91%	1%	5%	2%	1%	< 1%
Leamington	49%	37.1	7%	72%	15%	90%	1%	2%	2%	< 1%	5%
Pelee	42%	45.1	2%	86%	16%	87%	< 1%	< 1%	< 1%	< 1%	13%
Tecumseh	51%	39.9	5%	73%	10%	94%	< 1%	4%	1%	< 1%	< 1%
Windsor	51%	37.5	6%	75%	14%	79%	4%	11%	5%	< 1%	1%

Source: **StatCan 2007**

Table 2.6-8: Minority and Low-Income Population Census Block Groups (50% Criteria)

Location		Total Block Groups within 50 Miles	Minority								Low-Income
State	County		Black	American or Alaska Native	Asian	Native Hawaiian or Pacific Islander	Other	Multi-Racial	Aggregate	Hispanic	
Ohio	Ashland	1	0	0	0	0	0	0	0	0	0
	Crawford	9	0	0	0	0	0	0	0	0	0
	Erie	73	2	0	0	0	0	0	2	0	0
	Fulton	16	0	0	0	0	0	0	0	0	0
	Hancock	56	0	0	0	0	0	0	0	0	0
	Henry	11	0	0	0	0	0	0	0	0	0
	Huron	48	0	0	0	0	0	0	0	0	0
	Lorain	87	0	0	0	0	0	0	10	3	0
	Lucas	431	67	0	0	0	0	0	79	0	8
	Ottawa	39	0	0	0	0	0	0	0	0	0
	Richland	4	0	0	0	0	0	0	0	0	0
	Sandusky	61	0	0	0	0	0	0	0	0	0
	Seneca	57	0	0	0	0	0	0	0	0	0
	Wood	86	0	0	0	0	0	0	0	0	2
	Wyandot	10	0	0	0	0	0	0	0	0	0
Michigan	Lenawee	18	0	0	0	0	0	0	0	0	0
	Monroe	127	0	0	0	0	0	0	1	0	0
	Washtenaw	29	4	0	0	0	0	0	4	0	0
	Wayne	584	56	0	0	0	0	0	73	28	3
Totals:		**1747**	**129**	**0**	**0**	**0**	**0**	**0**	**169**	**31**	**13**

Sources: **ESRI 2007**; **USCB 2000a, b**

Table 2.6-9: Minority and Low-Income Population Census Block Groups (20% Criteria)

Location		Total Block Groups within 50 Miles	Minority								Low-Income
State	County		Black	American or Alaska Native	Asian	Native Hawaiian or Pacific Islander	Other	Multi-Racial	Aggregate	Hispanic	
Ohio	Ashland	1	0	0	0	0	0	0	0	0	0
	Crawford	9	0	0	0	0	0	0	0	0	0
	Erie	73	7	0	0	0	0	0	7	0	2
	Fulton	16	0	0	0	0	0	0	0	0	0
	Hancock	56	0	0	0	0	0	0	0	0	0
	Henry	11	0	0	0	0	0	0	0	0	0
	Huron	48	0	0	0	0	0	0	0	0	1
	Lorain	87	16	0	0	0	3	0	20	11	8
	Lucas	431	103	0	0	0	0	0	107	3	62
	Ottowa	39	0	0	0	0	0	0	0	0	0
	Richland	4	0	0	0	0	0	0	0	0	0
	Sandusky	61	0	0	0	0	0	0	1	2	1
	Seneca	57	0	0	0	0	0	0	0	0	0
	Wood	86	0	0	0	0	0	0	0	0	9
	Wyandot	10	0	0	0	0	0	0	0	0	0
Michigan	Lenawee	18	0	0	0	0	0	0	0	0	0
	Monroe	127	1	0	0	0	0	0	1	0	1
	Washtenaw	29	9	0	0	0	0	0	9	0	0
	Wayne	584	72	0	2	0	34	2	113	41	36
Totals:		**1747**	**208**	**0**	**2**	**0**	**37**	**2**	**258**	**57**	**120**

Sources: **ESRI 2007**; **USCB 2000a, b**

Table 2.6-10: Seasonal Workers in Agriculture for Counties Surrounding Davis-Besse

State	County	2007 Census of Agriculture Farms with Seasonal Workers (Workers by days worked - Less than 150 days)	2007 Census of Agriculture Seasonal Workers (Workers by days worked - Less than 150 days)
Ohio	Ashland	184	421
	Crawford	107	313
	Erie	68	383
	Fulton	148	686
	Hancock	130	324
	Henry	119	487
	Huron	122	1,595
	Lorain	156	651
	Lucas	78	519
	Ottawa	78	406
	Richland	113	385
	Sandusky	140	699
	Seneca	154	347
	Wood	148	600
	Wyandot	82	350
Ohio County Total		**1,827**	**8,166**
Michigan	Lenawee	214	908
	Monroe	193	1,035
	Washtenaw	196	835
	Wayne	66	601
Michigan County Total		**669**	**3,379**

Sources: **USDA 2007a, b**

Table 2.6-11: Seasonal and Transient Estimated Population Within 10 Miles of Davis-Besse

Miles	Estimated Population		
	Permanent	Seasonal	Transient
0-2	715	0	0
2-5	1,357	1,863	9,454
5-10	12,998	963	3,237
Total	**15,070**	**2,826**	**12,691**

Figure 2.6-1: Demographic Study Area and Surrounding Counties

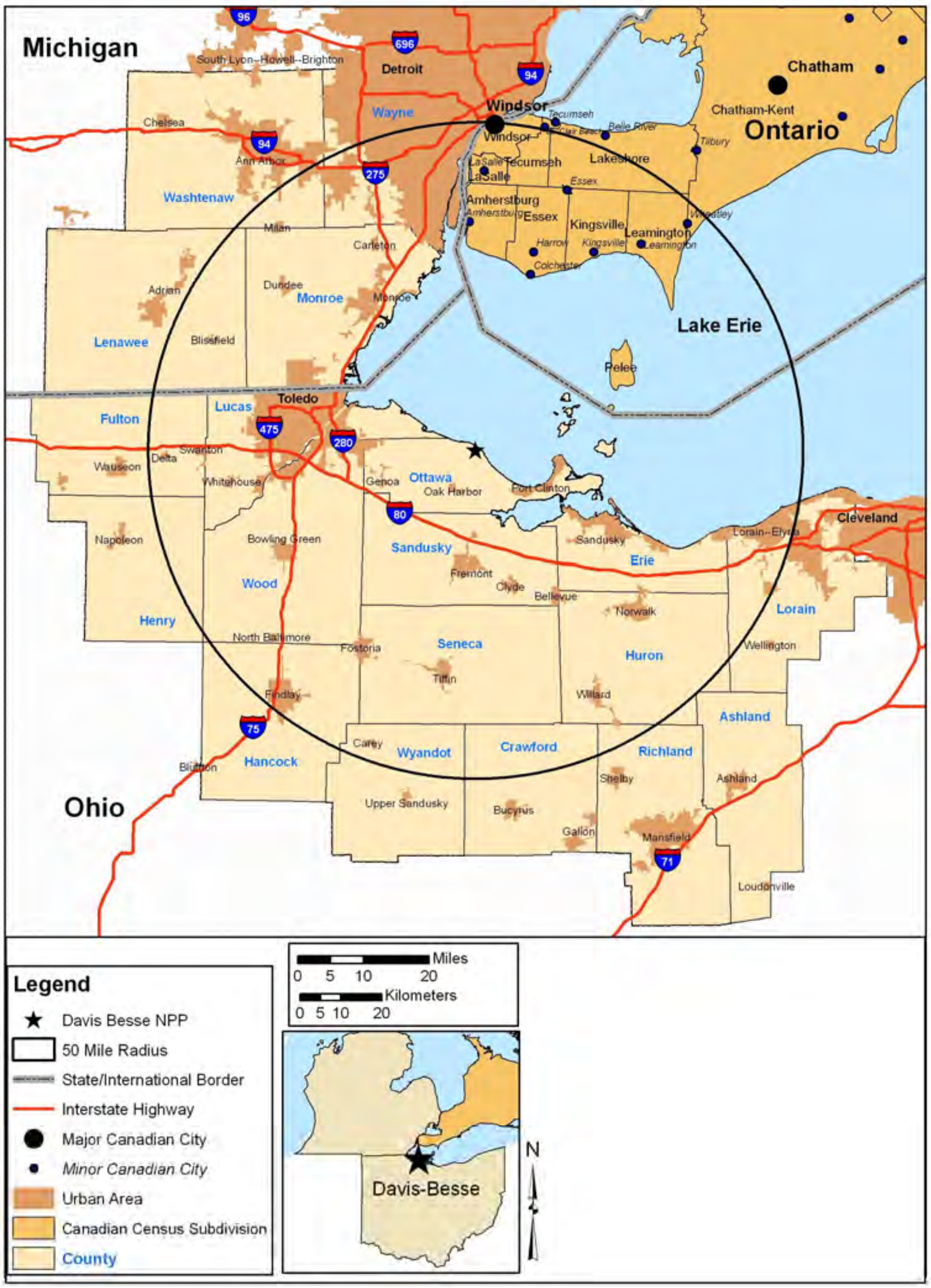

**Figure 2.6-2: Black Population Block Groups
Within a 50-Mile Radius of the Davis-Besse Site**

Figure 2.6-3. Asian Population Block Groups Within a 50-Mile Radius of the Davis-Besse Site

Figure 2.6-4: Other Minority Population Block Groups Within a 50-Mile Radius of the Davis-Besse Site

Figure 2.6-5: Multiracial Population Block Groups Within a 50-Mile Radius of the Davis-Besse Site

Figure 2.6-6: Hispanic Ethnicity Population Block Groups Within a 50-Mile Radius of the Davis-Besse Site

Figure 2.6-7: **Aggregate Minority Population Block Groups Within a 50-Mile Radius of the Davis-Besse Site**

Figure 2.6-8: Low-Income Population Block Groups Within a 50-Mile Radius of the Davis-Besse Site

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2.7 TAXES

The Ohio Tax Reform Act (Amended Substitute House Bill 66,126th General Assembly), which went into effect on July 1, 2005, has made significant changes in the structure of almost all major state and local taxes. Major business tax components of the tax reform act consist of the phase-out of both the tangible personal property tax (which excludes electric companies) and the corporate franchise tax and the phase-in of the commercial activity tax. It is a privilege tax measured by gross receipts from activities within the state. The fully phased-in 0.26% commercial activity tax rate took effect on April 1, 2009 (impacting fiscal year 2010 tax revenues). Prior phase-in rates are as follows:

Tax Period	Base Tax Rate	Phase-in Percentage	Effective Rate
July 1, 2005 to December 31, 2005	0.06%	N/A	0.0600%
January 1, 2006 to March 31, 2006	0.26%	23%	0.0598%
April 1, 2006 to March 31, 2007	0.26%	40%	0.1040%
April 1, 2007 to March 31, 2008	0.26%	60%	0.1560%
April 1, 2008 to March 31, 2009	0.26%	80%	0.2080%
After March 31, 2009	0.26%	100%	0.2600%

Table 2.7-1 compares property taxes paid by FENOC for Davis-Besse to the annual total operating budgets for Ottawa County, Carroll Township, the Benton-Carroll-Salem School District, and the Penta County Joint Vocational School for the years 2004 through 2008. During this five-year period, Davis-Besse property taxes contributed less than 10% to the Ottawa County total operating budget. The percentage of Davis-Besse property tax to the operating budget in Carroll Township, where Davis-Besse is located, varied widely from about 11% to nearly 28%. Property taxes paid to the Benton-Carroll-Salem School District and the Penta County Joint Vocational School, on the other hand, were more stable, averaging about 17% for the school district and 1.6% for the vocational school.

The amount of future property tax payments for Davis-Besse and the proportion of those payments are dependent on future market value of the units, future valuations of other properties in these jurisdictions, and other factors. FENOC assumes that the values presented in Table 2.7-1 are substantially representative of conditions that would exist in the license renewal term of the unit.

Table 2.7-1: Davis-Besse Property Tax Distribution and Jurisdictional Operating Budgets, 2004-2008

Year	Property Tax Paid for Davis-Besse	Operating Budget	Percent of Operating Budget
Ottawa County			
2004	$846,190	$13,808,101	6.1%
2005	$1,171,511	$13,909,810	8.4%
2006	$890,177	$15,111,168	5.9%
2007	$949,380	$15,846,381	6.0%
2008	$897,881	$16,053,182	5.6%
Carroll Township			
2004	$485,644	$4,334,322	11.2%
2005	$675,842	$3,510,297	19.3%
2006	$533,277	$1,908,000	27.9%
2007	$551,766	$2,307,692	23.9%
2008	$558,791	$4,829,032	11.6%
Benton-Carroll-Salem Local School District			
2004	$3,211,588	$20,142,955	15.9%
2005	$4,484,582	$21,114,350	21.2%
2006	$3,495,600	$20,953,869	16.7%
2007	$3,607,888	$22,038,419	16.4%
2008	$3,707,221	$23,938,413	15.5%
Penta County Joint Vocational School			
2004	$372,018	$24,832,789	1.5%
2005	$507,832	$25,644,335	2.0%
2006	$397,738	$26,553,076	1.5%
2007	$412,907	$28,015,110	1.5%
2008	$417,247	$29,793,427	1.4%

2.8 LAND USE PLANNING

This section focuses on the four counties of Ottawa, Lucas, Wood, and Sandusky since approximately 88% of the permanent Davis-Besse workforce lives in these counties (see Section 3.4) and, as a result, would more likely influence present and future land use.

2.8.1 EXISTING LAND USE

County government in Ohio was established in 1788 as the administrative arm of the territorial government. Today, it serves the same purpose for the state, although the structure has changed and its range of responsibilities has increased. There are certain state-mandated services that all counties must provide, such as property tax assessment and collection, land records, election administration, public welfare and social services, and certain legal and judicial services that apply throughout the county. State law also permits counties to perform certain functions for their residents if they so choose, e.g., parks and recreation, drainage, and economic development. (**Lucas 2008**)

Table 2.8-1 lists the types of land use in the four-county area. As shown, three of the counties are principally rural. Only one county contains large urban area.

Ottawa County, the smallest of the four counties in land area (255 sq. mi.), is typical of the rural land-use character of the four-county area. Over 90% of the total county area comprises cropland, pasture, forest, open water, and wetlands. Urban areas, on the other hand, account for less than 10% of the total county area. Wood and Sandusky counties have a similar distribution of land area. Ottawa County, although the smallest in land area, has the most open water (7%), as its northeastern boundary abuts Lake Erie and includes a peninsula and several islands. (**Ottawa 2008**)

Lucas County has the largest urban area, accounting for nearly 37% of the total county area. It is also the most populated of the of the four-county area, with Toledo being the county seat and largest city. (**Lucas 2008**)

Wood County is the largest county in land area (617 sq. mi.) and comprises the most land in farms (over 301,000 acres). It also has the most number of farms (1,040) and largest average farm size (289 acres). (**Wood 2008**)

Sandusky County is similar in land category to Wood County, with most land in farms. The county’s land area (409.2 sq. mi.), number of farms (780), and average farm size (247 acres) is second only to Wood County. (**Sandusky 2008**)

2.8.2 Future Land Use

FENOC surveyed the local townships in Ottawa County adjacent to Davis-Besse as to the existence of any growth-control measures that would restrict the development of residential housing. In Carroll Township, where Davis-Besse is located, there is no land use control mechanism such as zoning. Subdivision approval is subject to county rules and regulations, but the actual use of the land is not (**Carroll 1995**, Page 5). Erie Township, which is adjacent and east of Carroll Township, also has no land use control mechanism (**Erie 1995**, Page 6). Instead, both township land use plans encourage development in areas that can be served by existing infrastructure, while preserving open space and environmentally sensitive areas.

The other adjacent townships, Benton to the west and Salem to the south, both have land use zoning to control growth (**Benton 1995**, Page 5; **Salem 2004**, Page 5). Future land use residential growth, however, is limited due to the lack of an extensive public sewer system in each township. As a result, construction of single family residences is more likely than the construction of multi-family/high density housing development.

2.8.3 References

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

Benton 1995. Benton Township Land Use Plan, Benton Township, Ohio, March 1995.

Carroll 1995. Carroll Township Land Use Plan, Carroll Township, Ohio, July 1995.

Erie 1995. Erie Township Land Use Plan, Erie Township, Ohio, September 1995.

Lucas 2008. Lucas County Profile, Ohio Department of Development, http://www.odod.state.oh.us/research/FILES/S0/lucas.pdf, accessed March 7, 2009.

Ottawa 2008. Ottawa County Profile, Ohio Department of Development, http://www.odod.state.oh.us/research/FILES/S0/ottawa.pdf, accessed March 7, 2009.

Salem 2004. Salem Township Land Use Plan, Salem Township, Ohio, August 2004.

Sandusky 2008. Sandusky County Profile, Ohio Department of Development, http://www.odod.state.oh.us/research/FILES/S0/sandusky.pdf, accessed March 7, 2009.

Wood 2008. Wood County Profile, Ohio Department of Development, http://www.odod.state.oh.us/research/FILES/S0/Wood.pdf, accessed March 7, 2009.

Table 2.8-1: Land Uses in Four-County Area

Land Category	County			
	Ottawa	Lucas	Wood	Sandusky
Land Cover (%)				
- Urban [1]	8.12	36.69	9.42	5.71
- Cropland	60.62	36.56	80.38	71.64
- Pasture	10.90	1.81	3.51	10.46
- Forest	7.47	14.89	4.47	6.55
- Open Water	7.01	3.01	0.90	1.49
- Wetlands [2]	5.18	6.58	1.19	3.77
- Bare Mines	0.72	0.47	0.13	0.42
Land in Farms (acres)	109,000	75,000	301,000	193,000
- Number of Farms	500	390	1,040	780
- Average size (acres)	218	192	289	247
Total County Area (sq. mi.)	255.1	340.4	617.4	409.2

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**

Notes:

(1) Residential, Commercial, Industrial, Transportation, Urban Grasses, Wooded, Herbaceous
(2) Wooded, Herbaceous

2.9 SOCIOECONOMIC CHARACTERISTICS

Table 3.4-1 presents the places of residence of the Davis-Besse operational workforce. The vast majority (88%) of the workforce reside in Ottawa, Lucas, Wood, or Sandusky counties. As stated in Section 3.4, FENOC believes that it can continue to operate the power plant for the 20-year license renewal period with the existing workforce and has no plans to add full-time employees to support plant operations during the period of extended operation. However, FENOC assumes that if any additional staff is required, that they will also reside primarily within the four-county area and in the same proportions as the existing workforce. Thus, the study area to describe the socioeconomic characteristics in the following sections is limited to the four-county area.

2.9.1 ECONOMY, EMPLOYMENT, AND INCOME

2.9.1.1 Economy

The state of Ohio is one of the larger economies in the United States, with an estimated 2007 state gross domestic product of $466.3 billion in nominal dollars, making it the seventh-largest state economy (**Ohio 2008**, Economic Page 4). The four-county area is part of the northwest Ohio economic development region, referred to as Region 2 (**Ohio 2008**, Appendix A). As such, its economy reflects the encompassing county's character and is less dependent on the industrial and technology-based economy of Ohio in general and the "Rust Belt" image of the 1980s in particular. Most of the state's income, for example, is derived from commerce and manufacturing, whereas the four-county area shares the region's industry base with extensive farmland, which produces large amounts of crops and livestock. The subsections following illustrate this diverse economy for the years 2003-2007, before the economic downturn starting in 2008.

2.9.1.2 Employment

Table 2.9-1 lists the civilian labor force during the period 2003-2007. In general, the civilian labor force was stable in Ottawa, Lucas, and Sandusky counties. Wood County, on the other hand, increased its workforce from 2003 through 2006, before declining slightly in 2007. Unemployment rates during the five-year period generally declined in all counties from 2003 through 2006, with an increase occurring in 2007 in each county. Wood County had the lowest unemployment rate, remaining below 6% over the 2003-2007 period.

In 2006, the combined four-county area had a total civilian labor force of over 279,050 people (Table 2.9-2). The combined largest industrial sectors providing employment included trade, transportation and utilities (19.8%); educational and health social services (16.1%); and manufacturing (15.5%). The trade, transportation and utilities sector also was the largest industrial sector in Ottawa, Lucas, and Wood counties, but manufacturing was largest in Sandusky County. A large employer in all counties was combined government, with local government being the largest between federal, state, and local.

Industry growth since 2001, as shown in Table 2.9-3, has occurred in education and health services throughout the four-county area, with increases in financial services in most counties as well. The largest percentage industrial sector decline in all counties has been information services. Although still a significant employer, manufacturing has also seen a large decline in all counties.

2.9.1.3 Income

Table 2.9-4 shows income and poverty levels for the four-county area and state of Ohio, as estimated by the U.S. Census Bureau from the three-year survey during 2005-2007 (**USCB 2009**). Ottawa County had the highest median household income, at $53,183, which is well above the state level of $46,296. Ottawa County also had the lowest poverty rates for both families (6.1%) and individuals (8.0%), which is well below the state levels of 9.7% and 13.2%, respectively. Lucas County had the lowest median household income, at $43,527, below the state level. Lucas County was well above the state poverty levels for both families and individuals at 12.9% and 16.8%, respectively.

2.9.2 HOUSING

Table 2.9-5 presents information about the housing market in the four-county area and the state of Ohio. The estimates are based upon U.S. Census Bureau data from 2005-2007 survey data (**USCB 2009**). The most notable characteristic is the high vacancy rate (32.6%) in Ottawa County. This is likely a result of seasonal properties associated with the county's large number of recreational facilities (see Section 2.9.6). Otherwise, housing vacancy is below the state rate of 10.7% in Wood and Sandusky counties, but above the state rate in the more urban Lucas County, which includes Toledo. The median house values in Ottawa and Wood counties are above the state value of $134,400, but below the state value in Sandusky and Lucas counties.

Residential construction generally increased for the four-county area for the greater part of the five-year period, 2003 through 2007, as shown in Table 2.9-6. The number of total units, for example, increased in all counties through 2005, before starting a decline in 2006 through 2007. The average cost per unit of single and multiple-unit buildings followed a similar trend.

2.9.3 Education

Public education in Ohio is provided through regional school districts, which are funded by a school tax levied as part of the state income tax. Corporations, in general, are exempt from the school tax. (**ODT 2006**) Table 2.9-7 lists information regarding education in the four-county area.

Regionally, Lucas County, as the most populated of the four-county area, has the most schools, including college level. Ottawa County has the least number of students. Ottawa County also has the smallest student-teacher ratio, the highest graduation rate, and expends the most per student. (Table 2.9-7)

Locally, the Benton-Carroll-Salem School district serves the area surrounding Davis-Besse. The school district has four elementary schools, one middle school, and one high school. Enrollment was 1,984 during the 2008 school year and the district employed 102 teachers, with a 19:1 student to teacher ratio. (**PSR 2009**) The Benton-Carroll-Salem School district also works closely with the Penta County Joint Vocational School, which provides certificates in various trades for students in or beyond high school in a five-county area. The public institution is located in Perrysburg, Ohio, southwest of Toledo, in Wood County. Enrollment in 2007 was approximately 195 students (**Penta 2009**).

2.9.4 Public Facilities

Table 2.9-8 provides a summary of the public facilities in the four-county area. Included is information on libraries, health care facilities, and communication services, such television and radio stations, and daily newspapers. Lucas County, which has the most urban area (see Section 2.8, including Toledo, has the greatest number of facilities. Ottawa County, on the other hand, has the least.

Table 2.9-9 provides a summary of the community public water systems in the four-county area from surface water supplies. Information included is the population served, water use, and system capacity. Due to its urban populations, Lucas County has the largest water supply systems. The smallest system (140,000 gallons per day (gpd) capacity) is Put-in-Bay Village located in Ottawa County.

2.9.5 Transportation

The four-county area is served by all modes of transportation, depending on location.

Highway

State and interstate highways, especially U.S. 80/90, which includes the Ohio Turnpike, interconnects each county. State Highway Route 2, located immediately adjacent to the Davis-Besse site, provides local access to the surrounding area. The two-lane highway is used extensively for commercial truck carriers. Approximately six miles east of the site (and continuing east), Route 2 becomes a four-lane, divided and limited-access highway. (**FENOC 2010**, Section 2.2.2.1) Table 2.9-10 lists the annual average daily traffic (AADT) for various points along Route 2 and for Routes 190 and 590 that feed into Route 2 from the south.

As described in Section 2.9.6, there is a significant percentage of recreation in the four-county area and Ottawa County, in particular. The great majority of people using the facilities travel in private vehicles. As a result, there is an increase in the number of seasonal and transient vehicles within a 10-mile radius of Davis-Besse. Table 2.9-14 lists the estimated number of these vehicles, along with the resident vehicles within the 10-mile area. Seasonal vehicles are those that remain in the area during warmer months, principally May through October. Transient vehicles are those that enter the area for a specific purpose (e.g., recreation) and leave on the same day or stay overnight. As shown in Table 2.9-14, the total combined number of seasonal and transient vehicles is equivalent to the total number of resident vehicles within a 10-mile radius of Davis-Besse.

Airports

The closest airport serving commercial airlines is Toledo Express Airport, located 38 miles west of the site. The nearest airport with a paved runway is at Port Clinton, located 13 miles east-southeast from the site. (**FENOC 2010**, Section 2.2.2.3)

Water Transportation

Commercial shipping, both domestic and international, uses Lake Erie extensively. However, the shallowness of the western lake basin, particularly near shore, limits any closer approach than eight miles for ships of any size. The nearest shipping lanes from the site are approximately 20 miles offshore. (**FENOC 2010**, Section 2.2.2.1)

Railroads

Railroad transportation to the four-county area is available for passengers and freight. Amtrak provides passenger rail service from Cleveland to Toledo, with service through Sandusky (**Amtrak 2009**). Mainline rail freight service is provided by the Norfolk Southern Corporation and CSX Transportation, Inc. (**ODOT 2009**).

Locally, the nearest railroad to Davis-Besse is the Norfolk Southern, which runs in an east-west direction from Port Clinton to Oak Harbor, about five miles south of the site. The Norfolk Southern continues to run from Oak Harbor northwest to Toledo. (**ODOT 2009**) A local rail spur line services the site, starting at a point 7.5 miles southwest of the site. This entire spur is owned by Toledo Edison and was built solely for service to Davis-Besse. (**FENOC 2010**, Section 2.2.2.1)

Table 2.9-11 summarizes transportation data in the four-county area.

2.9.6 Recreation

Activities on Lake Erie and the rivers and streams flowing into it comprise a significant percent of all recreation in the four-county area, as listed in Table 2.9-12. Ottawa County, in particular, has the most facilities and acreage devoted to state parks, forests, natural preserves, and wildlife. Its location along Lake Erie and its islands provide a wide variety of opportunities for water-based recreational and tourist activities. As a result, the area has large seasonal and transient populations, which are discussed in Section 2.6.2.4.

Other major regional recreational resources include three of the four U.S. Fish and Wildlife Service National Wildlife Refuges located in Ohio. The three refuges together protect approximately 9,000 acres of habit and some of the last remnants of the “Great Black Swamp” in the heart of the Lake Erie marshes (**USFWS 2009**).

- Ottawa NWR – located adjacent to the Davis-Besse site, management of the refuge focuses on providing resting habitat for migratory birds.
- West Sister Island NWR - located offshore and to the northwest of Davis-Besse, management of the refuge focuses on nesting habitat for the largest heron/egret rookery in the U.S. Great lakes.
- Cedar Point NWR – located northwest of Davis-Besse, the refuge provides a stopover habitat for migratory birds; its marsh land is divided into three large pools, one of which is a public fishing area.

The Ottawa NWR is split between Ottawa and Lucas Counties, with the majority in Ottawa County. The West Sister Island NWR and Cedar Point NWR are entirely in Lucas County.

As noted in Table 2.9-13, utilization of the major park facilities in the Ottawa-Lucas County region is nearly 70% during the summer months.

2.9.7 REFERENCES

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

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Table 2.9-1: Civilian Labor Force by County, 2003-2007

County	2003	2004	2005	2006	2007
Ottawa					
Labor Force	21,400	21,600	21,800	21,900	21,800
Employed	19,700	19,900	20,100	20,400	20,300
Unemployed	1,700	1,700	1,700	1,500	1,600
Unemployment Rate (%)	8.1	8.1	7.6	6.9	7.2
Lucas					
Labor Force	225,000	224,700	224,000	225,800	225,300
Employed	208,300	208,100	208,800	211,700	210,200
Unemployed	16,800	16,600	15,100	14,100	15,100
Unemployment Rate (%)	7.5	7.4	6.8	6.2	6.7
Wood					
Labor Force	66,100	66,800	67,700	68,900	68,600
Employed	62,300	63,00	63,900	65,400	64,900
Unemployed	3,800	3,800	3,800	3,500	3,700
Unemployment Rate (%)	5.8	5.7	5.6	5.1	5.4
Sandusky					
Labor Force	33,000	33,400	33,300	33,400	33,900
Employed	30,800	31,300	31,200	31,500	31,800
Unemployed	2,100	2,200	2,000	1,900	2,100
Unemployment Rate (%)	6.5	6.5	6.2	5.7	6.1

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**

Table 2.9-2: Employment by Industry, 2006

Employment by Industry	Average Employment				
	Ottawa County	Lucas County	Wood County	Sandusky County	Four-County Area
Private Sector	12,117 (83.6%)	196,078 (87.4%)	47,846 (81.6%)	23,006 (87.8%)	279,047 (86.2%)
Natural Resources and mining	305 (2.1%)	481 (0.2%)	304 (0.5%)	290 (1.1%)	1,380 (0.4%)
Construction	547 (3.8%)	10,343 (4.6%)	2,998 (5.1%)	897 (3.4%)	14,785 (4.6%)
Manufacturing	2434 (16.8%)	25,528 (11.4%)	13,206 (22.5%)	8,859 (33.8%)	50,027 (15.5%)
Trade, Transportation, Utilities	3,441 (23.7%)	44,349 (19.8%)	12,402 (21.1%)	3,902 (14.9%)	64,094 (19.8%)
Information	87 (0.6%)	3,125 (1.4%)	627 (1.1%)	179 (0.7%)	4,018 (1.2%)
Financial Services	535 (3.7%)	9,509 (4.2%)	1,752 (3.0%)	912 (3.5%)	12,708 (3.9%)
Professional and Business Services	406 (2.8%)	28,625 (12.8%)	3,414 (5.8%)	1,724 (6.6%)	34,169 (10.6%)
Educational and Health Services	1,468 (10.1%)	42,381 (18.9%)	5,194 (8.9%)	3,188 (12.2%)	52,231 (16.1%)
Leisure and Hospitality	2,474 (17.1%)	22,996 (10.2%)	6,159 (10.5%)	2,225 (8.5%)	33,854 (10.5%)
Other services	421 (2.9%)	8,665 (3.9%)	1,764 (3.0%)	824 (3.1%)	11,674 (3.6%)
Unclassified	No Data	74 (<0.1%)	26 (<0.1%)	7 (<0.1%)	107 (<0.1%)
Government Sector	2,376 (16.4%)	28,281 (12.6%)	10,821 (18.4%)	3,374 (12.8%)	44,852 (13.8%)
Federal	176 (1.2%)	1,993 (0.9%)	243 (0.4%)	119 (0.5%)	2,531 (0.8%)
State	204 (1.4%)	7,743 (3.5%)	3,649 (6.2%)	212 (0.8%)	11,808 (3.6%)
Local	1996 (13.8%)	18,545 (8.3%)	6,929 (11.8%)	3,043 (11.5%)	30,513 (9.4%)

Source: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**

Table 2.9-3: Employment Change by Industry 2001-2007

Employment by Industry	Average Employment Change (%)			
	Ottawa County	Lucas County	Wood County	Sandusky County
Natural Resources and mining	18.2	-14.1	23.1	-13.4
Construction	-0.5	-10.9	-9.4	-13.7
Manufacturing	-12.7	-19.4	-12.3	-10.8
Trade, Transportation, Utilities	-5.9	-9.6	9.1	3.1
Information	-27.5	-15.9	-31.3	-34.9
Financial Services	2.5	-1.0	10.7	30.8
Professional and Business Services	-20.7	-1.8	-25.1	16.7
Educational and Health Services	16.8	12.5	21.2	20.3
Leisure and Hospitality	-3.4	-2.3	26.8	8.4
Other services	-26.3	0.2	-6.7	-20.5
Federal	-5.9	-8.6	2.1	-7.0
State	3.0	-1.4	4.3	7.6
Local	4.7	-3.8	6.6	-6.7

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**

Table 2.9-4: Income and Poverty Levels, 2007

Income [a]	Ottawa County	Lucas County	Wood County	Sandusky County	State of Ohio
Median Household:	53,186	43,527	51,001	46,366	46,296
Median Family:	62,963	55,709	68,387	54,269	57,999
Per Capita:	27,246	23,759	25,878	21,447	24,296
% Below Poverty[b]:					
Families	6.1	12.9	6.3	7.0	9.7
Individuals	8.0	16.8	11.6	9.7	13.2

Source: **USCB 2009**

Notes:

(1) In 2007 inflation-adjusted dollars.
(2) Poverty level for a family of four people is $21,203; individual is $10,590.

Table 2.9-5: Housing Characteristics

Housing Characteristic	Ottawa County	Lucas County	Wood County	Sandusky County	State of Ohio
Total Units:	26,897	202,655	51,445	26,070	5,038,654
Occupied:	18,125	178,247	48,712	23,915	4,500,621
Owner-occupied	14,001	118,721	34,261	17,819	3,152,182
Renter-occupied	4,124	59,526	14,451	6,096	1,348,439
Vacant:	8,772	24,408	2,733	2,155	538,033
Total Vacancy Rate:	32.6%	12.0%	5.3%	8.3%	10.7%
Median House Value:	$140,200	$123,300	$149,000	$116,000	$134,400

Source: **USCB 2009**

Table 2.9-6: Residential Construction, 2003-2007

County	2003	2004	2005	2006	2007
Ottawa					
Total Units	259	255	336	300	276
Total Valuation (000)	$21,389	$20,421	$64,256	$62,969	$48,837
Total single-unit bldgs	247	243	328	291	207
Avg cost per unit	$84,489	$83,530	$195,866	$214,843	$209,529
Total multi-unit bldgs	12	12	8	9	69
Avg cost per unit	$43,333	$10,250	$1,500	$50,000	$79,191
Lucas					
Total Units	1,681	1,947	1,507	938	1,076
Total Valuation (000)	$240,742	$249,089	$236,733	$134,313	$111,087
Total single-unit bldgs	1,499	1,582	1,297	831	511
Avg cost per unit	$155,266	148,590	$170,178	$153,623	$175,046
Total multi-unit bldgs	182	365	210	107	565
Avg cost per unit	$43,945	$38,412	$76,248	$62,172	$38,298
Wood					
Total Units	1,095	1,705	1,152	651	521
Total Valuation (000)	$108,648	$146,084	$126,344	$68,991	$54,626
Total single-unit bldgs	616	595	609	452	439
Avg cost per unit	$134,020	$136,963	$139,909	$127,739	$109,392
Total multi-unit bldgs	479	1,110	543	199	82
Avg cost per unit	$54,471	$58,190	$75,764	$56,548	$80,519
Sandusky					
Total Units	239	198	132	112	60
Total Valuation (000)	$23,595	$23,597	$16,858	$14,117	$9,331
Total single-unit bldgs	156	167	128	102	60
Avg cost per unit	$119,980	$127,883	$127,177	$128,398	$155,517
Total multi-unit bldgs	83	31	4	10	0
Avg cost per unit	$58,768	$72,258	$144,759	$102,000	$0

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**

Table 2.9-7: Education Characteristics

Constituent	Ottawa County	Lucas County	Wood County	Sandusky County
Public Schools:	18	153	50	29
Students	5,683	70,472	18,708	10,404
Expenditures per student	$10,498	$10,104	$9,603	$8,575
Student-teacher Ratio	15.9	19.1	16.1	18.2
Graduation rate (%)	95.1	77.8	93.7	88.6
Non-Public Schools	2	42	9	7
Students	171	12,868	1,440	1,095
Colleges (public and private)	0	3	2	1

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**

Table 2.9-8: Public Facilities

Type	Ottawa County	Lucas County	Wood County	Sandusky County
Public Libraries (Branches)	3 (2)	1 (19)	7 (4)	2 (3)
Hospitals	1	8	1	2
- Beds	25	3,119	162	263
Nursing Homes	4	67	18	19
- Beds	339	6,483	1,586	1,746
Residential Care	4	24	7	16
- Beds	238	1,821	381	636
TV Stations	0	6	2	0
Radio Stations	0	21	2	1
Daily Newspapers	1	2	2	1
- Circulation	6,100	147,000	21,500	14,100
Prisons	0	1	0	0

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008; ODCR 2010**

Table 2.9-9: Public Water Systems

County	Public Water System*	Population Served	Water Use (gpd)	Treatment Capacity (gpd)
Lucas	Toledo	380,000	75,838,000	181,000,000
	Oregon City	18,334	4,463,000	8,087,000
Ottawa	Marblehead Village	1,600	193,000	553,000
	Put-in-Bay Village	700	67,000	140,000
	Ottawa County Regional	14,500	3,507,000	9,000,000
	Carroll	2,000	300,000	1,000,000
Sandusky	Clyde	5,900	958,000	2,000,000
	Fremont City	20,500	4,917,000	7,500,000
Wood	Bowling Green City	30,000	3,389,000	5,400,000
	North Baltimore	3,361	550,000	1,600,000

* Surface water community systems that do not purchase water.

Sources: **OEPA 2010**; **OSUE 2009a, b, c, d**

Table 2.9-10: Ottawa County Annual Average Daily Traffic, 2006

Road / Location	Annual Average Daily Traffic (AADT)		
	Vehicles (2 axles)	Vehicles (>2 axles)	Total
SR-2, West of Davis-Besse			
At Lucas County Line	3,900	820	4,720
At SR-579 Intersection	5,190	1,240	6,430
At SR-590 Intersection	5,060	1,150	6,210
At SR-19 Intersection	4,810	1,070	5,880
SR-2, East of Davis-Besse			
At SR-358 Intersection	5,450	1,220	6,670
At SR-163 Intersection	9,480	1,550	11,030
At SR-53 Intersection	11,460	1,820	13,280
South of Davis-Besse			
SR-19, Salem-Carroll Rd.	2,050	150	2,200
SR-590, Trowbridge Rd.	320	10	330

Source: **ODOT 2006**

Table 2.9-11: Transportation Data Summary

Type	Ottawa County	Lucas County	Wood County	Sandusky County
Registered Vehicles	59,429	417,347	135,877	72,969
Passenger cars	36,412	312,305	87,837	43,420
Noncommercial trucks	10,451	46,578	19,462	13,541
Interstate Highway (mi)	4.57	48.59	54.64	27.34
Turnpike (mi)	4.57	14.56	11.18	27.34
U.S. Highway (mi)	0.00	65.20	61.32	62.68
State Highway (mi)	139.96	115.67	206.86	112.41
County, Local (mi)	549.08	2,068.35	1,610.78	925.58
Commercial Airports	5	1	4	2

Sources: **Ottawa 2008**, **Lucas 2008**, **Wood 2008**, **Sandusky 2008**

Table 2.9-12: Recreational Facilities

Attributes	Ottawa County	Lucas County	Wood County	Sandusky County
Acreage	5,540	4,359	670	4,018
Facilities	23	13	6	9
State Parks	-East Harbor -Lake Erie Islands -Catawba Island -Kelleys Island -Middle Bass Island -Oak Point -South Bass Island -Marblehead Lighthouse		-Mary Jane Thurston	
Forests		-Maumee		
Natural Areas	-Lakeside Daisy	-Audubon Islands -Lou Campbell Prairie -Irwin Prairie -Kitty Todd -Scenic River: Maumee	-Scenic River: Maumee	-Scenic River: Sandusky
Wildlife	-Green Island -Honey Point -Kuehnle -Little Portage -Magee Marsh -Toussaint Creek -West Harbor Refuge	-Magee Marsh -Mallard Club Marsh -Metzger Marsh -Missionary Island		-Aldrich Pond -Miller Blue Hole -Pickerel Creek -Resthaven (Erie) -Willow Point (Erie)

Table 2.9-12: Recreational Facilities
(continued)

Attributes	Ottawa County	Lucas County	Wood County	Sandusky County
Boating*	-Brown's Marina -Catawba Island Park -Dempsey Wildlife Area -East Harbor Park Camp ground -East Harbor Park Marina -Floro's Marina -Little Portage Access -Mazurik Access -Oak Point Park -Ottawa County Ramp -Portage River Wildlife Area -Put-in-Bay Docks -South Bass Island -Toussaint Creek Wildlife Area -Turtle Creek Wildlife Area	-Cullen Park -Farnsworth Metropark -Lucas County Ramp -Metzger Marsh State Wildlife Area -Walbridge Park	-Farnsworth Park -Perrysburg City Ramp -Orleans Park -Otsego Park -Rossford City Ramp	-Fremont City Ramp -Tackle Box 2 -Memory Marina -Riverfront Marina -White's Landing

* Lists obtained from referenced sources are not complete listings of boating facilities, ramps or marinas.

Sources: **Ottawa 2008**; **Lucas 2008**; **Wood 2008**; **Sandusky 2008**; **ODNR 2009**

Table 2.9-13: Ottawa-Lucas County Region Park Utilization

Facility 2009	Attendance	2009 Utilization[(1)]
State		
East Harbor State Park	1,310,000	75%
Marblehead Lighthouse State Park	1,200,000	80%
Kelleys Island State Park	125,000	80%
North Bass Island State Park	1,335	80%
Middle Bass Island State Park	27,000	80%
South Bass Island State Park	511,000	80%
Maumee Bay State Park	1,100,000	70%
Federal		
Ottawa NWR	176,000	60
Cedar Point NWR	600	5
West Sister Island NWR[(2)] 0		N/A
Total	4,450,935	**68%**

Notes:

(1) Percent utilization is seasonal. Estimates are based on summer weekdays when the parks may be near peak attendance.

(2) Closed to the public.

Table 2.9-14: Seasonal and Transient Estimated Vehicles within 10 Miles of Davis-Besse

Miles	Estimated Number of Vehicles		
	Resident	Seasonal	Transient
0-2	353	0	0
2-5	668	752	3,812
5-10	6,310	387	1,306
Total	7,331	1,139	5,118

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2.10 METEOROLOGY AND AIR QUALITY

2.10.1 METEOROLOGY

Lying in the humid continental zone, Ohio has a generally temperate climate. The Davis-Besse region also has a continental climate, but it is modified by its proximity to the Great Lakes. Summers are warm to hot, with humid weather being common. Winter is cold although frequent thaws occur. The Great Lakes have a moderating effect on temperature and extremes are seldom recorded. On average, only 15 days a year reach or exceed 90 degrees. On about eight days a year the temperature drops to zero degrees or lower. (**NOAA 2009**)

While the Great Lakes contribute little to the annual precipitation, they do enhance cloudiness during the winter months. Heavy snow storms typically occur once or twice a winter, but light snows are common. Thunderstorms occur regularly from late spring through summer, with much of the summer precipitation coming from thunderstorm rains. Strong thunderstorms occur a few times each year. (**NOAA 2009**)

The terrain in the western Lake Erie region is mostly flat and has little influence on the weather. An east wind off Lake Erie will bring significant cooling to the lake shore areas each spring and fog can also occur. The lake breeze brings a comfortable cooling effect to the lake shore during the summer months. A prolonged strong east wind, although rare, can produce lake shore flooding. (**NOAA 2009**)

Table 2.10-1 summarizes various climatological data for the western Lake Erie region computed from daily observations gathered at the Toledo Airport (**NCDC 2008**). The prevailing wind direction during most of the year (10 of the 12 months) is from the west southwest (240-260 degrees). Mean monthly wind speeds range from 7-11 mph, with peak gusts of 50-70 mph expected throughout the year. Monthly temperatures range from a normal daily maximum in January of 31.3°F to a minimum of about 16.4°F. In July, the daily average normal maximum is 83.4°F and the daily normal minimum is 62.6°F. Annual precipitation is about 33 inches, with the maximum monthly values occurring from June through September. Snowfall averages about 37 inches per year and can occur throughout the year. Thunderstorms occur nearly 32 days per year, mostly during June, July, and August.

Locally, meteorological observations at Davis-Besse began in October 1968. Wind speed and direction are collected from various levels at a 100-meter primary tower and a nearby 10-meter backup tower. The 100-meter tower also measures differential temperatures at several levels to determine atmospheric stability. Precipitation is measured at the base of the 10-meter backup tower. (**DBNPS 2009**, Pages 119-120)

During 2008, winds at Davis-Besse occurred most frequently from south-southwest to west-southwest, accounting for about 40%. Annual wind speeds averaged nearly 9.4 mph, with the maximum speed of almost 45 mph occurring in January. Stability class D (neutral conditions) was the most frequent during the year, occurring 52% of the time. Annual precipitation was nearly 28 inches, with the most (5.55 inches) occurring during June. (**DBNPS 2009**, Tables 31 and 32)

Meteorological data relevant to the Severe Accident Mitigation Alternatives (SAMA) analysis are provided in Attachment E.

2.10.2 AIR QUALITY

The USEPA has established National Ambient Air Quality Standards (NAAQS) for six common pollutants: nitrogen dioxide, sulfur dioxide, carbon monoxide, lead, ozone, and particulate matter (PM). The USEPA has designated all areas of the United States as having air quality better ("attainment") or worse ("non-attainment") than the NAAQS. Areas that have been redesignated to attainment from nonattainment are called maintenance areas. To be re-designated an area must both meet air quality standards and have a 10-year plan for continuing to meet and maintain air quality standards and other requirements of the *Clean Air Act*.

Davis-Besse is located in the Sandusky Intrastate Air Quality Control Region (40 CFR 81.203), which includes Ottawa County. Since 1984, the overall air quality in the county has been in attainment (**USEPA 2008**). Ottawa County, as noted in 40 CFR 81.336, is better than the national air quality standards for sulfur dioxide (SO_2). The county is considered unclassifiable/attainment for carbon monoxide (CO), ozone (O_3, including both the 1- and 8-hour average), and particulate matter less than 2.5 µm ($PM_{2.5}$). Particulate matter less than 10 µm (PM_{10}) is considered unclassifiable, while lead (Pb) is not designated.

There are no mandatory Class I federal areas within the 50-mile radius of Davis-Besse (**USEPA 2010**). The closest area to Davis-Besse that is designated in 40 CFR 81.400 et seq. as a mandatory Class I federal area, in which visibility is an important value, is the Otter Creek Wilderness Area located in West Virgina, approximately 350 miles southeast of the site (40 CFR 81.435).

Section 9.1, Table 9.1-1, describes Davis-Besse air emission sources and lists authorizations.

2.10.3 REFERENCES

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

DBNPS 2009. 2008 Annual Radiological Environmental Operating Report, including Radiological Effluent Release Report, Davis-Besse Nuclear Power Station, May 2009.

NCDC 2007. 2007 Local Climatological Data Annual Summary with Comparative Data, Toledo, Ohio (KTOL), National Climatic Data Center, NOAA, Ashville, NC.

NCDC 2008. 2008 Local Climatological Data Annual Summary with Comparative Data, Toledo, Ohio (KTOL), National Climatic Data Center, NOAA, Ashville, NC.

NOAA 2009. NOAA e-mail, J. Kosanik to J, Snooks (AREVA), National Weather Service, March 3, 2009.

USEPA 2008. Currently Designated Nonattainment Areas for all Criteria Pollutants, U.S. Environmental Protection Agency, http://www.epa.gov/air/oaqps/greenbk/, accessed February 18, 2010.

USEPA 2010. List of Mandatory Class I Federal Areas, U.S. Environmental Protection Agency, http://www.epa.gov/oar/vis/class1.html, accessedFebruary 18, 2010.

Table 2.10-1: Summary of Local Climatology Data (Toledo)

Parameter[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (deg F)													
Daily Maximum Normal[2]	31.4	35.1	46.5	58.9	70.7	79.5	83.4	81.0	74.0	62.1	48.3	36.0	58.9
Daily Minimum, Normal[2]	16.4	18.9	27.9	37.7	48.6	58.2	62.6	60.7	52.9	41.6	32.6	22.3	40.0
Monthly, Normal[2]	23.9	27.0	37.2	48.3	59.6	68.8	73.0	70.8	63.5	51.8	40.5	29.2	49.5
Record High[3]	66	71	81	88	95	104	104	99	98	91	80	70	104
Year	2008	2000	1998	2002	1962	1988	1995	1993	1978	1963	2003	2001	Jul 1995
Record Low[3]	-20	-14	-6	8	25	32	40	34	26	15	2	-19	-20
Year	1984	1982	1984	1982	2005	1972	1988	1982	1974	1976	1958	1989	Jan 1984
Precipitation (inches, water equiv)													
Monthly, Normal[2]	1.93	1.88	2.62	3.24	3.14	3.80	2.80	3.19	2.84	2.35	2.78	2.64	33.21
Maximum Monthly[3]	4.61	5.50	5.70	6.10	6.80	8.48	9.19	8.47	8.10	6.26	6.86	6.81	9.19
Year	1965	2008	1985	1977	2000	1981	2006	1965	1972	2001	1982	1967	Jul 2006
Minimum Monthly[3]	0.27	0.27	0.58	0.88	0.96	0.27	0.34	0.40	0.58	0.27	0.55	0.54	0.27
Year	1961	1969	1958	1962	1964	1988	1995	1976	1963	2005	1976	1958	Oct 2005
Maximum in 24 hrs[3]	1.78	2.59	2.60	3.43	2.34	3.21	4.39	2.42	3.97	3.21	3.17	3.53	4.39
Year[7]	1959	1990	1985	1977	1991	1978	1969	1972	1972	1988	1982	1967	Jul 1969
Snowfall[4] (inches)													
Monthly, Normal [2]	10.8	8.5	5.6	1.3	0.1	0.0	0.0	0.0	0.0	0.2	2.6	8.3	37.4
Maximum Monthly[5]	30.8	23.6	17.7	12.0	1.3	Trace	Trace	Trace	Trace	2.0	17.9	24.2	30.8
Year	1978	2008	1993	1957	1989	1995	1992	1994	1993	1989	1966	1977	Jan 1978
Maximum in 24 Hours[5]	12.0	7.7	9.7	9.8	1.3	Trace	Trace	Trace	Trace	1.8	8.3	13.9	13.9
Year	2005	1981	1993	1957	1989	1995	1992	1994	1993	1989	1966	1974	Dec 1974

Table 2.10-1: Summary of Local Climatology Data (Toledo)

(continued)

Parameter[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Wind[5]													
Mean Speed (mph)[6]	10.7	10.3	10.6	10.5	9.1	7.8	7.2	6.5	7.0	8.4	9.9	10.0	9.0
Prevailing Direction[7]	25	25	07	07	24	24	24	25	25	24	25	25	25
Maximum 2-minute (mph)	47	46	46	48	46	53	44	43	38	45	51	48	53
Direction (tenths)	26	26	24	25	25	25	36	26	24	24	21	30	25
Year	2008	2001	2002	1997	2000	2007	2008	1998	2001	1996	2005	1998	Jun 2007
Peak Gust (3-second)	56	56	69	61	68	62	54	54	47	59	66	66	69
Direction (tenths)	25	26	23	27	27	26	35	26	23	25	24	25	23
Year	2008	2001	2002	2003	1999	2007	2008	1998	2001	1996	1998	2008	Mar 2002
Miscellaneous													
Pressure (inches)[6]	30.09	30.09	30.05	29.98	29.98	29.97	29.99	30.03	30.06	30.08	30.07	30.10	30.04
Percent Sunshine[8]	41	46	50	52	60	64	65	63	61	54	37	33	52
Fog (days visibility ≤¼mi)	1.7	1.7	1.8	0.8	0.8	1.1	0.8	1.5	1.7	1.7	1.4	2.4	17.4
Thunderstorms (days)	0.1	0.5	1.5	3.2	4.4	6.1	6.1	5.1	2.9	1.1	0.8	0.1	31.9

Notes:
(1) Source: **NCDC 2008**
(2) Based on 30-year period of record, 1971-2000
(3) Based on 53-year period of record; dates are the most recent occurrence
(4) Includes all forms of frozen precipitation, including hail
(5) Based on 47-year period of record; dates are the most recent occurrence
(6) Based on 25-year period of record
(7) Based on 34-year period of record; direction in tenths of degrees
(8) Average from sunrise to sunset, 40-year period of record

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2.11 HISTORIC AND ARCHAEOLOGICAL RESOURCES

The National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470-470w-6, in Section 106, requires that Federal agencies take into account the effects on properties included in or eligible for the National Register of Historic Places and to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection.

Data relating to historic and archaeological resources was gathered by employing the Ohio Historic Preservation Office's Online Mapping System. A query of a 6-mile radius around the Davis-Besse site was used to identify previously recorded cultural resources that are listed in the National Register of Historic Places (NRHP); that have been determined eligible or potentially eligible for listing in the NRHP; and that have not been evaluated for NRHP listing.

As presented in Table 2.11-1 through Table 2.11-4, the background research identified 378 previously recorded cultural resources within a 6-mile radius of Davis-Besse. This number includes buildings, archaeological sites, cemeteries, churches, and other structures. Resource types range from a historic military base with many contributing structures to archaeological sites and individual architectural resources. Although consultation with the Ohio Historical Society prior to construction did not identify any known deposits of archaeological or geological interest (**AEC 1973**, Section 2.3), one resource, a historic-period site (Table 2.11-3, OT0025), appears to be located at the extreme southeastern corner of the Davis-Besse property. However, the area is overgrown with brush and there does not appear to be visible remnants of the site.

Of the 378 previously recorded cultural resources, only one was listed in the NRHP. This includes Carroll Township Hall located about 3.2 miles to the southwest of Davis-Besse at the intersection of Toussaint E. Road and Behlman Road.

The majority of structures within the 6-mile radius are related to the Camp Perry Military Reservation, located 4.5 miles to the southeast of Davis-Besse, on the shore of Lake Erie, just north of the Portage River. Camp Perry includes housing, firing ranges, railroad tracks, and other structures related to the operations of the facility.

2.11.1 REFERENCES

AEC 1973. Final Environmental Impact Statement Related to Construction of Davis-Besse Nuclear Power Station, Docket No. 50-346, Toledo Edison Company and Cleveland Electric Illuminating Company, U.S. Atomic Energy Commission, March 1973.

Table 2.11-1: National Register Listed Properties Within 6 miles of Davis-Besse Nuclear Power Station (*n* = 1)

ID No.	Name	Criteria	Function
90000385	Carroll Township Hall	Event, Architecture/Engineering	Social, Government

Table 2.11-2: Cemeteries Within 6 miles of Davis-Besse Nuclear Power Station (*n* = 5)

ID No.	Name	County
9173	Locust Point	Ottawa
9174	Rusha	Ottawa
9175	Saint Joseph, Saint Josephs Toussaint	Ottawa
9195	Lacarp, Lacarpe	Ottawa
9208	County Home	Ottawa

Table 2.11-3: Archaeological Sites Within 6 miles of Davis-Besse Nuclear Power Station (*n* = 88)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status
LU0004	Ward's Canale / Crane's Creek	Oak Harbor	Precontact	Village	LW	Not Assessed
OT0004	Lacarne Cemetery Site and Village	Lacarne	Precontact	Cemetery / Village	--	Not Assessed
OT0006	Arthur Libben Site	Lacarne	Precontact and Historic	Cemetery / Village	LW, H	Not Assessed
OT0007	Montogomery Burial Site	Lacarne	Precontact	Cemetery	LW	Not Assessed
OT0025	Refuge Site	Lacarne	Historic	Historic Building	H	Not Assessed
OT0055	Riverview Site	Lacarne	Precontact	Camp	LW	Not Assessed
OT0072	Church of God Isolated Find	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	UP, H (1930-present)	Not Assessed
OT0073	Horvath Site 1	Lacarne	Precontact	Unknown Precontact Site Type	LW	Not Assessed
OT0074	Gradel Site 1	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0075	Rockwell Historic Site	Lacarne	Historic	Residential	H (18^{th}-19^{th} C.)	Not Assessed
OT0076	Lipstraw Isolated Find	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0077	Van Rensselaer	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Unrecorded Historic Site Type	UP, H (1850-1899)	Not Assessed
OT0078	F. Miller Historic Scatter	Lacarne	Historic	Residential	H (19^{th}-20^{th} C)	Not Assessed
OT0079	Miller Isolated Find	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	UP, H (1850-1929)	Not Assessed

Table 2.11-3: Archaeological Sites Within 6 miles of Davis-Besse Nuclear Power Station (n = 88)

(continued)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status
OT0080	Jacobs	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0081	Dick Isolated Find A	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0082	Dick Isolated Find B	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	UP, H (1880-1899, 20th C.)	Not Assessed
OT0083	Arvilla Winter	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	UP, H (1850-1899, 20th C.)	Not Assessed
OT0084	Thorban Isolated Find	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0085	Rice	Lacarne	Precontact	Unknown Precontact Site Type	LW	Not Assessed
OT0086	Titus Road	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	LW, H (19th-20th C.)	Not Assessed
OT0087	Floro Marina	Lacarne	Precontact	Unknown Precontact Site Type	LA, LW	Not Assessed
OT0088	Blausey Site	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	LW, H (19th-20th C.)	Eligible
OT0089	Finken River Edge	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Unknown Historic Site Type	LW, H (19th-20th C.)	Not Assessed
OT0090	Finken Isolated Find	Lacarne	Precontact	Unknown Precontact Site Type	EA	Not Assessed
OT0091	Moskal Site	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential, Commerical, Government	LW, H (19th-20th C.)	Eligible
OT0092	Moskal Site 1	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0093	Moskal Site 2	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed

Table 2.11-3: Archaeological Sites Within 6 miles of Davis-Besse Nuclear Power Station (n = 88)
(continued)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status
OT0094	Moskal Isolated Find	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0095	Laubacher Isolated Find B	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0096	Apling Site 1	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0097	Apling Site 2	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0098	Apling Site Isolated Find	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0099	Hemminger Site	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0100	Mosquito Site	Oak Harbor	Precontact and Historic	Unknown Precontact Site Type / Residential	LW, PH, H (20th C.)	Not Assessed
OT0101	Kontz Isolated Find	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0102	Kontx & Mowl Historic Site	Oak Harbor	Historic	Residential	H (20th C.)	Not Assessed
OT0103	Elmer Kholman Historic Site	Oak Harbor	Historic	Residential	H (19th C.)	Not Assessed
OT0111	5-Oaks	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0112	Tyma Historic Scatter	Lacarne	Historic	Unknown Historic Site Type	UP	Not Assessed
OT0113	Tyma Isolated Find A2	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0114	Priesman Isolated Find	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0115	Dead Egret Site A	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed

**Table 2.11-3: Archaeological Sites
Within 6 miles of Davis-Besse Nuclear Power Station (n = 88)**
(continued)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status
OT0116	Dead Egret Site B	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0119	Laubacher Isolated Find A	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0122	Rusha Creek 1	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0123	Rusha Creek 2	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0140	Toussaint Burials	Lacarne	Precontact	Cemetery	UP	Not Assessed
OT0141	Finken Site	Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	LW, H (19^{th}-20^{th} C.	Eligible
OT0155	Dornbusch Isolated Find	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0156	Fehr Isolated Find	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0160	Hetrick Isolated Find C	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0161	Hetrick Isolated Find B	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0162	Hetrick Isolated Find A	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0197	Roland Lewitz	Oak Harbor	Precontact	Unknown Precontact Site Type	EA	Not Assessed
OT0198	Lewitz Isolated Find C	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0199	Lewitz Isolated Find E	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0200	Lewitz Isolated Find F	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed

**Table 2.11-3: Archaeological Sites
Within 6 miles of Davis-Besse Nuclear Power Station (n = 88)**
(continued)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status
OT0201	Lewitz Isolated Find G	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0202	Dick Site	Lacarne	Precontact	Unknown Precontact Site Type	EA	Not Assessed
OT0203	Dick Isolated Find C	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0204	Dick Isolated Find M	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0207	Floro A	Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0218	Snyder-Nov 01	Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0228		Oak Harbor	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0229		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0230		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0231		Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	UP, H (19^{th}-20^{th} C.)	Not Assessed
OT0232		Lacarne	Precontact and Historic	Unknown Precontact Site Type / Residential	UP, H (19^{th}-20^{th} C.)	Not Assessed
OT0233		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0234		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0235		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0236		Lacarne	Precontact	Unknown Precontact Site Type	LW	Not Assessed

Table 2.11-3: Archaeological Sites Within 6 miles of Davis-Besse Nuclear Power Station (n = 88)
(continued)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status
OT0237		Lacarne	Precontact	Unknown Precontact Site Type	LW	Not Assessed
OT0238		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0239		Lacarne	Precontact	Unknown Precontact Site Type	LA	Not Assessed
OT0240		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0241		Lacarne	Precontact	Unknown Precontact Site Type	UP	Not Assessed
OT0242		Lacarne	Historic	Residential, Subsistence	H (19^{th}-20^{th} C.)	Not Assessed
OT0243		Lacarne	Historic	Unknown Historic Site Type	H (19^{th}-20^{th} C.)	Not Assessed
OT0245		Lacarne	Precontact	Unknown Precontact Site Type	EA, MA	Not Assessed
OT0294	Silo	Lacarne	Historic	Residential, Subsistence	H (19^{th}-20^{th} C.)	Not Assessed
OT0295		Lacarne	Historic	Subsistence	H	Not Assessed
OT0296		Lacarne	Historic	Transportation	H	Not Assessed
OT0297		Lacarne	Historic	Residential	H (19^{th} C.)	Not Assessed
OT0300		Lacarne	Precontact	Unrecorded Precontact Site Type	MW	Not Assessed
OT0302		Lacarne	Historic	Military	H (1880-2000)	Not Assessed
OT0303	CP1	Lacarne	Historic	Military	H (1930-1949)	Not Assessed

**Table 2.11-3: Archaeological Sites
Within 6 miles of Davis-Besse Nuclear Power Station (n = 88)**
(continued)

Site No.	Site Name	Quadrangle	Precontact / Historic	Site Type	Components*	NR Eligibility Status

* Refers to the time period each site represents:

19th C.	=	Nineteenth Century
EA	=	Early Archaic (8000 to 6000 BC)
EW	=	Early Woodland (1000 to 1 BC)
H	=	Historic
LA	=	Late Archaic (3000 to 1000 BC)
LW	=	Late Woodland (500 to 1000 AD)
MA	=	Middle Archaic (6000 to 3000 BC)
MW	=	Middle Woodland (1 to 500 AD)
PH	=	Protohistoric
UP	=	Unknown Prehistoric

Table 2.11-4: Structures
Within 6 miles of Davis-Besse Nuclear Power Station (*n* = 284)

ID No.	Name	Address	Date	Use	NR Eligibility Status	Ownership	Agency
OTT0058003	Albert Apling House	8592 Duff-Washa Rd	1900	Single Dwelling	Not Eligible	Private	
OTT0063104	Richard Arnold House	5756 W Lakeshore Rd	1905	Single Dwelling	Not Eligible	Private	
OTT0063204	James Deluca House	5510 W Lakeshore Rd	1914	Single Dwelling	Not Eligible	Private	
OTT0063308	Dorothy Minier House	6862 W Harbor Rd	1900	Single Dwelling	Not Eligible	Private	
OTT0063403	Ruth Dick Property	8645 Toussaint E Rd	1842	Single Dwelling	Not Eligible	Private	
OTT0063503	Edward Moskal House	4864 W Lakeshore Rd	1919	Single Dwelling	Not Eligible	Private	
OTT0063603	Latter Day Saints Church	Toussaint S Rd	1870	Church/Religious Structure	Not Eligible	Private	
OTT0063703	Kenneth Priesman Etal Property	Duff-Washa Rd	1870	Church/Religious Structure	Not Eligible	Private	
OTT0063803	Toussaint Founders Club Hall	Toussaint E Rd	1875	Entertainment/ Recreation/Cultural Activities	Not Eligible	Private	
OTT0063904	Erie Twp Hall	State Rte 163 and Ontario Rd	1885	One Room Schoolhouse	Not Eligible	Public	Erie Township Trustees
OTT0064004	Erie Twp Garage	W Harbor Rd		School	Eligible	Public	Erie Township Trustees
OTT0064104	Richard Tettau Property	Tettau Rd	1912	Single Dwelling	Not Eligible	Private	
OTT0064203	Carroll Twp Hall	9977 Toussaint E Rd	1874	Village/Twp/City Hall	Not Eligible	Public	Carroll Township Trustees

**Table 2.11-4: Structures
Within 6 miles of Davis-Besse Nuclear Power Station (n = 284)**
(continued)

ID No.	Name	Address	Date	Use	NR Eligibility Status	Ownership	Agency
OTT0064403	Gerald Humphrey Property	12233 Zenzer Rd	1910	Single Dwelling	Not Eligible	Private	
OTT0064503	Kenneth Gyde Property	11055 Duff-Washa Rd	1880	Single Dwelling	Not Eligible	Private	
OTT0067008	Lorna Ballin House	7154 W Harbor Rd	1890	Single Dwelling	Not Eligible	Private	
OTT0067303	Gary Apling Property	3770 Toussaint S Rd	1860	Single Dwelling	Not Eligible	Private	
OTT0068804	Erie Industrial Park	Btwn Lake Erie & SR 2	1920	Arms Storage	Unknown	Unknown	
OTT0069703	R & D Dwight House	3985 N SR 2	1900	Single Dwelling	Not Assessed	Private	
OTT0069803	John & Ruth Dick Farm	4090 SR 2	1900	Single Dwelling	Not Assessed	Private	
OTT0069903	Arville Winter Farm	4216 N SR 2	1890	Single Dwelling	Not Assessed	Private	
OTT0070003	A Winter Farm	4216 N SR 2	1890	Barn	Not Assessed	Private	
OTT0070103	Leona Fizer House	4445 N SR 2	1900	Single Dwelling	Not Assessed	Private	
OTT0070203	Jeffrey King House	SEC of Lemon Rd & SR 2	1937	Single Dwelling	Not Eligible	Private	
OTT0070303	Blausey Property	SR 2 S of Toussaint River	1850	Single Dwelling	Not Assessed	Private	
OTT0070403	Phillip van Rensselaer Farm	S of Rusha Creek on SR 2	1875	Single Dwelling	Not Assessed	Private	

**Table 2.11-4: Structures
Within 6 miles of Davis-Besse Nuclear Power Station (n = 284)**
(continued)

ID No.	Name	Address	Date	Use	NR Eligibility Status	Ownership	Agency
OTT0070504	A Jacobs House	3225 N Lakeshore Rd	1920	Single Dwelling	Not Assessed	Private	
OTT0071708	Janet Welch Farm	8043 SR 163	1825	Single Dwelling	Not Eligible	Private	
OTT0071808	SL Schau House	8213 SR 163	1865	Single Dwelling	Not Eligible	Private	
OTT0071904-OTT0090604	Camp Perry Bldg 2811	Ariel Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0090704	Camp Perry Bldg 5040	Cartwright Trail	1933	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0090804	Camp Perry Pump Station 4058	CR 171	1938	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0090904-OTT0091304	Camp Perry Bldg 2008	Davis Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0091404	Camp Perry Main Flagpole	Lawrence Rd opposite Niagara	1876	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0091504-OTT0092004	Camp Perry Bldg 800	Lawrence Rd	1948	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0092104-OTT0092204	Camp Perry Range 5036	N of Lawrence Rd	1910	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0092304-OTT0092604	Camp Perry Rodriguez Firing Range	Lawrence Rd	1910	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0092704	Camp Perry Railroad Tracks	Near Niagara Rd	1906	Post/Military Base	Not Eligible	Public	Adjutant General's Department
OTT0092804	Camp Perry Bldg 8E	E of Niagara Rd	1942	Post/Military Base	Not Assessed	Public	Adjutant General's Department

**Table 2.11-4: Structures
Within 6 miles of Davis-Besse Nuclear Power Station (n = 284)**
(continued)

ID No.	Name	Address	Date	Use	NR Eligibility Status	Ownership	Agency
OTT0092904-OTT0093804	Camp Perry Bldg 3082Q	Niagara Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0093904	Camp Perry Bldg No 2100 A	Niagara Rd opposite Davis Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0094004	Camp Perry Bldg No 2101 Q	Niagara Rd opposite Davis Rd	1945	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0094104-OTT0094504	Camp Perry Bldg No 1841 Q	Niagara Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0094604	Camp Perry Bldg 2506	Niagara Rd at Davis Rd	1916	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0094704-OTT0095104	Camp Perry Bldg 2505	Niagara Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0095204-OTT0096204	Camp Perry Bldg No 3203	Scorpion Rd	1942	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0096304-OTT0097004	Camp Perry Bldg No 2024	Trippe Rd	1943	Post/Military Base	Eligible	Public	Adjutant General's Department
OTT0097103	Priesmans Farm Market	SR 2 & Humprey Rd	1900	Grange Hall	Not Eligible	Private	
OTT0101804 / OTT0069404	Camp Perry	Btwn Lake Erie & SR 2	1937	Post/Military Base	Some Structures are Eligible	Public	Ohio National Guard
OTT0103004	Hess Property & Silo	W Fritche Rd & N Tettau Rd	1920	Silo	Not Eligible	Private	

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2.12 KNOWN AND REASONABLY FORESEEABLE PROJECTS IN SITE VICINITY

This section describes the activities and projects, both Federal and non-Federal, in the local and regional area of the site that may potentially contribute to the cumulative environmental impacts of Davis-Besse extended plant operation for an additional 20 years.

As shown in Figure 2.1-2, there are no urban areas within the 6-mile radius of Davis-Besse. The only Federal project is the Camp Perry Military Reservation, located 4.5 miles southeast of the site (**FENOC 2010**, Section 2.2.2.2). Camp Perry is an Ohio National Guard facility used for small arms firing. The limited firing of anti-aircraft ordnance was suspended in 1988 (**FENOC 2010**, Section 2.2.2.4). Immediately adjacent to and west of Camp Perry is the Lake Erie Industrial Park.

North of the Toussaint River is the former Locust Point Firing Range, which occupied approximately 70 acres of property currently owned by The Illuminating Company and Toledo Edison (both subsidiaries of FE). This area occupied a portion of the property currently within the eastern limits of the Davis-Besse site. The balance of the former Locust Point property extends to the northeast along the western edge of the Davis-Besse intake canal, and spans the beachfront between the canal and the Toussaint River. This property served as an anti-aircraft artillery range in support of the Erie Army Depot from 1953 to 1963. In 1996 and 2001, Davis-Besse personnel found ordnance rounds along the beach area near the mouth of the Toussaint River. In both cases, the U.S. Department of Defense (USDOD) was notified, who responded and disposed of the devices.

In 2010, the USACE initiated a preliminary assessment of the former Locust Point property. The focus of the assessment is to determine whether releases or potential releases of contaminants related to operation, occurred while the property was under the USDOD jurisdiction. The USACE completed a site inspection in April 2010. No physical evidence of contamination or ordnance was observed during the inspection. Final reporting of the findings is anticipated in October 2010.

Beyond the 6-mile radius, Table 2.12-1 lists the number of local facilities within the Oak Harbor area that have the potential to contribute to the cumulative environmental impacts. These listed facilities produce and release air pollutants, have reported toxic releases, are hazardous waste sites that are or have the potential to be part of Superfund, or have permits to discharge to Lake Erie and surrounding rivers and other waters (**USEPA 2009**). Table 2.12-1 also lists these type facilities regionally in the four-county area of Ottawa, Lucas, Wood, and Sandusky.

The nearest existing electric generating plant to Davis-Besse is the Bay Shore Plant. Three coal-fired units, one petroleum coke-fired unit, and one oil-fired unit produce 648 megawatts of electricity (**FECorp 2009**). The plant site is situated on Maumee Bay in Oregon, Ohio, which is about 16 miles northwest of Davis-Besse.

New major utility facilities must obtain a certificate of environmental compatibility and public need prior to construction from the Ohio Power Siting Board (OPSB). A major utility facility is a generating plant of 50 megawatts (MW) or more; an electric transmission line of 125 kilovolts (kV) or more; or a gas or natural gas transmission line capable of transporting gas at more than 125 pounds per square inch of pressure. (**OPSB 2007**, Page 16)

As of 2007, the OPSB approved two generation plant applications within the Davis-Besse four-county area. One plant is operational, the other is under construction. The Troy Energy Facility achieved commercial operation in 2002. It is a 600 MW gas turbine peaking plant located at the Lemoyne Industrial Park, Troy Township, Wood County (**OPSB 2003**, Page 17), approximately 20 miles southwest of Davis-Besse. The Fremont Energy Center is projected for commercial operation in 2011 (**EEPI 2009**). It is a 540 MW natural gas-fired combined-cycle electric generating plant, with a peaking capacity of 704 MW (**OPSB 2007**, Page 22). The facility is located in Sandusky Township, Sandusky County, approximately 15 miles south of Davis-Besse.

2.12.1 REFERENCES

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

EEPI 2009. Electric Energy Publictions, Inc, Electric Energy Online.com, http://www.electricenergyonline.com/?page=show_news&id=118772, accessed July 8, 2010.

FECorp 2009. FirstEnergy Corp., Bay Shore Plant Fact Sheet, http://www.firstenergycorp.com/environmental/files/Fact_Sheets/Bay_Shore_Plant_FS_%2808-2007%29.pdf, accessed 4/3/2009.

FENOC 2010. Updated Safety Analysis Report (USAR) Davis-Besse Nuclear Power Station No. 1, Docket No: 50-346, License No: NPF-3, FirstEnergy Nuclear Operating Company (FENOC), Revision 27, June 2010.

OPSB 2003. Ohio Power Siting Board, 2003 Annual Report, http://www.puco.ohio.gov/emplibrary/files/media/OPSB/2003OPSBAR.pdf, accessed April 3, 2009.

OPSB 2007. Ohio Power Siting Board, 2007 Annual Report, http://www.puco.ohio.gov/emplibrary/files/media/OPSB/2007OPSBAR.pdf, accessed April 3, 2009.

USEPA 2009. U.S. Environmental Protection Agency, Envirofacts Warehouse, http://oaspub.epa.gov/enviro/ef_home3.html?p_zipcode=wood%2C+oh&p_type=county, accessed March 26, 2009.

Table 2.12-1: Potential Cumulative Environmental Impacts Facilities

Area	Potential Impacts (Number of Facilities)			
	Air[(1)]	**Toxics**[(2)]	**Waste**[(3)]	**Water**[(4)]
Oak Harbor	2	0	1	10
Ottawa County[(5)]	27[(6)]	7	1	57[(6)]
Lucas County	204	110	29	56
Wood County	88	50	0	63
Sandusky County	34	23	5	26

Source: **USEPA 2009**

Notes:

(1) Facilities that produce and release air pollutants.
(2) Facilities that reported toxic releases.
(3) Potential hazardous waste sites that are part of Superfund that exist.
(4) Facilities issued a permit to discharge to waters of the U.S. (which includes Lake Erie and surrounding rivers and other waters in the four county area).
(5) Oak Harbor facilities are also included as part of Ottawa County.
(6) Number of facilities includes Davis-Besse.

3.0 PROPOSED ACTION

Regulatory Requirement: 10 CFR 51.53(c)(2)

"The report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures.... This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…."

FirstEnergy Nuclear Operating Company (FENOC) requests that the NRC renew the Davis-Besse operating license for an additional 20 years beyond the current operating license term, which is the maximum allowable under the Atomic Energy Act and the NRC's regulations at 10 CFR 54.31. Renewal would give the State of Ohio, FirstEnergy Corp. and its subsidiary companies, and other participants in the wholesale power market the option to rely on Davis-Besse to meet future electric power needs through the period of extended operation.

The Chapter 3 sections below describe the Davis-Besse facilities and activities relevant to the assessments presented in Chapter 4. Section 3.1 discusses the plant in general. Sections 3.2 through 3.4 address the activities necessary to support the renewed operating license.

3.1 GENERAL PLANT INFORMATION

Davis-Besse is a nuclear-powered steam electric generating facility. The nuclear reactor is a Babcock and Wilcox-designed pressurized water reactor (PWR) producing a licensed reactor core power of 2,817 megawatts-thermal, and an electric rating of 908 megawatts-electric gross. Figure 3.1-1 depicts the site layout.

General information about the design and operational features of the Davis-Besse site from an environmental impact standpoint is available from a number of documents. Among the most comprehensive sources are the Final Environmental Statement (FES) prepared by the NRC and the Updated Safety Analysis Report (USAR). In 1975, the NRC issued the FES that addressed operation of Davis-Besse (**NRC 1975**). FENOC routinely updates the USAR (**FENOC 2010**) for Davis-Besse to reflect current plant design and operating features. FENOC relied on these documents, operating manuals, design-basis documents, technical documentation related to power uprate of the unit, and other relevant sources of information as a basis for descriptions of Davis-Besse presented in the remainder of Section 3.1.

3.1.1 Major Facilities

The station site is located on the southwestern shore of Lake Erie and consists of 954 acres. Approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge. The topography of the site and vicinity is flat with marsh areas bordering the lake and the upland area rising to only 10 to 15 feet above the lake low water datum level in the general surrounding area. The site itself varies in elevation from marsh bottom, below lake level, to approximately six feet above lake level. (**FENOC 2010**, Section 2.1.2)

The major station structures are located approximately in the center of the site area, 3,000 feet from the shoreline. The Containment Building is located 2,400 feet from the nearest site boundary, which is to the north. (**FENOC 2010**, Section 2.1.2) The site, site arrangement, and location of the 17 major station structures are shown on Figure 3.1-1. The site boundary, as shown on Figure 2.1-3, is the limit of the exclusion area (**FENOC 2010**, Section 2.1.2.1). Ownership of the site area, within the site boundary, resides with FENGenCo (Section 1.3).

3.1.2 Nuclear Steam Supply, Containment, and Power Conversion Systems

The Reactor Coolant System (RCS) consists of the reactor vessel, two vertical once-through steam generators, four shaft-sealed coolant circulating pumps, an electrically heated pressurizer, and interconnecting piping. The system is arranged as two heat transport loops, each with two circulating pumps and one steam generator (**FENOC 2010**, Section 1.2.2.1.1).

The RCS is designed to contain and circulate reactor coolant at pressures and flows necessary to transfer the heat generated in the reactor core to the secondary fluid in the steam generators. In addition to serving as a heat transport medium, the coolant also serves as a neutron moderator and reflector, and as a solvent for the soluble boron utilized in chemical shim reactivity control.

The steam and power conversion system provides steam for driving the main turbine and the main feed pump turbines. Steam is also used for the auxiliary feed pump turbines, gland sealing, condenser inventory heating, steam jet air ejector, turbine reheater steam heating, building heating (steam supplied unit heaters), station heating heat exchangers and outdoor tank heating.

The complete core has 177 fuel assemblies arranged in a square lattice to approximate a cylinder. All fuel assemblies are identical in mechanical construction and mechanically interchangeable in any core location. Each fuel assembly will accept any control assembly. The fuel is sintered, cylindrical pellets of low-enriched uranium dioxide. The pellets are clad in Zircaloy-4 or M5 tubing and sealed by Zircaloy-4 or M5 end caps, welded at each end. The cladding, fuel pellets, end caps, and fuel support components form a fuel rod. (**FENOC 2010**, Section 4.2.1.3)

Refueling of the reactor core takes place approximately every 24 months. At this time, as dictated by the fuel management program, spent and partially spent fuel assemblies are replaced with new fuel assemblies. (**FENOC 2010**, Section 9.1.4.2.1) Fuel assemblies containing up to 5.00 wt% uranium-235 may be stored in the new fuel storage area. New fuel assemblies are transferred from the new fuel storage area into the spent fuel pool area. They are then transferred into the containment vessel by the fuel transfer carriages operating through the fuel transfer tubes. Transfer of new fuel and removal of spent fuel occurs after the reactor is shut down and the refueling canal is filled with borated water. (**FENOC 2010**, Section 1.2.7.2)

The Shield Building is a reinforced concrete structure of right cylinder configuration with a shallow dome roof. The Shield Building has a height of 279.5 feet measured from the top of the foundation ring to the top of the dome. The thicknesses of the wall and the dome are approximately 2.5 feet and 2 feet, respectively. (**FENOC 2010**, Section 3.8.2.2.1) The structure is designed to withstand an internal pressure of 40 pounds per square inch gage (psig) and sufficient to withstand design-basis accidents (**FENOC 2010**, Section 3.8.2.1.4.e).

Davis-Besse was initially licensed to operate at a maximum steady-state core power level of 2,772 megawatts-thermal (MWt). However, the Operating License and Technical Specifications were subsequently amended in 2008 to allow an increase in the Rated Thermal Power of 1.63%, to 2,817 MWt (**NRC 2008**). The description of plant facilities and operations and associated impact evaluations in this ER, therefore, assume operation at 2,817 MWt, which is equivalent to an electric capacity of 908 MWe (**FENOC 2009**).

3.1.3 Cooling and Auxiliary Water Systems

3.1.3.1 Service Water and Make-up Water Treatment Systems

The Service Water System (SWS) is designed to serve two functions during station operation. The first function is to supply cooling water to the component cooling heat exchangers, the containment air coolers, and the cooling water heat exchangers in the turbine building during normal operation. The second function is to provide, through automatic valve sequencing, a redundant supply path to the engineered safety features components during an emergency. Only one path, with one service water pump, is necessary to provide adequate cooling during this mode of operation. (**FENOC 2010**, Section 9.2.1.1)

Three service water pumps are part of the SWS. They are installed in the intake structure and use Lake Erie as a source of water. Two pumps are used in normal operation. Motor-operated strainers at the pump outlets filter any material that may plug heat exchanger tubes and the orifices of the auxiliary feedwater pump bearing oil cooler, turbine bearing cooler, and governor oil cooler. (**FENOC 2010**, Section 9.2.1.2)

The Make-up Water Treatment System is designed to supply high quality water in sufficient quantity for primary and secondary plant makeup. Under normal operation, Lake Erie water, which may be treated with sodium hypochlorite and a molluscicide (i.e., sodium bromide) at the Intake Structure, is delivered to one of two chlorine detention tanks. Sodium hypochlorite may also be injected into the tanks, but not sodium bromide, which cannot be delivered to the tanks. From the chlorine detention tank the water is sent to a vendor supplied processing system. The vendor's system provides all necessary equipment and components to produce demineralized water for makeup to the demineralized water storage tank. The demineralized water in the storage tank, in turn, is transferred to various points throughout the station, such as the condenser hotwell, condensate storage tanks, and for miscellaneous flushing operations. (**FENOC 2010**, Section 9.2.3.2)

3.1.3.2 Circulating Water and Cooling Tower Systems

The Circulating Water System (CWS) is a closed cycle system consisting of the condenser, cooling tower, circulating water pumps, makeup pumps, and water chlorination system and chemical feed system. The CWS is designed to remove 6.69×10^9 Btu/hr from the power cycle. The condenser is designed to operate efficiently with circulating water over the range of 50°F to 100°F. (**FENOC 2010**, Section 10.4.5.1)

Four equal capacity, motor driven, horizontal split-case circulating water pumps take suction from the common discharge channel from the cooling tower basin and supply cooling water to the two halves of the low pressure shell of the dual pressure condenser. Each half is supplied by two pumps. The circulating water leaves the condenser at the two high pressure shell outlet waterboxes in two independent steel pipes and returns to the cooling tower. A provision is made for cross-connecting the inlet low pressure shell waterboxes to equalize flow through each tube bundle and allow for less than four pump operation. (**FENOC 2010**, Section 10.4.5.2.1)

A natural draft hyperbolic cooling tower rejects the heat from the circulating water. Circulating water loss from the cooling tower occurs by evaporation and blowdown. A makeup water system replaces these losses. (**FENOC 2010**, Section 10.4.5.2.1) The tower is 493 feet high, constructed of non-combustible material, and its base is located about 700 feet from the closest structure, the Emergency Diesel Generator fuel oil storage tanks (**FENOC 2010**, Section 10.4.5.3). See Figure 3.1-1, No. 15.

Blowdown from the cooling tower is accomplished downstream of the circulating water pumps and is controlled to maintain a dissolved solids concentration ratio. Slime and algae control is achieved by a chlorination system, which includes the addition of a sodium bromide solution to the sodium hypochlorite to enhance the biocidal effectiveness of the water treatment without increasing the level of chlorine. Should the sodium bromide portion of the system not be available, sodium hypochlorite solution may be used alone. (**FENOC 2010**, Section 10.4.5.2.1)

The primary source of makeup water is the SWS, which is connected to the circulating water pump suction lines. Also, two vertical turbine pumps, located on the intake structure, can supply lake water as an alternate source of makeup water. Blowdown is not accomplished from a circulating water line when the same line is supplied with makeup. (**FENOC 2010**, Section 10.4.5.2.1)

Chlorination of the CWS is done on a periodic basis to prevent algae growth within the system. Sodium hypochlorite and a sodium bromide solution are mixed to enhance the biocide effectiveness of the water treatment without increasing the level of chlorine and together are injected into those circulating pump suctions whose discharges are not providing blowdown water. Should the sodium bromide portion of the system not be available, sodium hypochlorite may be used alone. In this way, blowdown water contains essentially no free chlorine residual and the chloride content is unchanged. A chemical feed system is used to reduce scaling tendencies of the circulating water and disperse silt. Treatment increases the sulfate content of the water to more than 80 ppm. Since the system water, in passing through the cooling tower, is in intimate contact with air to accomplish the cooling, the outlet water contains an oxygen content that is essentially at the saturation level corresponding to the cold water outlet temperature. The oxygen content for the highest tower outlet temperature will be 7 ppm. (**FENOC 2010**, Section 10.4.5.2.2)

3.1.3.3 Domestic Water System

The source of water for the Domestic Water System is the off-site Carroll Township Water System. Water for the township system is taken from Lake Erie west of the Davis-Besse site, filtered and treated to meet the requirements of the OEPA. The township system pressure is maintained by the use of an elevated 500,000-gallon storage tank with a maximum water level of 742.5 feet International Great Lakes Datum, which provides sufficient pressure to supply all station needs. (**FENOC 2010**, Section 9.2.4.2)

3.1.4 POWER TRANSMISSION SYSTEMS

During the original construction of Davis-Besse, three new high-voltage transmission lines were constructed to connect Davis-Besse to the nearby Toledo Edison (a FirstEnergy transmission company) transmission 345 kV substations at Bay Shore, Lemoyne, and Ohio Edison - Beaver substation (**AEC 1973**, Section 3.7). See Figure 3.1-2. Office building support equipment at Davis-Besse receives some power from local distribution systems, but there are no transmission connections other than the three 345 kV connections described above (**FENOC 2010**, Section 8.1.1).

The Bay Shore line is about 21 miles long, extending from the Davis-Besse switchyard west and then northwest to Toledo Edison's Bay Shore substation. The right-of-way is 150 feet, except where it parallels the existing Bay Shore to Ottawa 138-kV line. In this region, the right-of-way is 145 feet, contiguous to the existing 100 feet for the 138 kV line. The Lemoyne line also is about 21 miles long, extending from the Davis-Besse switchyard west and then southwest to Toledo Edison's Lemoyne substation, with a 150-foot right-of-way. The Beaver line is about 59 miles long, extending from the Davis-Besse switchyard south and then southeast to Ohio Edison's Beaver substation. The portion of the Beaver line for Davis-Besse only extends about 15 miles from the station south and then southeast to a tie point on the boundary between Toledo Edison and Ohio Edison. The remaining 44 miles was constructed under a separate project. (**AEC 1973**, Section 3.7)

Approximately 1,800 acres, primarily flat agricultural land, were required for the rights of way (**AEC 1973**, Section 3.7). FirstEnergy conducts routine vegetation maintenance of its rural transmission line corridors approximately every five years. Trees and shrubs that do not interfere with transmission facilities are not disturbed, and portions of corridors that are not cultivated or devoted to other intensive uses are managed to promote a diversity of shrubs, grasses, and other groundcover that provides wildlife food and cover. Maintenance includes removal or pruning of woody vegetation as necessary to ensure adequate line clearance (no less than 30 feet from the conductor for transmission lines operated above 138 kV) and to allow vehicular access for maintenance. (**FE 2007**)

Toledo Edison uses transmission voltages other than 345 kV. The most important voltage is 138 kV (nominal). There are several interconnections to other utilities at 345 kV and 138 kV. Utilities connected to the Toledo Edison grid include Detroit Edison, American Electric Power, and Ohio Edison. Each of the 345 kV substations connected to Davis-Besse is associated with at least one inter-utility connection. (**FENOC 2010**, Section 8.1.1)

The transmission lines related to Davis-Besse are also shown in Figure 2.1-1 Figure 2.1-2, and Figure 2.1-3.

3.1.5 WASTE MANAGEMENT SYSTEMS

3.1.5.1 Non-Radioactive Waste System

Non-radioactive waste is produced from plant maintenance, cleaning, and operational processes. The majority of the wastes generated consists of non-hazardous waste oil and oily debris and result from operation and maintenance of oil-filled equipment. Universal wastes, such as spent lamps and batteries, common to any industrial facility, comprise a majority of the remaining waste volumes generated. Hazardous wastes routinely make up a small percentage of the total wastes generated and include and consist of spent and off-specification (e.g., shelf-life expired) chemicals, laboratory chemical wastes, and occasional project-specific wastes.

Non-radioactive chemicals, paint, oil, lamps, and other items that have either been used or exceeded their useful shelf life are collected in designated collection areas and managed in accordance with federal (40 CFR) and state (Ohio Administrative Code (OAC) Chapter 3745-50) rules via Davis-Besse and FENOC procedures. The materials are received in various forms and are packaged to meet regulatory requirements prior to final disposition at an offsite facility licensed to receive and manage the material. Typical waste streams include waste oil, oily debris, glycol, lighting ballasts containing PCBs (not typical), lamps, batteries, and hazardous wastes. The FENOC Chemical Control Program establishes the standard method for the control of chemicals and promotes waste minimization.

Davis-Besse is a Small Quantity Generator registered with the OEPA. However, during refueling outage years, hazardous waste generation may exceed 2,200 pounds in a month, requiring Davis-Besse to file a report with the OEPA for a temporary Large Quantity Generator status in accordance with the OAC, Rule 3745-52-41 (**FENOC 2008**).

3.1.5.2 Liquid Radioactive Waste Systems

The Liquid Radioactive Waste System is designed so that effluents released by the system, when mixed with the cooling tower blowdown, meet the requirements in Appendix B of 10 CFR Part 20 and 10 CFR Part 50 (**FENOC 2010**, Section 11.2.1). Before processed water is released to the environment it is mixed in a collection box with the discharge from the SWS, the dilution pump, a cooling tower make up pump, or the cooling tower blowdown. Processed liquid waste enters Lake Erie. The Off-site Dose Calculation Manual (ODCM) provides the day-to-day methods for determining release rates, cumulative releases and for calculating the corresponding dose rates and cumulative quarterly and yearly doses.

The design is based on receiving, segregating, and batch-storing two categories of solutions:

Clean Liquid Radwaste System - The major source of waste for this system is reactor coolant letdown resulting from boron dilution operations or from coolant expansion during reactor startups. Other sources include leakage, drainage, and relief flows from valves and equipment containing reactor-grade liquid. (**FENOC 2010**, Section 11.2.2.2.1)

Miscellaneous Liquid Radwaste System - The major sources of this class of wastes are further categorized as non-detergent wastes such as miscellaneous system leakage, drainage from area washdown, sampling and laboratory operations, condensate polishing demineralizer backwash (if there is a significant primary-secondary leak), and detergent wastes. Detergent waste comes from the hot showers (used to decontaminate personnel) and drains in the laboratory. (**FENOC 2010**, Section 11.2.2.2.2)

The system can accommodate the full range of volumes and activities delivered to it. Suitability for discharge is determined not only by comparison of waste samples with applicable limits, but also by the opportunity afforded the station to further reduce activity with existing equipment.

3.1.5.3 Gaseous Radioactive Waste System

The gaseous radioactive waste disposal system is designed to process effluents to meet the requirements of 10 CFR Part 20, 10 CFR Part 50, Appendix I, and 40 CFR Part 40 (**FENOC 2010**, Section 11.3.1). The system provides selective holdup such that the short-lived isotopes have decayed prior to release. It also provides a 30-day holdup of these gases when refueling cold shutdown degassing is required. The ODCM provides the day-to-day methods for determining release rates, cumulative releases and for calculating the corresponding dose rates and cumulative quarterly and yearly doses (**FENOC 2010**, Section 11.3.2).

When a decay tank is full (i.e., contains gas at 150 psig) or when the operator decides, it is valved out-of-service and another put in its place. A sample is then taken from the isolated tank and analyzed. If it shows a sufficiently low activity level, the stored gas can be released in a controlled manner through waste gas charcoal and high efficiency particulate air filters to the station vent. If the analysis indicates significant radioactivity, the gases are allowed to decay until future sampling shows that they are suitable for release to the environment. Using two of the decay tanks, gases can be held for at least 60 days with release spread out over the next 30 days. (**FENOC 2010**, Section 11.3.3)

Gaseous wastes that contain little or no radioactivity or may contain oxygen are handled separately. These gases are collected, passed through a charcoal filter, and then released through the station vent. (**FENOC 2010**, Section 11.3.3)

3.1.6 Transportation of Radioactive Materials

Radioactive wastes are packaged and shipped from Davis-Besse in containers that meet the requirements established in 49 CFR Parts 171-180 for the Department of Transportation and 10 CFR Part 71 for the NRC. The radiation levels of the waste containers are monitored so that provisions can be made to ensure that radiation levels established by shipping regulations are not exceeded. Radioactive waste is transported to a commercial low-level radioactive waste disposal facility located near Clive, Utah. Low activity waste may be transported to a vendor for volume reduction prior to disposal. The Davis-Besse Process Control Program and FENOC procedures related to shipment of radioactive material ensure compliance with the requirements governing packaging, transportation, and disposal of solid radioactive wastes, including spent resin liquor that is picked up and transported directly by a vendor for processing and disposal.

3.1.7 Maintenance, Inspection, and Refueling Activities

Maintenance and inspection activities are performed to ensure that plant equipment is functioning properly to support plant operations. Routine maintenance and inspection activities are performed during normal operation of the plant; other maintenance and inspection activities are performed during scheduled refueling outages. Maintenance, inspection and refueling activities are conducted in accordance with various plant programs implemented to comply with industry codes and standards, including the following:

- 10 CFR Part 50, Appendix B, Quality Assurance;
- 10 CFR 50.55a, American Society of Mechanical Engineers Boiler and Pressure Vessel Code;
- 10 CFR 50.65, The Maintenance Rule.

In addition, periodic maintenance and inspection procedures have been initiated in response to NRC generic communications. Periodic maintenance, inspection, testing, and monitoring are also performed to meet Technical Specification surveillance requirements and for managing the effects of aging on systems, structures and components.

Figure 3.1-1: General Plant Layout

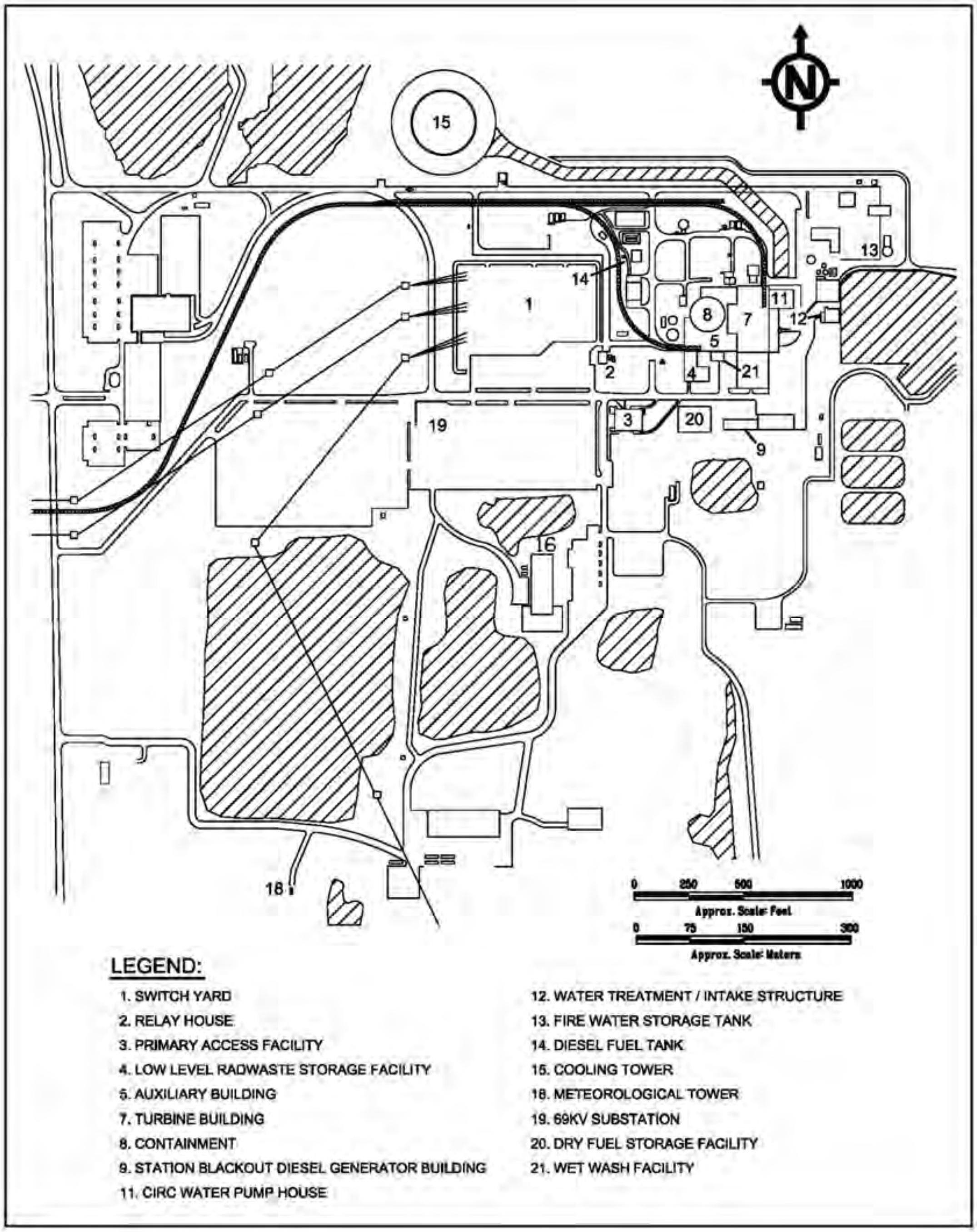

Figure 3.1-2: High-Voltage Transmission Lines Constructed to Connect Davis-Besse to Power Grid

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3.2 REFURBISHMENT ACTIVITIES

> **Regulatory Requirement: 10 CFR 51.53(c)(2); 51.53(c)(3)(ii)**
>
> "The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…."
>
> "The environmental report must contain analyses of …refurbishment activities, if any, associated with license renewal…."

FENOC has addressed refurbishment activities in accordance with NRC regulations and complementary information in the NRC GEIS for license renewal (**NRC 1996**). In particular, NRC requirements for the renewal of operating licenses for nuclear power plants include the preparation of an Integrated Plant Assessment (IPA) in accordance with 10 CFR 54.21. The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, the reactor vessel piping, supports, and pump casings, as well as items that are not subject to periodic replacement.

In addition, the GEIS (**NRC 1996**, Section 2.6) provides information on the scope and preparation of refurbishment activities to be evaluated in this environmental report. It describes major refurbishment activities that utilities might perform for license renewal that would necessitate changing administrative control procedures and modifying the facility. The GEIS analysis assumes that an applicant would begin any major refurbishment work shortly after NRC grants a renewed license and would complete the activities during five outages, including one major outage at the end of the 40th year of operation. The GEIS refers to this as the refurbishment period.

NRC regulations for implementing the National Environmental Policy Act require environmental reports to describe in detail and assess the environmental impacts of refurbishment activities such as planned modifications to systems, structures, and components or plant effluents [10 CFR 51.53(c)(2)]. NRC regulations at 10 CFR Part 51 do not define "refurbishment," but the GEIS provides some examples of refurbishment activities and explains that these are actions that typically take place only once in the life of a nuclear plant, if at all (**NRC 1996**, Section 2.6.2.6). Relevant examples of possible refurbishment activities include replacing the turbine and turbine pedestal, steam generator, or reactor coolant system piping when these activities are carried out to ensure safe or more economic operations during the period of extended operations. The GEIS assumes, however, that refurbishment activities would take place during a "refurbishment period"; i.e., within the 10 years prior to current license expiration, over the course of numerous outages, and culminating in a major outage immediately prior to the extended (license renewal) term.

FENOC plans to replace the reactor vessel head in 2011 (see **NRC 2010**) and the two original steam generators in 2014. FENOC has determined that the most cost-effective method for long-term management of the reactor vessel head, steam generators, and other large irradiated plant equipment, is to store them on-site in a dedicated storage facility, and then disposition them along with the remaining plant equipment when Davis-Besse is decommissioned. Therefore, a new permanent Storage Facility is planned to be constructed in 2011, which will provide approximately 12,000 square feet of space to house indefinitely the current (Midland) reactor vessel head, and later house the original steam generators and the Reactor Coolant System hot legs (see below). A permanent multi-story office building also is planned to be constructed in 2011 adjacent to the Auxiliary Building to house personnel that will support the replacement activities for the reactor vessel head and steam generators.

The replacement of the reactor vessel head and the construction of the two new permanent structures to support the head replacement project are being performed for and under the current facility operating license. Therefore, the associated environmental impacts are enveloped by the Final Environmental Statement for the current Davis-Besse operating license (**NRC 1975**).

In 2014, FENOC plans to replace the two original Davis-Besse once-through steam generators with new once-through steam generators, and plans to replace the Reactor Coolant System hot leg piping in conjunction with the replacement of the steam generators. Replacement activities are expected to last approximately 70 days and are currently planned to be conducted during a slightly-extended Cycle 18 refueling outage in the spring of 2014. FENOC considers the replacement activities associated with the steam generators and the hot leg piping to be license renewal refurbishment activities. Therefore, the associated environmental impacts are assessed in this ER.

Each of the once-through steam generators is a vertically-mounted, straight-tube and shell counter-flow heat exchanger that converts heat from the reactor coolant system into steam to drive the turbine generators and produce electricity. The existing steam generators are each approximately 75 feet long, have a diameter of approximately 15 feet, and weigh approximately 590 tons. The replacement steam generators will be dimensionally equivalent to the original steam generators, but weigh only approximately 465 tons each.

The approximately 15,500 straight tubes in the original steam generators are 56 feet long and are made of Alloy 600 (inconel) material. This alloy degrades over time as a result of a variety of corrosion and mechanical factors. Alloy 600 degradation affects both of the steam generators at Davis-Besse. Accordingly, FENOC has determined that they should be replaced with steam generators that use Alloy 690 tubing material to minimize tube degradation due to Alloy 690's improved resistance to stress corrosion cracking.

The replacement steam generators are being manufactured in Cambridge, Ontario, Canada by Babcock and Wilcox Canada, Ltd., and will be transported to Davis-Besse. The steam generators are planned to ship separately, and transport is expected to involve the following methods of transportation and routes:

- Rail transport from Cambridge, Ontario, to the Port of Toronto;
- Barge transport across Lake Ontario, through the Welland Canal, and across Lake Erie to the Port of Toledo; and,
- Rail transport from the Port of Toledo to Davis-Besse.

Babcock and Wilcox Canada, Ltd., is responsible for the transportation and delivery of the steam generators to Davis-Besse, and would ensure that all federal, state, and local requirements are met for associated transportation activities. Physical modifications to the rail lines may be necessary to transport the replacement steam generators.

After the replacement steam generators arrive at Davis-Besse, FENOC plans to transport the steam generators on a heavy-duty self-propelled modular transporter, and move them to a temporary New Steam Generator Storage Facility (described below) to be constructed at Davis-Besse.

Site planning, construction of temporary facilities, modification of existing buildings, and other preparation activities are planned to occur at Davis-Besse prior to removal of the original steam generators from the Containment Vessel.

Temporary facilities consisting of approximately 80,000 square feet are planned for additional offices, fabrication and assembly activities, mock-up activities, weld testing, decontamination, warehouse areas, and lay down areas. These temporary facilities consisting of tents and portable trailers would use portions of existing Davis-Besse structures and facilities (e.g., permanent parking lot, dry cask storage pad), would require construction of a concrete pad that may remain following the steam generator replacement project, or would consist of temporary structures that would be completely removed following completion of the project. All temporary facilities and any permanent concrete pads that remain following the replacement project are planned to be located within the developed industrial areas of the site on previously-disturbed land.

FENOC estimates that the total area disturbed by permanent and temporary construction, decontamination, and laydown activities would be less than 10 acres, all of which would be on previously-disturbed property within the bounds of the Davis-Besse owner-controlled area. A load-haul path consisting of fill and gravel would likely be constructed for transporting the original steam generators to the permanent Storage Facility. A minimal amount of fill soil may be temporarily required in certain locations along the on-site haul route to ensure the stability of the roads and transporter. The small amount of disturbed area and implementation of best management practices in accordance with FENOC and site procedures (e.g., watering) would minimize the amount of fugitive dust generated by refurbishment activities.

To perform the steam generator replacement, FENOC plans for a temporary construction opening approximately 24 feet wide by 39 feet high to be created in the Shield Building and free-standing Containment Vessel. The Shield Building is composed of reinforced concrete walls approximately two and one-half feet thick, and the free standing Containment Vessel is approximately 1.5 inches thick steel. The process of creating the opening would include activities such as removing concrete, cutting rebar, and cutting and removing a section of the steel Containment Vessel. A hydro-demolition (high pressure water) process or other mechanical methods are being considered to remove the Shield Building concrete, and mechanical methods are being considered to cut the Containment Vessel opening. After installation of the new steam generators, the openings would be sealed and the Containment Vessel and Shield Building returned to their original configurations and integrity.

The two original steam generators would be drained and cut-away from existing piping and supports. Steel covers would be seal-welded to the nozzles of main coolant, steam, and feedwater piping openings of the original steam generators to preclude the release of contamination and seal-off internal sections during removal, transport and storage. Loose contamination would be removed from the exterior of each original steam generator and a coating would be applied to affix any remaining contamination. The steam generators would then be rigged-out of Containment through the temporary openings.

After removal from Containment, the original steam generators would be transported on a self-propelled modular transporter to the permanent Storage Facility. The replacement steam generators would be removed from temporary storage and moved by the self-propelled modular transporter to the vicinity of the Davis-Besse Containment, and rigged into place. Installation would include construction of supports, connection of piping, and testing of system integrity.

Construction activities would likely result in noise levels (primarily from hydro-demolition, if used, or other mechanical means of concrete removal) greater than those associated with normal Davis-Besse operation. Noise from construction activities, however, would be intermittent and temporary in nature, and would decrease as the distance from the source increases.

The peak period of activity would likely occur when the actual removal and replacement of the steam generators take place. FENOC anticipates that approximately 900 additional workers would be on-site to support the replacement of the steam generators. Approximately 1,300 additional temporary workers would be on-site supporting the refueling outage as well, for a peak total of approximately 2,200 additional workers.

FENOC anticipates that on-site storage of diesel fuel and various lubricating oils may be required during the 70-day steam generator replacement project. FENOC site and company environmental protection procedures (e.g., the Spill Prevention Control and Countermeasure (SPCC) Plan) will be used to control the storage of fuel and oils. Non-hazardous waste generated during the steam generator replacement project and hydro-demolition concrete and demolition debris will be disposed of in accordance with FENOC and site procedures. Water used in the hydro-demolition process, and other temporary discharges will be addressed in accordance with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit.

In advance of the steam generator replacement project, FENOC plans to resolve relevant environmental permit requirements (e.g., Ohio Final General Permit for Storm Water Discharge) to ensure compliance. No significant impacts to bodies of water, ecological resources, cultural resources or land use are anticipated in association with the steam generator replacement project because activities are planned to be undertaken on previously-disturbed parcels of land, and fugitive dust generation and water run-off will be managed in accordance with FENOC and site procedures and best-management practices. In addition, many of the facilities and activities will be short-term and temporary in nature.

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3.3 PROGRAMS AND ACTIVITIES FOR MANAGING THE EFFECTS OF AGING

Regulatory Requirement: 10 CFR 51.53(c)(2)

"The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures…This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…."

The IPA required by 10 CFR 54.21 identifies the programs and inspections determined to be necessary for managing aging at Davis-Besse during the additional 20 years beyond the initial license term. Appendix B of the Davis-Besse license renewal application contains descriptions of the programs and activities credited for managing the effects of aging during the period of extended operation. Appendix B also identifies programs and activities that are new and describes proposed revisions (enhancements) to the existing programs and activities.

In addition to implementation of the specific programs and inspections identified in the IPA, some enhancements to Davis-Besse administrative control procedures may be required in association with license renewal. The additional programs and inspection activities, and the potential enhancements to administrative control procedures, are consistent with normal plant component inspections and, for that reason, are not expected to cause significant environmental impact.

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3.4 EMPLOYMENT

3.4.1 CURRENT WORKFORCE

The non-outage work force at Davis-Besse, as of January 2009, consists of approximately 825 FENOC employees and approximately 60 contractor employees. As shown in Table 3.4-1, approximately 88% of employees reside in the four contiguous counties of Ottawa (37.2%), Lucas (19.8%), Wood (15.5%), and Sandusky (15%).

The Davis-Besse reactor is on a 24-month refueling cycle (Section 3.1.2). During refueling outages, which average about 48 days, site employment is supplemented with the addition of an average 1,300 temporary workers. Should turbine generator work occur during an outage, FENOC estimates that site employment would be supplemented with the addition of an average 1,500 temporary workers. FENOC expects the number of workers required on site for normal plant outages during the period of extended operation to be consistent with the number of additional workers used for past outages at Davis-Besse.

3.4.2 LICENSE RENEWAL INCREMENT

The GEIS estimated that an additional 60 employees per unit would be necessary for operation during the period of extended operation to perform the license renewal surveillance, on-line monitoring, inspections, testing, trending, and recordkeeping activities (**NRC 1996**, Table 2.8). FENOC, however, believes that it will be able to manage the necessary programs with existing staff.

Most of the new activities, for example, are one-time inspections that will be performed prior to entering the extended license period. Many other activities will be performed during outages, when supplemental technical staff is available. The few new ongoing programs that will continue into the extended license period are not expected to require plant resources beyond the current staffing. Therefore, FENOC has no plans to add non-outage employees to support plant operations during the extended license period. As a result, there is no anticipated effect to indirect employment or population associated with the extended license period.

Table 3.4-1: Estimated Distribution of Davis-Besse Employee Residences, January 2009

State	County	Percent of Workforce*
Ohio	Ashland	0.12
	Clark	0.12
	Clyde	0.12
	Crawford	0.24
	Cuyahoga	0.12
	Erie	5.58
	Fulton	0.36
	Hancock	0.24
	Huron	1.09
	Lake	0.12
	Locus	0.12
	Lorain	0.24
	Lucas	19.76
	Morrow	0.12
	Ottawa	37.21
	Portage	0.12
	Putnam	0.12
	Richland	0.12
	Sandusky	15.03
	Seneca	1.45
	Summit	0.12
	Wood	15.52
Michigan	Monroe	1.70
	Van Buren	0.12
Pennsylvania	Beaver	0.12

*Includes approximately 825 FENOC employees.

3.5 REFERENCES

AEC 1973. Final Environmental Impact Statement Related to Construction of Davis-Besse Nuclear Power Station, Docket No. 50-346, Toledo Edison Company and Cleveland Electric Illuminating Company, U.S. Atomic Energy Commission, March 1973.

FE 2007. FirstEnergy Vegetation Management Specifications, FirstEnergy Forestry Services, Revision 2007.

FENOC 2008. Submittal of 2007 Annual Hazardous Waste Report Forms Site ID, OI and GM, FirstEnergy Nuclear Operating Company (FENOC), L-08-086, February 27, 2008.

FENOC 2009. FENOC Letter L-09-175, NRC Quarterly Performance Indicators Including Monthly Operating Report Data (P-50), July 10, 2009.

FENOC 2010. Updated Safety Analysis Report (USAR) Davis-Besse Nuclear Power Station No. 1 Docket No: 50-346 License No: NPF-3, FirstEnergy Nuclear Operating Company (FENOC), Revision 27, June 2010.

NRC 1975. Final Environmental Statement Related to Operation of Davis-Besse Nuclear Power Station, Unit 1, NUREG 75/097, U.S. Nuclear Regulatory Commission, October 1975.

NRC 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), NUREG-1437, Volumes 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1996.

NRC 1999. Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437, Volume 1, Addendum 1, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, NUREG-1437, August 1999.

NRC 2008. Davis-Besse Nuclear Power Station, Unit No. 1 - Issuance of Amendment Re: Measurement Uncertainty Recapture Power Uprate (TAC NO. MD8326) U.S. Nuclear Regulatory Commission, ML081410652, June 30, 2008.

NRC 2010. NRC Letter, M.A. Satorius to B. Allen (FENOC), CAL No. 3-10-001, Confirmatory Action Letter – Davis-Besse Nuclear Power Station, June 23, 2010.

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4.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTION AND MITIGATING ACTIONS

Regulatory Requirement: 10 CFR 51.53(c)(2)

"The environmental report must include an analysis that considers…the environmental effects of the proposed action…and alternatives available for reducing or avoiding adverse environmental effects." 10 CFR 51.45(c) as adopted by 10 CFR 51.53(c)(2)

The environmental report shall discuss the "…impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance…." 10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)

"The information submitted…should not be confined to information supporting the proposed action but should also include adverse information."
10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)

Chapter 4 assesses the environmental consequences associated with the renewal of the Davis-Besse operating license. The assessment is based on the 92 environmental issues that the NRC has identified, analyzed, and considered to be associated with nuclear power plant license renewal. The NRC has designated the issues as Category 1, Category 2, or NA (not applicable).

Category 1 issues met the following criteria:

- the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic;

- a single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts that would occur at any plant, regardless of which plant is being evaluated (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent-fuel disposal); and

- mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

NRC rules do not require analyses of Category 1 issues that the NRC resolved using generic findings (10 CFR Part 51, Appendix B, Table B-1) as described in the GEIS (**NRC 1996**). An applicant may reference the generic findings or GEIS analyses for Category 1 issues.

If the NRC analysis concluded that one or more of the Category 1 criteria could not be met, NRC designated the issue as Category 2. NRC requires plant-specific analyses for Category 2 issues.

Finally, NRC designated two issues as NA (not applicable), signifying that the categorization and impact definitions do not apply to these issues.

Attachment A of this report lists the 92 issues and identifies the environmental report section that addresses each issue applicable to Davis-Besse. For organization and clarity, FENOC has assigned a number to each issue and uses the issue numbers throughout the environmental report.

Category 1 License Renewal Issues

FENOC has determined that, of the 69 Category 1 issues, eight are not applicable to Davis-Besse because they apply to design or operational features that do not exist at the facility. With respect to the remaining 61 Category 1 issues, including seven issues applicable to refurbishment, FENOC has not identified any new and significant information that would invalidate the NRC findings (at 10 CFR Part 51, Appendix B, Table B-1). Therefore, FENOC adopts by reference the NRC findings for these Category 1 issues.

Category 2 License Renewal Issues

NRC designated 21 issues as Category 2. Sections 4.1 through 4.20 address these Category 2 issues, beginning with a statement of the issue. Nine Category 2 issues apply to operational features that Davis-Besse does not have. In addition, four Category 2 issues apply to refurbishment activities. If the issue does not apply to Davis-Besse, the section explains the basis for inapplicability.

For the 12 Category 2 issues that FENOC has determined to be applicable to Davis-Besse, the appropriate sections contain the required analyses. These analyses include conclusions regarding the significance of the impacts relative to the renewal of the operating license for Davis-Besse and, if applicable, discuss potential mitigative alternatives to the extent required. FENOC has identified the significance of the impacts associated with each issue as either SMALL, MODERATE, or LARGE, consistent with the criteria that NRC established in 10 CFR Part 51, Appendix B, Table B-1, Footnote 3 as follows:

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.

MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.

LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

In accordance with National Environmental Policy Act (NEPA) practice, FENOC considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

"NA" License Renewal Issues

NRC determined that its categorization and impact-finding definitions did not apply to two issues (Issues 60 and 92). FENOC has, however, included these issues in Attachment A.

NRC noted that applicants do not need to submit information on chronic effects from electromagnetic fields (10 CFR Part 51, Table B-1, Note 5). For the environmental justice issue, NRC does not require information from applicants, but notes that it will be addressed in individual license renewal reviews (10 CFR Part 51, Table B-1, Note 6). FENOC has included environmental justice information in Sections 2.6.2 and 4.21 and both issues are listed in Attachment A, Table A-1.

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4.1 WATER USE CONFLICTS

> **Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(A)**
>
> "If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×1012 ft^3/year (9×1010 m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 13]

The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 13. The issue, however, is dependent on river size and the corresponding annual river flow rate.

As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system. Although the system uses a natural draft cooling tower, it withdraws make-up water from Lake Erie instead of a small river. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.2 ENTRAINMENT OF FISH AND SHELLFISH IN EARLY LIFE STAGES

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(B)

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from… entrainment." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 25]

NRC made impacts on fish and shellfish resources from entrainment a Category 2 issue because it could not assign a single significance level (small, moderate, or large) to the issue. The impacts of entrainment are small at many facilities, but may be moderate or large at others. In addition, ongoing restoration efforts may increase the number of fish susceptible to intake effects during the license renewal period (**NRC 1996**, Section 4.2.2.1.2). Information needing to be ascertained includes (1) type of cooling system (whether once-through or cooling pond), and (2) status of Clean Water Act (CWA) Section 316(b) determination or equivalent state documentation.

The issue of entrainment of fish and shellfish in early life stages, however, applies to plants with once-through cooling or cooling pond heat dissipation systems. As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system that uses a natural draft cooling tower. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.3 IMPINGEMENT OF FISH AND SHELLFISH

> **Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(B)**
>
> "If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from…impingement…." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 26]

NRC made impacts on fish and shellfish resources from impingement a Category 2 issue, because it could not assign a single significance level to the issue. Impingement impacts are small at many facilities, but might be moderate or large at other plants (**NRC 1996**, Section 4.2.2.1.3). Information that needs to be ascertained includes (1) type of cooling system (whether once-through or cooling pond), and (2) current CWA 316(b) determination or equivalent state documentation.

The issue of impingement of fish and shellfish, however, applies to plants with once-through cooling or cooling pond heat dissipation systems (10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 26). As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system that uses a natural draft cooling tower. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.4 HEAT SHOCK

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(B)

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act… 316(a) variance in accordance with 40 CFR Part 125, or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from heat shock …." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 27]

NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue, because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (**NRC 1996**, Section 4.2.2.1.4). Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 27.

The issue of heat shock, however, applies to plants with once-through cooling or cooling pond heat dissipation systems. As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system that uses a natural draft cooling tower. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.5 GROUNDWATER USE CONFLICTS

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(C)

"If the applicant's plant…pumps more than 100 gallons (total onsite) of groundwater per minute, an assessment of the impact of the proposed action on groundwater use must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 33]

NRC made this groundwater use conflict a Category 2 issue because overuse of an aquifer could exceed the natural recharge. Locally, a withdrawal rate of more than 100 gpm could create a cone of depression that could extend offsite. This could inhibit the withdrawal capacity of nearby offsite users.

The issue of groundwater use conflicts, however, applies to plants that use more than an annual average of 100 gpm of groundwater. As discussed in Section 2.3, Davis-Besse does not use groundwater at the site for plant operations. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.6 GROUNDWATER USE CONFLICTS (PLANTS USING COOLING TOWERS WITHDRAWING MAKEUP WATER FROM A SMALL RIVER)

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(A)

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×1012 ft^3/year (9×1010 m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 34]

The issue has been a concern at nuclear power plants with cooling towers. Impacts may result, for example, from surface water withdrawals from small water bodies during low flow conditions, which may affect aquifer recharge. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 34. The issue, however, is dependent on river size and the corresponding annual river flow rate.

As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system. Although the system uses a natural draft cooling tower, it withdraws make-up water from Lake Erie instead of a small river. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.7 GROUNDWATER USE CONFLICTS (PLANTS USING RANNEY WELLS)

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(C)

"If the applicant's plant uses Ranney wells…an assessment of the impact of the proposed action on groundwater use must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 35]

The issue applies to plants using Ranney wells for cooling tower make up water. Ranney wells can result in potential groundwater depression beyond the site boundary. Impacts of large groundwater withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 35.

As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system that uses a natural draft cooling tower. Davis-Besse does not use Ranney wells. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.8 DEGRADATION OF GROUNDWATER QUALITY

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(D)

"If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 39]

The issue applies to plants at inland sites with cooling ponds. Evaporation from closed-cycle cooling ponds concentrates dissolved solids in the water and settles suspended solids. In turn, seepage into the water table aquifer could degrade groundwater quality. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 30.

As discussed in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system that does not use cooling ponds, but instead uses a natural draft cooling tower that withdraws make-up water from Lake Erie. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.9 IMPACTS OF REFURBISHMENT ON TERRESTRIAL RESOURCES

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(E)

"All license renewal applicants shall assess the impact of refurbishment and other license-renewal-related construction activities on important plant and animal habitats." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 40]

The impacts of refurbishment on terrestrial resources and the significance of the ecological impacts cannot be determined without considering site-specific and project-specific refurbishment details (**NRC 1996**, Section 3.6). Aspects of the site and the project to be ascertained are the identification of important ecological resources, the nature of refurbishment activities, and the extent of impacts to plant and animal habitat.

Activities associated with refurbishment at Davis-Besse are described in Section 3.2. Based on the Beaver Valley Power Station (BVPS) Unit 1 steam generator replacement experience in 2006, a Davis-Besse steam generator replacement project would have little potential for disturbing or otherwise impacting local flora and fauna. The total area disturbed would be less than 10 acres. The two new permanent structures should already have been constructed on previously-disturbed land in 2011 to allow them to be used in support of the reactor vessel head replacement project, expected to occur in 2011. Temporary facilities, including laydown areas and concrete pad construction, will be located within the developed industrial areas of the site. Additionally, the proposed transportation route is by rail along an existing right-of-way. Therefore, no natural habitat would be lost or altered due to the planned steam generator replacement project.

The only project effects are expected to be noise and construction activity-related impacts on existing wildlife populations, such as the bald eagles on site, possibly disrupting existing behaviors and distribution during the short period of on-site activity. However, the use of mitigation measures for bird species (see Section 4.10.1), fugitive dust, or sediment transport as directed by FENOC and site procedures during construction activities associated with the temporary facilities for the Davis-Besse steam generator replacement project will reduce impacts to the terrestrial environment. Based on these elements, FENOC concludes that refurbishment project impacts on terrestrial resources would be SMALL, and no further mitigation would be warranted.

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4.10 THREATENED OR ENDANGERED SPECIES

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(E)

"All license renewal applicants shall assess the impact of refurbishment and other license–renewal-related construction activities on important plant and animal habitats. Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 49]

The NRC has found that plant refurbishment and continued operation, in general, are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies is needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 49.

In addition, a site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations through the renewal period. Information pertinent to this assessment includes: (a) actual or potential occurrence of threatened or endangered species on or in the vicinity of the Davis-Besse site and associated transmission lines that are in the scope of Davis-Besse license renewal, (b) impact initiators presented by continued operation of Davis-Besse and those transmission lines that could affect threatened or endangered species that do or may occur, (c) controls established for impact initiators, and (d) industry and plant experience related to potential impacts.

Section 2.2 of this ER describes the aquatic environment of Lake Erie near Davis-Besse. Section 2.4 describes the terrestrial environment of the Davis-Besse site and Section 2.5 discusses threatened or endangered species that occur in the vicinity of the site and associated transmission lines.

4.10.1 REFURBISHMENT

Section 3.2 describes Davis-Besse refurbishment activities and Section 2.5 addresses endangered, threatened or otherwise sensitive species potentially located at the Davis-Besse site. Based on this information and consultation with regulatory agencies, the only species that may be impacted by a planned steam generator replacement at Davis-Besse would be nesting and young bald eagles (see Section 4.10.2). FENOC plans to follow the requirements provided by the USFWS and ODNR regarding construction activities within the specified distance to nesting and young bald eagles.

No impacts are anticipated for the Indiana bats, as described in the ODNR letter (**ODNR 2009b**) (see Section 4.10.2), because no tree removal is proposed in the areas where permanent and temporary facilities will be located.

All planned construction-related activities are on previously-developed or altered industrial lands on site. Additionally, the proposed transportation route is by rail along an existing right-of-way. As a result, FENOC concludes that refurbishment project-related impacts to threatened or endangered species would be SMALL, and no further mitigation would be warranted.

4.10.2 LICENSE RENEWAL TERM

Current Davis-Besse operations and the associated transmission lines do not adversely affect any special-status species or important habitats. As noted in Section 3.1.4, there are approximately 1,800 acres for the rights-of-way along the transmission lines, which are primarily located over existing farmland. FirstEnergy Corp. (FE) conducts routine vegetation maintenance of these rural transmission corridors approximately every five years. Trees and shrubs that do not interfere with transmission facilities are not disturbed, and portions of corridors that are not cultivated or devoted to other intensive uses are managed to promote a diversity of shrubs, grasses, and other groundcover that provides wildlife food and cover. Plant operations and transmission line maintenance activities are not expected to change significantly during the license renewal term.

FENOC has written to the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Ohio Department of Natural Resources, which includes the Ohio Natural Heritage Program, requesting information on any listed species or critical habitats that might occur in the vicinity of the Davis-Besse site and along transmission line corridors, with particular emphasis on species that might be adversely affected by continued operation over the license renewal period. Agency responses are provided in Attachment C.

USFWS determined that the Davis-Besse license renewal project will not impact federally listed species and will have minimal environmental impacts, as no change in operation or extent of the facility is proposed. However, the USFWS noted that a bald eagle (*Haliaeetus leucocephalus*) nest exists on the Davis-Besse property. Although the bald eagle was removed from the Federal list of endangered and threatened species in July 2007 due to recovery, this species continues to be afforded protection by the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. To avoid disturbing nesting and young eagles, USFWS requested that no activity occur within 660 feet of the nest between January 1 and July 31, when the nesting eagles are most vulnerable. FENOC plans to incorporate the USFWS requirement into station procedures. (**USFWS 2009**)

NMFS stated that no threatened or endangered species listed by NMFS are known to occur in Lake Erie and that no Essential Fish Habitat (EFH), as designated under the Magnuson-Steven Fisheries Management and Conservation Act, occurs in the vicinity of Davis-Besse. As a result, NMFS noted that no further coordination with NMFS on the effects of Davis-Besse license renewal is necessary. (**NMFS 2010**)

ODNR reported that the project is within the range of the Indiana bat *(Myotis sodalis),* a state and federally endangered species, and listed a number of high value trees that protect its habitat. ODNR requires that if such trees occur within the project area, these trees must be conserved. In addition, if suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. If no tree removal is proposed, the project is not likely to impact this species. FENOC plans to incorporate the ODNR requirement into station procedures. (**ODNR 2009a**)

ODNR also reported that the project is within the range of the following state, federal, or both endangered or threatened species:*

- Piping plover *(Charadrius melodus),* a state and federally endangered bird species
- Eastern massasauga *(Sistrurus catenatus),* a state endangered and a federal candidate snake species
- Bald eagle *(Haliaeetus leucocephalus),* a state threatened species
- Eastern pondmussel *(Ligumia nasuta),* a state endangered mussel
- Spotted gar *(Lepisosteus oculatus)*, a state endangered fish
- Blacknose shiner *(Notropis heterolepis)* , a state endangered fish
- American bittern *(Botaurus lentiginosus)*, a state endangered bird
- Black tern *(Chlidonias niger),* a state endangered bird
- Cattle egret *(Bubulcus ibis),* a state endangered bird
- Common tern *(Sterna hirundo),* a state endangered bird
- King rail *(Rallus elegans*, a state endangered bird
- Loggerhead shrike *(Lanius ludovicianus)* , a state endangered bird
- Northern harrier *(Circus cyaneus)*, a state endangered bird
- Snowy egret *(Egretta thula)*, a state endangered species
- Trumpeter swan *(Cygnus buccinator),* a state endangered bird

*Section 2.5 provides a more comprehensive list developed by FENOC based on its data searches.

ODNR determined that the Davis-Besse license renewal project is not likely to impact these species. Nevertheless, because the location of bald eagle activity frequently changes, a status update must be obtained from ODNR prior to any construction activity. This requirement is in addition to the USFWS request that no activity occur within 660 feet of the nest between January 1 and July 31. FENOC plans to incorporate the ODNR requirement into station procedures. Otherwise, ODNR is not aware of any threatened or endangered species in the vicinity of Davis-Besse. (**ODNR 2009a**)

Based on the list of species identified in Section 2.5, FENOC is not aware of any potential concerns regarding threatened or endangered species that could occur due to the site or transmission line operations. Maintenance activities necessary to support license renewal would be limited to previously disturbed areas on-site and no additional land disturbance is anticipated in support of license renewal. In addition, there are no plans to alter plant operations during the license renewal term which would affect threatened or endangered species. Furthermore, FENOC has procedural controls in place to ensure that reviews are conducted for protection of envrionmental resources prior to engaging in land-disturbing construction activities on the site. These controls include activities involving disturbing land, removing trees, or vegetation, etc. Similarly, transmission line maintenance is conducted in accordance with FE policies that are protective of threatened or endangered species.

From the information above, including the results of correspondence with agencies, FENOC concludes that impact to threatened or endangered species from continued operation of Davis-Besse would be SMALL and do not warrant mitigation.

4.11 AIR QUALITY DURING REFURBISHMENT (NONATTAINMENT AREAS)

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(F)

"If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce must be provided in accordance with the Clean Air Act as amended." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 50]

Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the numbers of workers expected to be employed during the outage. See10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 50. Information needed to determine air quality impacts would include the attainment status of the plant-site area and the number of vehicles added as a result of refurbishment activities.

As discussed in Section 2.10, Davis-Besse is located in the Sandusky Intrastate Air Quality Control Region (40 CFR 81.203), which is in attainment for all national air quality standards. The nearest nonattainment area is located in Monroe County, Michigan, more than 50 miles northwest of the Davis-Besse site. The nearest maintenance area is located in the city of Toledo, Lucas County, approximately 25 miles west-northwest.

As a result, FENOC believes that this issue does not apply to Davis-Besse, whether or not refurbishment will occur, because Davis-Besse is not located in or near a nonattainment or maintenance area. Therefore, further assessment is not required.

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4.12 IMPACT ON PUBLIC HEALTH OF MICROBIOLOGICAL ORGANISMS

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(G)

"If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flow rate of less than 3.15×1012 ft^3/year (9×1010 m^3/year), an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 57]

Some microorganisms associated with cooling towers and thermal discharges can have deleterious impacts on human health, and their presence can be enhanced by thermal additions (**NRC 1996**, Section 4.3.6). These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 57.

As described in Section 3.1.3, Davis-Besse has a closed-cycle heat dissipation system that uses a natural draft cooling tower and does not make use of a cooling pond, lake or canal. In addition, the cooling tower discharges into Lake Erie instead of a small river. As a result, this issue does not apply to Davis-Besse and further assessment is not required.

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4.13 ELECTROMAGNETIC FIELDS – ACUTE EFFECTS

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(H)

"If the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents, an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 59]

The NRC has concluded that electrical shock from energized conductors or from induced charges in metallic structures is not a problem at most operating plants and is not likely to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential at the site (10 CFR Part 51, Subpart A, Table B 1, Issue 59). The transmission lines to be addressed for license renewal, as NRC noted in the GEIS and its guidance, are those that were constructed to connect the plant switchyard to the existing transmission system and reviewed as part of the construction permit for the plant (**NRC 1996**, Section 4.5.4; **NRC 2000**, Section 4.13).

The electrical shock issue, which is generic to all types of electrical generating stations, including nuclear power plants, is of small significance for transmission lines that are operated in adherence with National Electric Safety Code (NESC). Without review of each nuclear plant's transmission line conformance with NESC criteria, it is not possible to determine the significance of the electrical shock potential. (**NRC 1996**, Sections 4.5.4 and 4.5.4.1)

According to the NESC, for voltages exceeding 98 kV alternating current to ground, either the clearances shall be increased or the electric field, or effects thereof, shall be reduced by other means as required to limit the steady state current due to electrostatic effects to 5 mA if the largest anticipated truck, vehicle, or equipment under the line were short-circuited to ground. The size of the anticipated truck, vehicle, or equipment used to determine these clearances may be less than but need not be greater than that limited by federal, state, or local regulations governing the area under the line. For this determination, the conductors shall be at final unloaded sag at 120°F (**IEEE 2006**, Rule 232 D.3.c).

The critical parameters associated with the calculation of electric fields below transmission lines include the line voltage, conductor and phase dimensions, the line configuration, and the overhead clearance above ground. The shape, size, and position of objects beneath the line and the electric field in the area determine the induced voltages and currents that will be developed in these objects. The maximum or peak field values occur over a small area at midspan, where conductors are closest to the ground. Transmission line electric fields at the edge of the right-of-way are not as sensitive as the peak field to conductor height.

As described in Section 3.1.4, three new high-voltage transmission lines were built to connect Davis-Besse to the nearby Toledo Edison (an FE transmission company) transmission 345 kV substations at Bay Shore, Lemoyne, and Ohio Edison - Beaver substation. These transmission lines were constructed before the NESC adopted the 5 mA provision in 1977.

Therefore, FENOC conducted a screening analysis for each road crossing under the three transmission lines to determine conformance with the existing NESC standard. The analysis used methods prescribed by EPRI (**EPRI 2008**) to determine the current induced for the maximum vehicle size limited by Federal and state transportation regulations, located in the peak electric field under the transmission line, for the worst-case configuration, i.e., the vehicle is parallel to the conductors near the lowest clearance to ground.

For specific vehicle dimensions, the induced current is directly proportional to the electric field. Thus, for the maximum allowable vehicle (a triple tractor trailer combination measuring13.5 feet tall, 8.5 feet wide, and 95 feet long), the induced vehicle current is 1.2 mA per kV per meter of electric field. To meet NESC requirements of 5 mA maximum induced current, the maximum electric field must be limited to approximately 4.1 kV/m (5 mA/1.2 mA/kV/m).

For the configurations reviewed at each road crossing, the threshold electric field of 4.1 kV/m is exceeded if the transmission line road crossing clearance is less than 40 feet at 120^{o}F. All road crossing clearances for the three Davis-Besse high-voltage transmission lines exceed 40 feet at 120^{o}F, resulting in a calculated electric field at these locations of less than 4.1 kV/m. Consequently, the maximum induced current in a triple tractor trailer combination located in the peak electric field under the transmission line for the worst-case configuration is less than 5 mA.

Similar induced currents do not occur on railroad cars beneath transmission lines because the car is effectively connected to the track, unlike a vehicle mounted on insulating rubber tires. The distributed track to ground resistance is sufficiently low to discharge any rail car to ground capacitance before an electric charge can build within half a power frequency cycle.

Based on the above considerations, FENOC concludes that the potential for electric shock is of SMALL significance and mitigation measures are not warranted.

4.14 HOUSING IMPACTS

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(I)

"An assessment of the impact of the proposed action on housing availability…(impacts from refurbishment activities only) within the vicinity of the plant must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 63]

Housing impacts depend on local conditions. Impacts result when the demand for housing, caused by the project-related population increase, approaches or exceeds the number of available housing units in the vicinity of the plant. The magnitude of the impacts is determined by the number of additional workers associated with refurbishment activities or continued operation and maintenance, and by the population categorization, growth control measures, and housing inventory within the region.

4.14.1 REFURBISHMENT

As described in Section 3.2, FENOC estimates that approximately 900 additional temporary employees in addition to the approximately 1,300 temporary refueling outage workers would be needed to perform the planned Davis-Besse steam generator replacement project activities. The 1,300 temporary refueling outage workforce impacts are already addressed under normal operations, and will not be evaluated further. The temporary steam generator replacement project workforce, however, could generate demand for up to 900 additional housing units in the local area for a period of approximately 70 days.

FENOC expects to perform the steam generator replacement during the spring of 2014, a period when the seasonal and transient populations are low and many hotel rooms and short-term rental properties are available. As discussed in Section 2.6.2.4, the total combined seasonal and transient population is approximately equivalent to the total permanent population, and this transient population increase occurs predominantly in the summer to take advantage of outdoor recreational opportunities.

Based on the large population increase in the summer months, an additional 900 employees looking for short-term housing would have a beneficial impact to the local economy during the off-season period in which the steam generator replacement project should occur. In addition, Davis-Besse is located in a high population area that is near a major metropolitan area, Toledo (see Section 2.6.1). The number of refurbishment project workers, therefore, is small compared to the area's total population and would not cause a discernable change in housing availability, rental rates, or housing values.

As a result, FENOC expects steam generator replacement project-related housing impacts to be SMALL and does not warrant mitigation.

4.14.2 LICENSE RENEWAL TERM

NRC regulatory criteria indicate that housing impacts are expected to be of small significance at plants located in a medium or high population area and in an area where growth control measures that limit housing development are not in effect (10 CFR Part 51, Subpart A, Table B-1, Issue 63). Sections 2.6.1.1 and 2.8 demonstrate that Davis-Besse is located in a high population area that, although it is subject to growth planning, is not subject to control measures that limit housing development. Furthermore, FENOC does not anticipate a need for additional full-time workers during the license renewal period (Section 3.4).

FENOC concludes that, since there would be no increase in staffing, the impact to housing from the continued operation of Davis-Besse is categorized as SMALL and does not warrant mitigation.

4.15 PUBLIC UTILITIES: PUBLIC WATER SUPPLY AVAILABILITY

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(I)

"[T]he applicant shall provide an assessment of the impact of population increases attributable to the proposed project on the public water supply." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 65]

Potential for water shortages at some sites may lead to impacts of moderate significance on public water supply availability. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 65. These potential impacts to the public water supply system depend on both plant demand and plant-related population growth demands on public water systems.

Impacts on public utility services are considered SMALL if little or no change occurs in the ability to respond to the level of demand. Impacts are considered MODERATE if overtaxing of facilities during peak demand periods occurs and LARGE if existing service levels (such as quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services (**NRC 1996**, Section 3.7.4.5).

4.15.1 REFURBISHMENT

As discussed Section 3.2, FENOC estimates that approximately 900 temporary employees would be needed to perform the planned Davis-Besse steam generator replacement project activities for a period of approximately 70 days. The estimate also includes the assumption that additional indirect jobs would be filled by local residents, resulting in no additional population growth. Section 3.4.1 indicates that 88% of Davis-Besse employees reside in the four contiguous counties of Ottawa (37.2%), Lucas (19.8%), Wood (15.5%), and Sandusky (15%). FENOC assumes that the project temporary workforce would find temporary residences within this area and the workers would not relocate their families.

As noted above, impacts on public utility services are considered small if little or no change occurs in the ability to respond to the level of demand (**NRC 1996**, Section 3.7.4.5). Sections 2.9.4 and 3.1.3.3 describe the station and the public water supply systems in the four surrounding counties. Davis-Besse acquires potable water from the Carroll Township Water System, which has excess capacity of 700,000 gallons per day (Table 2.9-9). The combined water systems in the four counties surrounding Davis-Besse have a total excess capacity of approximately 121 million gallons per day.

The impact to the Carroll Township Water System due to hydro-demolition techniques, if used during the steam generator replacement project, is expected to be SMALL. Hydro-demolition requires up to approximately 230,000 gallons of water per day, which is approximately one-third of the excess capacity of the Carroll Township Water Supply system. Coordination between Davis-Besse and Carroll Township Water Supply personnel during hydro-demolition will minimize the impact of the increased demand in water use. Therefore, little or no change will occur in the ability of Carroll Township to respond to the level of water demand to its customers due to the use of hydro-demolition techniques during the proposed steam generator replacement project at Davis-Besse.

The maximum impact to the local water supply systems from the project temporary workforce was determined by calculating the amount of water that would be required by the temporary workforce for the planned Davis-Besse steam generator replacement project. The average American uses between 50 and 80 gallons per day for personal use. Conservatively assuming that each temporary employee used 80 gallons per day while at the Davis-Besse site, the additional maximum usage at Davis-Besse would be 72,000 gallons per day, well below the excess capacity available.

Also, conservatively assuming that each temporary employee also used 80 gallons per day while in their temporary residences, the additional maximum usage in the four-county region of interest would be 72,000 gallons per day, also well below the excess capacity available.

Lastly, portable sanitary units are planned to be used instead of the on-site sewage treatment facility to accommodate the temporary increase of steam generator replacement project employees. The portable units would be processed at a major wastewater treatment facility with adequate capacity, such as the Oregon or Toledo Bay plants in nearby Lucas County.

Based on the above, FENOC concludes that impacts resulting from the temporary work force at Davis-Besse and in their counties of temporary residence would be SMALL and would not require mitigation.

4.15.2 LICENSE RENEWAL TERM

FENOC does not anticipate a need for additional full-time workers during the license renewal period (Section 3.4). As a result, there will be no incremental impact to the public water supplies from refurbishment activities or additional workers in the four-county area near the plant.

Table 2.9-9 provides details on the community water suppliers in the four-county area surrounding the Davis-Besse site, including the Carroll Township Water System that supplies Davis-Besse's potable water needs (Section 3.1.3.3). For all systems, the average daily demand on the current water systems is considerably below the respective system capacities. Therefore, plant operations during the license renewal period are not projected to cause an adverse effect on the local water supply. Because no site-related population increases will occur during the license renewal period, there will be no indirect impacts to any public water systems in the area.

Based on the above, FENOC concludes that impacts to public water supplies will continue to be SMALL and further consideration of mitigation measures is not warranted.

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4.16 EDUCATION IMPACTS FROM REFURBISHMENT

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(I)

"An assessment of the impact of the proposed action on…public schools (impacts from refurbishment activities only) within the vicinity of the plant must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 66]

Impacts to education are a product of additional demand on the public education system resulting from refurbishment-related population growth and the capacity of the education system to absorb additional students.

As discussed Section 3.2, FENOC estimates that approximately 900 temporary employees would be needed for a period of approximately 70 days to perform the planned Davis-Besse steam generator replacement project activities. Based on FENOC experience from prior Davis-Besse refueling outages and the BVPS Unit 1 steam generator replacement experience gained in 2006, FENOC anticipates that the approximately 900 temporary workers would in-migrate, but would not relocate families to the plant site region for a project of this short duration. Therefore, FENOC estimates that few to no children would be relocated to the region, and there would be SMALL impacts to the education system.

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4.17 OFFSITE LAND USE

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(I)

"An assessment of the impact of the proposed action on…land use…within the vicinity of the plant must be provided."

Refurbishment: "Impacts may be of moderate significance at plants in low population areas…." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 68]

License renewal term: "Significant changes in land use may be associated with population and tax revenue changes resulting from license renewal." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 69]

Impacts to off-site land use take place when pressures resulting from project-related population or tax revenue increases result in changes to local land use and development patterns. These impacts could occur as a result of either refurbishment or during the license renewal period.

10 CFR Part 51 identifies that housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or in areas with growth control measures that limit housing development. See 10 CFR 51.53(c)(3)(ii)(I).

4.17.1 REFURBISHMENT

As discussed in Section 3.2, FENOC estimates that approximately 900 temporary employees would be needed for a period of approximately 70 days to perform the project activities associated with a planned Davis-Besse steam generator replacement project. The estimate also includes the assumption that additional short-term indirect jobs would be filled by local residents, resulting in no additional population growth.

The NRC stated in the GEIS that, if project-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile, and at least one urban area with a population of 100,000 or more within 50 miles (**NRC 1996**, Section 3.7.5).

Table 2.6-1 indicates that, within 20 miles of the Davis-Besse plant, which is assumed to be a reasonable commuting distance to work, and within which a majority of the 825 Davis-Besse employees reside, there are 129,411 persons, which equates to 168 per square mile. Five percent of this value is 6,471 persons. The project-related temporary population growth of 900 is well below 5 percent of the study area's total population. Also, within 50 miles, there are several urban areas (Toledo, Ohio, and portions of Detroit, Michigan) with populations of 100,000 or more. The population within 50 miles of Davis-Besse is 2,448,608 persons, which equates to 326 per square mile. Therefore, the area surrounding the Davis-Besse plant satisfies the GEIS criteria for predicting project-related offsite land use changes.

Due to the small number of project workers compared to the area's total population, available residential and commercial development, proximity to a major metropolitan area, and the short duration of a planned Davis-Besse steam generator replacement project, FENOC expects that project-related off-site land use changes would be SMALL and would not warrant mitigation.

4.17.2 License Renewal Term

During the license renewal term, new land use impacts could, as noted in the GEIS, result from plant-related population growth or from the use of tax payments from the plant by local government to provide public services that encourage development (**NRC 1996**, Section 4.7.4.2).

Population-Related Impacts

NRC concluded, based on the GEIS case-study analysis, that all new population-driven land use changes during the license renewal term at all nuclear plants would be small. Population growth caused by license renewal would represent a much smaller percentage of the local area's total population than the percentage presented by operations-related growth (**NRC 1996**, Section 4.7.4.2).

FENOC agrees with the NRC conclusion and judges that new population-driven land use changes at Davis-Besse during the license renewal term will, therefore, be SMALL. Furthermore, FENOC does not anticipate that additional workers will be employed at Davis-Besse during the period of extended operations (Section 3.4). As a result, there will be no impact to the offsite land use from plant-related population growth.

Tax Revenue-Related Impacts

Significance levels for license renewal are considered small if tax payments are less than 10% of the jurisdiction's tax revenue, moderate if payments are 10-20%, and large if payments are greater than 20%. (**NRC 1996**, Section 4.7.2.1).

Table 2.7-1 lists the proportional contribution of property taxes from Davis-Besse to Ottawa County and the Carroll Township property and school district tax bases for the five-year period 2004-2008.

Regionally, the tax contribution to Ottawa County and the Penta County Job Vocational School is less than 10%. Locally, the tax contribution to Carroll Township and Benton-Carroll-Salem local school district is greater, averaging nearly 19% for the township and 17% for the school district during the five-year period.

Lastly, FENOC plans to add two new permanent structures at Davis-Besse in 2011 to support the reactor vessel head replacement project. As a result, there may be related tax-increase-driven changes to offsite land use and development patterns during the license renewal term.

FENOC concludes that the regional tax-driven land use impact would be SMALL and mitigation is not warranted. FENOC concludes that the local tax-driven land use impact would be MODERATE, but positive, and for that reason mitigation is not warranted.

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4.18 TRANSPORTATION

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(J)

"All applicants shall assess the impact of highway traffic generated by the proposed project on the level of service of local highways during periods of license renewal refurbishment activities and during the term of the renewed license." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 70]

Transportation impacts, as discussed in the GEIS, would continue to be of small significance at all sites during operations and would be of small or moderate significance during scheduled refueling and maintenance outages. However, because impacts are determined primarily by road conditions existing at the time of the project, the impact significance needs to be determined at the time of license renewal. (**NRC 1996,** Section 4.7.3.2)

Transportation impacts are generally expected to be of small significance. However, the increase in traffic associated with the additional workers and local road and traffic control conditions may lead to impacts of moderate or large significance at some sites. See 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 70.

4.18.1 REFURBISHMENT

As discussed in Section 3.2, FENOC estimates that approximately 900 temporary employees would be needed for a period of approximately 70 days to perform the project activities associated with a planned Davis-Besse steam generator replacement project. Access to the Davis-Besse site would be via State Route 2, and the major commuting routes to the site are in rural and uncongested areas (Section 2.9.5). Historically, increased traffic during outages at Davis-Besse has not degraded the capacity of local roads, and does not create the need for additional or widening of roads, or traffic control devices. Some slowing of State Route 2 traffic using portable flashing caution and warning signs, however, is necessitated during outages to allow site traffic safe exit from the station into traffic flow on State Route 2.

More importantly, as shown in Table 2.6-11, the seasonal and transient populations that enter the region in the summer months cause the local population to nearly double as almost 13,000 persons descend on the area. Additionally, shown in Table 2.9-14 there are over 13,000 vehicles estimated to be within 10 miles of the plant. The addition of 900 vehicles from the temporary steam generator replacement project workforce results in an increase of less than seven percent of the total number of vehicles in the area.

Based on the seasonal and transient population changes and the number of vehicles within 10 miles of the plant, FENOC concludes that the impacts to area transportation of approximately 900 additional temporary workers and truck material deliveries associated with a short time duration (i.e., approximately 70 days) Davis-Besse steam generator replacement project expected in the spring season (i.e., off-season) would be SMALL and would not warrant mitigation.

4.18.2 LICENSE RENEWAL TERM

During the license renewal term, the GEIS noted that transportation impacts would continue to be of small significance at all sites during operations and would be of small or moderate significance during scheduled refueling and maintenance outages (**NRC 1996**, Section 4.7.3.2). In particular, highway Level of Service (LOS) A and B are associated with small impacts because the operation of individual users is not substantially affected by the presence of other users. LOS A conditions allow free flow of the traffic stream and users are unaffected by the presence of others. LOS B conditions allow stable flow in which the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished. At these levels, no delays occur and no improvements are needed. (**NRC 1996**; Section 3.7.4.2; **NRC 2000**, Section 4.18)

Given the rural character of the area in the Davis-Besse vicinity, the absence of pronounced grades, and the presence of few small metropolitan areas, commuter congestion arising from continued station operation will remain short-lived and not substantially affect other users of the roads. As a result, no added delays are expected and no improvements are needed.

Additionally, there is no expected increase in the number of employees required to support plant operation during the license renewal period (Sections 3.2 and 3.4). Therefore, impacts to transportation would be similar to those experienced during current operations and there should be no incremental impacts to transportation during the license renewal term.

Although the roads in the vicinity of Davis-Besse are adequate, compensating measures, such as staggered shift starting and ending times, are taken by the site to account for the increased traffic flow during outages to maintain a reasonable level of service. Therefore, FENOC concludes that impacts to transportation due to continued operation of Davis-Besse during the license renewal period would be SMALL and further mitigation is not warranted.

4.19 Historic and Archaeological Resources

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(K)

"All applicants shall assess whether any historic or archaeological properties will be affected by the proposed project." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 71]

Generally, plant refurbishment and continued operation are expected to have only small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection (10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 71).

The GEIS notes that sites are considered to have small impacts to historic and archaeological resources if (1) the State Historic Preservation Office (SHPO) identifies no significant resources on or near the site; or (2) the SHPO identifies (or has previously identified) significant historic resources but determines they would not be affected by plant refurbishment, transmission lines, and license renewal term operations and there are no complaints from the affected public about altered historic character; and (3) if the conditions associated with moderate impacts from site activities do not occur. (**NRC 1996**, Section 3.7.7)

Moderate impacts, as noted in the GEIS, may result if historic resources, determined by the SHPO not to be eligible for the National Register, nonetheless are thought by the SHPO or local historians to have local historic value and to contribute substantially to an area's sense of historic character. Lastly, the GEIS notes that sites are considered to have large impacts to historic resources if resources determined by the SHPO to have significant historic or archaeological value would be disturbed or otherwise have their historic character altered through refurbishment activity, installation of new transmission lines, or any other construction (e.g., for a waste storage facility). Determinations of significance of impacts are made through consultation with the SHPO. (**NRC 1996**, Section 3.7.7)

4.19.1 Refurbishment

There were no known deposits of archaeological interest on the site prior to construction (Section 2.11). In addition, a recent query of the Ohio Historic Preservation Office's Online Mapping System conducted for a 6-mile radius around the site identified 378 previously recorded cultural resources. This number includes buildings, archaeological sites, cemeteries, churches, and other structures. Resource types range from a historic military base with many contributing structures to archaeological sites and individual architectural resources. One resource, an historic-period site (Table 2.11-3, Site No. OT0025), appears to be located at the extreme southeastern corner of the station property. Only one resource was listed in the National Register of Historic Places, the Carroll Township Hall, located about 3.2 miles to the southwest of the Davis-Besse site.

As discussed in Section 3.2, the Davis-Besse steam generator replacement project activities involving ground disturbance are the construction of temporary or permanent concrete pads for temporary facilities. These temporary facilities and any permanent concrete pads that remain following the replacement project are expected to be constructed on previously disturbed land that was graded and otherwise disturbed during station construction. Also, as noted above, there were no known deposits of archaeological interest on the site prior to construction and only one resource appears on the Ohio Historic Preservation Office's Online Mapping System, which is located well beyond the proposed disturbed area.

All activities associated with the proposed Davis-Besse steam generator replacement, including construction and excavation for temporary structures and laydown areas, are planned for previously-disturbed and evaluated areas that should not require consultation with the Ohio State Historic Preservation Office prior to commencing work. These activities also include the rail delivery of the new steam generators to Davis-Besse and any physical modifications to improve existing rail lines, and transportation of the steam generators on-site.

Based on the above, FENOC concludes that the impacts of a Davis-Besse steam generator replacement project on archeological, cultural, or historic resources would be SMALL and further mitigation is not warranted.

4.19.2 LICENSE RENEWAL TERM

FENOC is not aware of any historic or archaeological resources that have been affected by Davis-Besse operations, including operation and maintenance of transmission lines. Nevertheless, FENOC has procedural controls in place to ensure that environmental reviews are conducted prior to engaging in additional construction or operational activities that may result in an environmental impact at the site. These controls include activities involving disturbance of surface or subsurface land areas and demolition of existing structures.

FENOC also contacted the Ohio Historic Preservation Office (OHPO) for information related to any known archaeological resources in the vicinity of the Davis-Besse site. In the opinion of the OHPO, license renewal will not affect historic properties (**OHPO 2010**). Copies of the correspondence are included in Attachment C.

As a result, FENOC concludes that the potential impact of continued operation of Davis-Besse during the period of the renewed license on historic or archaeological resources will be SMALL and further mitigation is not warranted.

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4.20 SEVERE ACCIDENT MITIGATION ALTERNATIVES

Regulatory Requirement: 10 CFR 51.53(c)(3)(ii)(L)
"If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environment assessment, a consideration of alternatives to mitigate severe accidents must be provided." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 76]

This section summarizes FirstEnergy's analysis of alternative ways to mitigate the impacts of severe accidents. Attachment E provides a detailed description of the severe accident mitigation alternative (SAMA) analysis.

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in the release or a potential for release of radioactive material to the environment. NRC categorizes accidents as "design basis" or "severe." Design basis accidents are those for which the risk is great enough that NRC requires plant design and construction to prevent unacceptable accident consequences. Severe accidents are those that NRC considers too unlikely to warrant design controls.

The NRC concluded that the generic analysis summarized in the GEIS applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts of severe accidents are of small significance for all plants. However, not all plants have performed a site-specific analysis of measures that could mitigate severe accidents. Consequently, severe accidents are a Category 2 issue for plants that have not performed a site-specific consideration of severe accident mitigation alternatives SAMAs and submitted that analysis for Commission review. (**NRC 1996**, Section 5.5.2.5)

- The Level 1 probabilistic risk assessment (PRA) and Level 2 PRA models for Davis-Besse (as discussed in Attachment E, Sections E.3.1, E.3.2, and E.3.3) were used to estimate the core damage frequency (CDF) and release category frequencies. The release category frequencies and characterizations (using the Modular Accident Analysis Program (MAAP) code) from the Level 2 PRA were provided as input to the subsequent Level 3 PRA. The Level 2 PRA results were combined with Davis-Besse site-specific parameters (e.g., population, meteorological data, topography, and economic data) for the Level 3 PRA to estimate the off-site dose and off-site property losses. Then, based on NRC guidance in NUREG/BR-0184 (**NRC 1997**), the maximum achievable benefit for any

SAMA candidate at Davis-Besse was estimated. This value provided an upper bound of any potential SAMA candidate benefit and was used to eliminate a SAMA candidate from any further analysis.

- The following provides a summary of the steps used during the SAMA process: Level 3 PRA Analysis – The Level 3 PRA model developed to support this cost-benefit evaluation used the MELCOR Accident Consequence Code System (MACCS2), which simulates the impact of severe accidents at nuclear power plants on the surrounding environment. The results of the Level 3 PRA model are vectors of off-site exposure and off-site property costs associated with each release category. These consequence vectors were combined with the results of the Level 2 PRA model (i.e., release category frequencies) to yield the probabilistic off-site dose and probabilistic off-site property losses. The final results of the Level 3 PRA evaluation for each SAMA candidate were the value of the cumulative dose expected to be received by off-site individuals and the value of the expected off-site property losses due to severe accidents given the plant configuration under evaluation. Sensitivity analyses were performed to assess the impact of assumptions associated with the site population, meteorological conditions, and evacuation timing when defining the input parameters to MACCS2. The Level 3 PRA is discussed in Attachment E, Sections E.3.4 and E.3.5.

- Cost of Severe Accident Risk – The cost of severe accident risk was estimated using guidance from NEI 05-01 (**NEI 2005**) and NUREG/BR-0184 (**NRC 1997**). The cost of severe accident risk was defined as the maximum achievable benefit a SAMA candidate could achieve if it eliminated all risk. The maximum achievable benefit was obtained by evaluating the total risk in U.S. dollars considering the risk of dose to the public and workers, off-site and on-site economic impacts, and replacement power costs. Any SAMA candidate for which the implementation cost was greater than the maximum achievable benefit was eliminated from any further cost-benefit analysis. The severe accident risk cost calculation is provided in Attachment E, Section E.4.

- Candidate SAMA Identification – SAMA candidates are defined as potential enhancements to the plant design, operating procedures, inspection programs, or maintenance programs that have the potential to prevent core damage and prevent significant releases from the Davis-Besse containment. A comprehensive initial list of SAMA candidates was developed by reviewing industry guidance documents, SAMA analyses of other plants, Davis-Besse Individual Plant Examination (IPE), Davis-Besse Individual Plant Examination External Events (IPEEE), Davis-Besse Level 1 PRA (SAMA PRA Model, Revision 01), and Davis-Besse Level 2 PRA (SAMA PRA Model, Revision 01). The PRA results were reviewed for the dominant cutsets, system importance, significant contributors to Level 2 release categories, and any insights or recommendations provided. The list of initial SAMA candidates is discussed in Attachment E, Section E.5.

- Phase I SAMA Analysis (Screening) – A qualitative screening was performed for each of the candidates identified on the initial SAMA candidate list. Several SAMA candidates were screened on the basis that the SAMA candidate was not applicable to Davis-Besse, was already implemented at Davis-Besse, required excessive implementation cost, or had very little perceived (risk) benefit. If SAMA candidates were similar, one was subsumed into the more risk-beneficial SAMA candidate. The screening process for each SAMA candidate is discussed in Attachment E, Section E.6.

- Phase II SAMA Analysis (Cost-Benefit) – Those SAMA candidates that passed the qualitative screening were selected for a detailed cost-benefit analysis, which compared the estimated benefit in dollars of implementing the SAMA candidate to the estimated cost of implementation. The methodology used for this evaluation was based on the regulatory guidance for cost-benefit evaluation in NUREG/BR-0184 (**NRC 1997**). The estimated benefit was determined by applying a bounding modeling assumption in the PRA model. For example, if a SAMA candidate would reduce the likelihood of a specific human error, the human error probability would be set to zero in the PRA model. This would completely eliminate the human error for the SAMA candidate, thus overestimating the potential benefit. This bounding treatment is conservative for a SAMA evaluation because underestimating the risk in the modified PRA case makes the modification look more beneficial than it may actually be. The costs to implement SAMA candidates considered for further evaluation were estimated by a Davis-Besse Expert Panel. If the estimated benefit exceeded the estimated implementation cost, the SAMA candidate was considered viable for implementation. The cost-benefit evaluation is discussed in Attachment E, Section E.7.

- Sensitivity Analysis – Sensitivity cases were performed to investigate the sensitivity of the results to certain modeling assumptions in the Davis-Besse SAMA analysis. Seven sensitivity cases were investigated. These cases examined the impacts of assuming damaged plant equipment is repaired and refurbished following an accident, a lower discount rate, a higher discount rate, higher on-site dose estimates, higher total on-site cleanup costs, higher costs for replacement power, and a higher non-internals event hazard groups' multiplier. Details on the sensitivity cases are discussed in Attachment E, Section E.8.

The results of the evaluation of 167 SAMA candidates did not identify any cost-beneficial enhancements at Davis-Besse. However, assuming a lower discount rate, higher replacement power costs, or an increased multiplier identified one potential cost-beneficial SAMA candidate. The SAMA candidate identified in the sensitivity cases is not related to plant aging. Therefore, the identified cost-beneficial SAMA candidate is not a required modification for the license renewal period. Nevertheless, this SAMA candidate will be considered through the normal FENOC processes for evaluating possible modifications to the plant.

4.21 ENVIRONMENTAL JUSTICE

Regulatory Requirement: 10 CFR 51.53, Subpart A, Appendix B, Table B1
"The need for and the content of an analysis of environmental justice will be addressed in plant specific reviews." [10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 92]

Environmental justice was not reviewed in the GEIS. However, Executive Order 12898, "Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations," issued in 1994, is intended to focus the attention of Federal agencies on the human health and environmental conditions in minority and low income communities.

The consideration of environmental justice is required to assure that federal programs and activities will not have disproportionately high and adverse human health or environmental effects on minority and low-income populations. Accordingly, the NRC's Nuclear Reactor Regulation (NRR) Office has a procedure for incorporating environmental justice into the licensing process (**NRC 2004**).

As the NRR procedure recognizes, if no significant off-site impacts occur in connection with the proposed action, then no member of the public will be substantially affected. Thus, no disproportionate impact on minority or low-income populations would occur from the proposed action.

Section 2.6.2 presents demographic information relating to environmental justice to assist the NRC in its review.

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4.22 REFERENCES

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5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

Regulatory Requirement: 10 CFR 51.53(c)(3)(iv)

"The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware."

The NRC licenses the operation of domestic nuclear power plants and provides for license renewal, requiring a license renewal application that includes an environmental report (10 CFR 54.23). NRC regulations 10 CFR Part 51 prescribe the environmental report content and identify the specific analyses the applicant must perform. In an effort to perform the environmental review efficiently and effectively, the NRC has resolved most of the environmental issues generically, but requires an applicant's analysis of all the remaining issues.

While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those environmental issues that have been generically resolved (10 CFR 51.53(c)(3)(i)), the regulations do require that an applicant identify any new and significant information of which the applicant is aware (10 CFR 51.53(c)(3)(iv)). The purpose of this requirement is to alert the NRC staff to such information so that the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis. The NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of GEIS conclusions (**NRC 1996a**, Pages C9-13, Concern NEP.015).

FENOC considers new and significant information would include the following:

- information that identifies a significant environmental issue not covered in the GEIS and codified in the regulations, or
- information that was not covered in the GEIS analyses and which leads to an impact finding different from that codified in the regulation.

The NRC does not define the term "significant." As a result, FENOC used guidance available in Council on Environmental Quality (CEQ) regulations for its review. CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment (40 CFR 1502.3), to focus on significant environmental issues (40 CFR 1502.1), and to eliminate from detailed study issues that are not significant (40 CFR 1501.7(a)(3)). The CEQ guidance includes a definition of “significantly” that requires consideration of the context of the action, and the intensity or severity of the impact(s) (40 CFR 1508.27). FENOC assumes that moderate or large impacts, as defined by the NRC, would be significant. Section 4.0 presents the NRC definitions of “moderate” and “large” impacts.

5.1 DESCRIPTION OF PROCESS

FENOC relied on two processes to identify potential new and significant information. First, a FENOC procedure establishes the method and guidance to perform and document environmental evaluations when required by the FENOC regulatory applicability determination process or by the design review process. The procedure requires due consideration of the 92 environmental issues identified in 10 CFR Part 51, Table B-1, before approving station changes, tests, and experiments (i.e., “proposed actions”). The environmental review also considers other applicable or relevant standards (e.g., 40 CFR and applicable state code) when judging the effects of proposed actions. Acceptance criteria for these effects include the environmental regulatory analyses supporting the current licensing basis.

Second, FENOC established an integrated information gathering process to identify potential new and significant information specific to Davis-Besse license renewal. The integrated process included the following tasks:

- A review of internal and external documents and records including, but not limited to environmental assessments and monitoring reports, procedures, and other management controls, compliance history reports, and environmental resource plans and data.
- A review of Supplemental Environmental Impact Statements associated with other license renewal applications to determine if there were new and significant information identified for those plants that may be applicable to Davis-Besse.
- Interviews with FENOC and FirstEnergy subject-matter experts regarding Davis-Besse environmental impacts and the appropriateness of GEIS scope and conclusions with respect to Davis-Besse.
- Solicitation and review of information relevant to environmental impacts of Davis-Besse from regulatory agencies and other stakeholder organizations.

Information identified as a result of these tasks was evaluated by a panel of subject-matter experts to determine its significance and then documented.

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5.2 ASSESSMENT

Based on the processes employed to identify new information and changing conditions, FENOC is not aware of any new and significant information regarding the environmental impacts of Davis-Besse license renewal.

One issue, however, was identified as new subsequent to when Davis-Besse became operational, but determined by FENOC to be not significant. Another potentially significant environmental issue identified as part of the original Davis-Besse operating license was determined subsequently to be not significant. These issues are described in more detail below.

Recovery of Burrowing Mayflies

Burrowing mayflies (*Hexagenia supp.*) are native to western Lake Erie and were abundant until the 1950s, when they disappeared due to degraded water and sediment quality. Nymphs were absent from sediments until 1993, when several small populations were discovered near the western and southern shores of Lake Erie. By 1995, nymphs had spread throughout the western and eastern half of the lake. Factors that have permitted the mayfly recovery include improved sediment and water quality attributed to pollution abatement programs implemented in the early 1970s. (**Krieger et al. 1996**)

Increasingly larger swarms of winged *Hexagenia* (mayflies) came onshore at Davis-Besse during the spring seasons in the 1990s. Attracted by station lighting, the mayflies became both a safety and security issue. The mayflies produced a slipping hazard due to the large number of carcasses strewn about the site. The mayflies also reduced the effectiveness of station lighting, resulting in a security issue in or around sensitive areas. By 1996, it became necessary for FENOC to implement procedures to mitigate the effects of the spring mayfly infestation.

The mayfly populations and intensities during the spring seasons, however, have varied over the years. This variation is likely the result of frequent or extended periods of lake stratification, which causes fall mayfly nymph recruitment failures. A trend toward increasing frequency of hot summers in the region could result in recurrent loss of mayfly larvae in western Lake Erie. (**Bridgeman et al. 2006**) Consequently, FENOC deems the spring mayfly infestation, although a new environmental issue, to be not significant due to the variability of infestations and the implementation of mitigation procedures.

Cooling Tower Bird Collisions

Avian mortality resulting from collisions of birds with the natural-draft cooling tower and other structures at Davis-Besse was an initial concern identified during the construction and operating licensing stages. As a result, extensive surveys were required to study the topic and included as part of the Environmental Technical Specifications, Appendix B, Section 3.1, to the Davis-Besse operating license. (**AEC 1973**, Pages i and iv; **NRC 1975**, Pages i and iii)

The significance of the mortality caused by the cooling tower was determined by examining the actual numbers and species of birds killed and comparing this mortality with the total avian mortality resulting from other man-made objects and with the abundance of bird populations near the towers and other structures from fall 1972 to fall 1979. The survey results were submitted to the NRC in 1980 (**Toledo Edison 1980**) and are discussed in the GEIS (**NRC 1996b**, Section 4.3.5.2).

In 1981, the NRC staff concurred with the survey report’s conclusion that there was no significant adverse effect on bird populations due to the cooling tower and other site structures. As a result, the NRC removed further monitoring of bird collisions at Davis-Besse. (**NRC 1981**)

5.3 REFERENCES

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6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

6.1 LICENSE RENEWAL IMPACTS

This section summarizes in tabular form the environmental impacts related to license renewal for the Davis-Besse operating license for Category 2 issues discussed in Chapter 4. In Section 4.1, FENOC incorporates, by reference, the NRC's findings for the 61 Category 1 issues that apply to Davis-Besse, all of which have impacts that are SMALL (see Attachment A). Sections 4.2 through 4.21 present FENOC's assessment of the Category 2 issues that apply to the Davis-Besse site.

Table 6.1-1 summarizes the impacts that Davis-Besse license renewal would have on resources associated with all Category 2 issues. As shown, the Category 2 issues evaluated are either not applicable or have impacts that would be SMALL, except a MODERATE beneficial impact due to tax revenues for off-site land use during the license renewal period.

Table 6.1-1: Environmental Impacts Related to License Renewal at Davis-Besse

No.	Category 2 Issue	Environmental Impact
Surface Water Quality, Hydrology, and Use (for all plants)		
13	Water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow) **10 CFR 51.53(c)(3)(ii)(A)**	**NONE**. This issue does not apply because Davis-Besse withdraws make-up water from Lake Erie instead of a small river with low flow.
Aquatic Ecology (for plants with once-through or cooling pond heat dissipation systems)		
25	Entrainment of fish and shellfish in early life stages **10 CFR 51.53(c)(3)(ii)(B)**	**NONE**. This issue does not apply because Davis-Besse does not use a once-through or cooling pond heat dissipation system.
26	Impingement of fish and shellfish 10 CFR 51.53(c)(3)(ii)(B)	**NONE**. This issue does not apply because Davis-Besse does not use a once-through or cooling pond heat dissipation system.
27	Heat shock **10 CFR 51.53(c)(3)(ii)(B)**	**NONE**. This issue does not apply because Davis-Besse does not use a once-through or cooling pond heat dissipation system.
Groundwater Use and Quality		
33	Groundwater use conflicts (potable and service water, and dewatering; plants that use > 100 gpm) **10 CFR 51.53(c)(3)(ii)(C)**	**NONE**. This issue does not apply because Davis-Besse does not use groundwater for plant operations.
34	Groundwater use conflicts (plants using cooling towers or cooling ponds and withdrawing makeup water from a small river) **10 CFR 51.53(c)(3)(ii)(A)**	**NONE**. This issue does not apply because Davis-Besse withdraws make-up water from Lake Erie instead of a small river.
35	Groundwater use conflicts (Ranney wells) **10 CFR 51.53(c)(3)(ii)(C)**	**NONE**. This issue does not apply because Davis-Besse does not use Ranney wells.
39	Groundwater quality degradation (cooling ponds at inland sites) **10 CFR 51.53(c)(3)(ii)(D)**	**NONE**. This issue does not apply because Davis-Besse does not use a once-through or cooling pond heat dissipation system.

Table 6.1-1: Environmental Impacts Related to License Renewal at Davis-Besse
(continued)

No.	Category 2 Issue	Environmental Impact
Terrestrial Resources		
40	Refurbishment impacts **10 CFR 51.53(c)(3)(ii)(E)**	**SMALL**. Impacts are expected to be minimal because, based on FENOC refurbishment experience at BVPS Unit 1 in 2006, the refurbishment work will be conducted within the existing industrial footprint of the station, which has previously been disturbed.
Threatened or Endangered Species		
49	Threatened or endangered species **10 CFR 51.53(c)(3)(ii)(E)**	**SMALL**. Impacts are expected to be minimal during refurbishment because FENOC will follow the requirements provided by the USFWS and ODNR regarding bald eagles and Indiana bats. Additionally, operation and maintenance of the plant and associated transmission lines are not expected to change significantly during the license renewal term.
Air Quality		
50	Air quality during refurbishment (non-attainment and maintenance areas) **10 CFR 51.53(c)(3)(ii)(F)**	**NONE**. This issue does not apply, whether or not refurbishment will occur, because Davis-Besse is not located in or near an air quality nonattainment or maintenance area.
Human Health		
57	Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river) **10 CFR 51.53(c)(3)(ii)(G)**	**NONE**. This issue does not apply because Davis-Besse uses cooling towers that discharge to Lake Erie instead of a small river.
59	Electromagnetic fields, acute effects (electric shock) **10 CFR 51.53(c)(3)(ii)(H)**	**SMALL**. The Davis-Besse transmission lines conform to the NESC provisions for preventing electric shock from induced current.

Table 6.1-1: Environmental Impacts Related to License Renewal at Davis-Besse
(continued)

No.	Category 2 Issue	Environmental Impact
Socioeconomics		
63	Housing impacts **10 CFR 51.53(c)(3)(ii)(I)**	**SMALL**. FENOC plans refurbishment during the spring of 2014, when seasonal and transient populations are low and hotel rooms and short-term rentals are plentiful. Also, no additional workers are anticipated during the license renewal term. Therefore, impacts to housing are expected to be minimal due to refurbishment or continued operation of Davis-Besse.
65	Public services: public utilities **10 CFR 51.53(c)(3)(ii)(I)**	**SMALL**. Impacts are expected to be minimal during refurbishment and the license renewal term because water suppliers in the four-county area in the vicinity of Davis-Besse have ample excess capacity.
66	Public services: education (refurbishment) **10 CFR 51.53(c)(3)(ii)(I)**	**SMALL**. Impacts are expected to minimal because, based on FENOC refurbishment experience at BVPS Unit 1 in 2006, the temporary workers in-migrate and do not relocate families to the region due to the short duration of refurbishment.
68	Offsite land use (refurbishment) **10 CFR 51.53(c)(3)(ii)(I)**	**SMALL**. Impacts are expected to be minimal because the number of project workers is small compared to the area's total population, there is available residential and commercial development, there is proximity to a major metropolitan area, and refurbishment is of short duration.
69	Offsite land use (license renewal term) **10 CFR 51.53(c)(3)(ii)(I)**	**MODERATE**. No plant-induced changes to offsite land use are expected from license renewal. Continued Davis-Besse operation would bring positive impacts due to the proportion of tax revenues to regional jurisdictions.
70	Public services: transportation **10 CFR 51.53(c)(3)(ii)(J)**	**SMALL**. Impacts to transportation are expected to be minimal due to refurbishment or continued operation of Davis-Besse because the area transportation infrastructure is capable of handling large seasonal and transient populations, FENOC plans refurbishment when seasonal and transient populations are low, and no additional workers are anticipated during the license renewal term.

Table 6.1-1: Environmental Impacts Related to License Renewal at Davis-Besse
(continued)

No.	Category 2 Issue	Environmental Impact
71	Historic and archaeological resources **10 CFR 51.53(c)(3)(ii)(K)**	**SMALL**. Refurbishment and continued operation of Davis-Besse would require limited land-altering construction and be restricted to previously disturbed areas. FENOC and site procedures ensure protection of potential unidentified archaeologically and historically sensitive areas.
Postulated Accidents		
76	Severe accident mitigation alternatives **10 CFR 51.53(c)(3)(ii)(L)**	**SMALL**. No impact from continued operation. FENOC did not identify any cost-beneficial enhancements, but did identify one potential cost-beneficial SAMA candidate, which FENOC will consider through normal processes for evaluating possible changes to the plant.

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6.2 MITIGATION

Regulatory Requirement: 10 CFR 51.53(c)(3)(iii)
"The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues in Appendix B to subpart A of this part. No such consideration is required for Category 1 issues in Appendix B to subpart A of this part."

When adverse environmental impacts are identified, 10 CFR 51.45(c) requires consideration of alternatives available to reduce or avoid these adverse effects. Furthermore, "Mitigation alternatives are to be considered no matter how small the adverse impact; however, the extent of the consideration should be proportional to the significance of the impact." (**NRC 2000**, Page 4.2-S-5)

As discussed in Chapter 4 and summarized in Table 6.1-1, the Category 2 issues evaluated are either not applicable or have impacts that would be SMALL, except for a MODERATE but beneficial impact on the local school district tax revenue, and do not require mitigation. For these issues, the current permits, practices, and programs that mitigate the environmental impacts of plant operations are adequate.

Current plant operations include monitoring programs that would continue during the license renewal period to ensure the safety of workers, the public, and the environment. These programs include, for example, the radiological environmental monitoring program, air quality emissions monitoring, and effluent chemistry monitoring. Their purpose is to ensure that the plant's permitted emissions and discharges are within regulatory limits and any unusual or off-normal emissions/discharges are quickly detected, thus mitigating potential impacts. Accordingly, FENOC concludes that further mitigation measures are not warranted.

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6.3 UNAVOIDABLE ADVERSE IMPACTS

Regulatory Requirement: 10 CFR 51.45(b)(2)

The report shall discuss …"[a]ny adverse environmental effects which cannot be avoided should the proposal be implemented" as adopted by 10 CFR 51.53(c)(2).

FENOC adopts, by reference, for this ER the NRC findings stated in the GEIS for applicable Category 1 issues (see Attachment A), including discussions of any unavoidable adverse impacts.

Chapter 4 contains the results of FENOC's review and analyses of Category 2 issues, as required by 10 CFR 51.53(c)(3)(ii). These reviews take into account the information that has been provided in the GEIS, Appendix B to Subpart A of 10 CFR Part 51, and information specific to Davis-Besse.

From the Chapter 4 reviews, FENOC identified the following unavoidable adverse impacts of license renewal and refurbishment activities:

- The cooling water system would cause some consumptive use of Lake Erie water to compensate for drift and evaporation losses from the cooling tower.
- The cooling tower and its vapor plume would be visible from offsite. This visual impact would continue during the license renewal term.
- Procedures for the disposal of sanitary, chemical, and radioactive wastes would be intended to reduce adverse impacts from these sources to acceptably low levels. Solid radioactive wastes would be a product of plant operations and long-term disposal of these materials must be considered.
- Operation of Davis-Besse would result in a very small increase in radioactivity in the air and water. However, fluctuations in natural background radiation would be expected to exceed the small incremental increase in dose to the local population. Operation of Davis-Besse also would create a very low probability of accidental radiation exposure to inhabitants of the area.
- Land is required to store the old steam generators onsite pending disposal.

Based on these reviews and analyses, FENOC is not aware of significant adverse environmental effects that cannot be avoided upon renewal of the Davis-Besse operating license.

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6.4 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

Regulatory Requirement: 10 CFR 51.45(b)(5)

The report shall discuss …"[a]ny irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented" as adopted by 10 CFR 51.53(c)(2).

The continued operation of Davis-Besse for the license renewal term will result in the following irreversible and irretrievable resource commitments:

- Nuclear fuel that is used in the reactor and is converted to radioactive waste.
- Land required to store permanently or dispose of spent nuclear fuel offsite and low-level radioactive wastes generated as a result of plant operations.
- Water that evaporates during cooling tower operation.
- Elemental materials that will become radioactive.
- Materials used for the normal industrial operations of the plant that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms.

Other than the above, there are no major changes in operation of Davis-Besse planned during the license renewal period that would irreversibly or irretrievably commit environmental components of land, water, and air. However, if Davis-Besse ceases operations on or before the expiration of the current license, then the likely power generation alternatives would require a commitment of resources for construction of the replacement plant as well as for fuel to operate the plant.

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6.5 SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

Regulatory Requirement: 10 CFR 51.45(b)(4)

The environmental report shall discuss …"[t]he relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity" as adopted by 10 CFR 51.53(c)(2).

The current balance between short-term use and long-term productivity at Davis-Besse has remained relatively constant since the plant began operating in 1978. The Final Environmental Statements (FESs) evaluated the relationship between the short-term uses of the environment and the maintenance and enhancement of the long-term productivity associated with the impacts of constructing (**AEC 1973**) and operating (**NRC 1975**) Davis-Besse.

The period of extended operation will not change the short-term uses of the environment from the uses previously evaluated in the FESs. In fact, these evaluations note in particular the arrangement between FENOC and the USFWS that furthers the interests of conservation by increasing the extent and improving the quality of the site marshland available as a wildlife refuge. FENOC notes that the current balance is now well established and can be expected to remain essentially unchanged by the renewal of the operating license and extended operation of Davis-Besse. The period of extended operation will postpone the availability of the land and water resources for other uses. However, extending operations will not adversely affect the long-term uses of the site.

Refurbishment would result in the consumption of additional water during hydro-demolition, if used, but the consumption would be limited in duration and would cease once the steam generators are replaced. Likewise, noise impacts would be localized and of short duration.

After decommissioning, many environmental disturbances would cease and some restoration of the natural habitat may occur. Thus, the "trade-off" between the production of electricity and changes in the local environment is reversible to some extent.

Lastly, experience with other experimental, developmental, and commercial nuclear plants has demonstrated the feasibility of decommissioning and dismantling such plants sufficiently to restore a site to its former use. The degree of dismantlement will take into account the intended new use of the site and a balance among health and safety considerations, salvage values, and environmental impact. However, decisions on the ultimate disposition of these lands have not yet been made. Continued operation for an additional 20 years would not increase the short-term productivity impacts described here.

6.6 REFERENCES

AEC 1973. Final Environmental Impact Statement Related to Construction of Davis-Besse Nuclear Power Station, Docket No. 50-346, Toledo Edison Company and Cleveland Electric Illuminating Company, U.S. Atomic Energy Commission, March 1973.

NRC 1975. Final Environmental Statement Related to the Operation of Davis-Besse Nuclear Power Station Unit 1, Docket No. 50-346, Proposed by Toledo Edison Company, NUREG-75/097, U.S. Nuclear Regulatory Commission, March 1973.

NRC 2000. Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses; Supplement 1 to Regulatory Guide 4.2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, September 2000.

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7.0 ALTERNATIVES TO THE PROPOSED ACTION

Regulatory Requirement: 10 CFR 51.45(b)(3)

The environmental report shall discuss "Alternatives to the proposed action." [adopted by reference at 10 CFR 51.53(c)(2)].

This chapter assesses alternatives to the proposed renewal of the Davis-Besse operating license. It includes discussions of the no-action alternative and alternatives that meet system generating needs. Descriptions are provided in sufficient detail to facilitate comparison of the impacts of the alternatives to those of the proposed action. In considering the level of detail and analysis that it should provide for each category, FENOC relied on the NRC decision-making standard for license renewal:

…the NRC staff, adjudicatory officers, and Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision makers would be unreasonable. [10 CFR 51.95(c)(4)]

As noted in 10 CFR 51.53(c)(2), a discussion is not required of need for power or economic costs and benefits of the proposed action or of alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation.

Section 7.1 addresses the "no-action" alternative in terms of the potential environmental impacts of not renewing the Davis-Besse operating license, independent of any actions taken to replace or compensate for the loss of generating capacity. Section 7.2 describes feasible alternative actions that could be taken, which FENOC also considers to be elements of the no-action alternative, and presents other alternatives that FENOC does not consider to be reasonable. Section 7.3 presents the environmental impacts for the reasonable alternatives.

The environmental impact evaluations of alternatives presented are intended to provide enough information to support NRC decision-making by demonstrating whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action. Additional detail or analysis was not considered useful or necessary if it would identify only additional adverse impacts of license renewal alternatives; i.e., information beyond that necessary for a decision. This approach is consistent with the CEQ regulations, which provide that the consideration of alternatives (including the proposed action) be adequately addressed so reviewers may evaluate their comparative merits (40 CFR 1502.14(b)).

The characterization of environmental impacts in this chapter applies the same definitions of “SMALL,” “MODERATE,” and “LARGE” used in Chapter 4 of this ER and by the NRC in the GEIS (**NRC 1996**). Chapter 8 presents a summary comparison of environmental impacts of the proposed action and alternatives.

7.1 NO-ACTION ALTERNATIVE

FENOC considers the no-action alternative is not to renew the Davis-Besse operating license. With this alternative, FENOC expects Davis-Besse would continue to operate until the expiration of the existing operating license in 2017, at which time plant operations would cease, decommissioning would begin, and FirstEnergy or others would take the appropriate actions to meet system-generating needs created by discontinued operation of the plant.

Section 7.1.1 addresses the impacts of terminating operations and decommissioning, whereas Section 7.1.2 discusses the actions to replace power from Davis-Besse.

7.1.1 TERMINATING OPERATIONS AND DECOMMISSIONING

In the event the NRC does not renew the Davis-Besse operating license, FENOC assumes for this ER that it would operate the plant until the current license expires, then terminate operations and initiate decommissioning activities in accordance with NRC requirements. For purposes of this discussion, terminating operations includes those actions directly associated with permanent cessation of operations, which may result in more or less immediate environmental impacts (e.g., socioeconomic impacts from reduction in employment and tax revenues).

Decommissioning, as defined in the GEIS, is the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license (**NRC 1996**, Section 7.1). The two decommissioning options typically selected for United States reactors are rapid decontamination and dismantlement (DECON), and safe storage of the stabilized and de-fueled facility (SAFSTOR), followed by final decontamination and dismantlement (**NRC 1996**, Section 7.2.2). Under the DECON option, radioactively contaminated portions of the facility and site are decontaminated or removed promptly after cessation of operations to a level that permits termination of the license; these activities require several years for large light-water reactors like Davis-Besse (**NRC 1996**, Table 7.8). The SAFSTOR option involves safe storage of the stabilized and defueled facility for a period of time followed by decontamination to levels that permit license termination. Regardless of the option selected, decommissioning typically must be completed within 60 years after operations cease in accordance with NRC requirements at 10 CFR 50.82 (**NRC 1996**, Section 7.2.2).

FENOC has not selected a decommissioning method for Davis-Besse. The decommissioning method for Davis-Besse would be described in post-shutdown decommissioning plans for the plant, which must be submitted to NRC within two years following cessation of operations. For purposes of the present analysis, FENOC assumes that the DECON option would be employed upon license termination.

The NRC presents in Chapter 7 and Section 8.4 of the GEIS a summary of generic environmental impacts of the decommissioning process and an evaluation of potential changes in impact that could result from deferring the decommissioning process for up to 20 years (**NRC 1996**). For a pressurized water reactor decommissioning, NRC used a 1,175 MWe reference reactor. Although larger than Davis-Besse (910 MWe), FENOC considers the reference reactor to be representative of Davis-Besse. As a result, FENOC believes the decommissioning activities described in the GEIS to be representative of activities FENOC would perform for decommissioning at Davis-Besse.

The NRC concluded from its evaluation that decommissioning impacts would not be significantly greater as a result of the proposed action, assumed to result in 20 additional years of operation (**NRC 1996**, Sections 7.3 and 8.4). The NRC conclusions also indicate that the impacts of the decommissioning process itself, addressed in this ER as part of the no-action alternative, would have SMALL impacts with respect to radiation dose, waste management, air quality, water quality, and ecological resources (see 10 CFR Part 51, Subpart A, Appendix B, Table B-1). FENOC considers this generic evaluation and associated conclusions applicable to Davis-Besse as well.

The NRC has provided additional analysis of the environmental impacts associated with decommissioning in the Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (**NRC 2002**). Except for issues that require site-specific evaluation, environmental impacts, including radiological releases and doses from decommissioning activities, were assessed to be SMALL (**NRC 2002**, Sections 4.3 and 6.1).

Regardless of the NRC decision on license renewal, FENOC will have to decommission Davis-Besse; license renewal would only postpone decommissioning for an additional 20 years. In the GEIS, the NRC concludes that there should be little difference between the environmental impacts from decommissioning at the end of 40 years of operation versus those associated with decommissioning after an additional 20 years of operation under a renewed license (**NRC 1996**, Section 7.4).

By reference, FENOC adopts the NRC findings regarding environmental impacts of decommissioning in the license renewal GEIS (**NRC 1996**) and in the decommissioning GEIS (**NRC 2002**), and concludes that environmental impacts under the no-action alternative would be similar to those that occur following license renewal. Further, FENOC believes that decommissioning activities would not involve significant land-use disturbance offsite or significant activities beyond current operational areas that would offer potential for impacts on land use, ecological resources, or cultural resources.

Decommissioning impacts would be temporary and occur at the same time as those associated with the operation of replacement generating sources.

7.1.2 Replacement Capacity

Davis-Besse is a base-load generator of electric power, with a net generating capability of 908 MWe (Section 3.1.2). In 2008, Davis-Besse generated approximately 8.3% of FirstEnergy's total base-load electricity generation (**FirstEnergy 2008a**, Page 7; **USDOE 2010**). The power produced by Davis-Besse, which represents a significant portion of the electricity FirstEnergy supplies to 2.1 million customers in its service territories located in Ohio (**FirstEnergy 2009a**, Page 81), would be unavailable in the event the Davis-Besse operating license are not renewed. As provided in 10 CFR 51.53(c)(2), FENOC does not consider the need for power from Davis-Besse in this analysis, but does consider the potential impact of alternatives for replacing this power. Replacement options considered include building new base-load generating capacity, purchasing power, delaying retirement of non-nuclear assets, and reducing power requirements through demand reduction, as discussed in Section 7.2.

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7.2 ALTERNATIVES THAT MEET SYSTEM GENERATING NEEDS

If the Davis-Besse operating license is not renewed, then the State of Ohio, FirstEnergy Corp. and its subsidiary companies, and other participants in the wholesale power market would lose approximately 910 MWe* of base-load capacity. Renewal would preserve the option of relying on Davis-Besse to meet future electric power needs through the period of extended operation.

While many methods are available to generate electricity, the GEIS indicates that a "reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable" (**NRC 1996**, Section 8.1). Considering that Davis-Besse serves as a large base-load generator, FENOC considers reasonable alternatives to be those that would also be able to generate base-load power. FENOC believes that any alternative would be unreasonable if it did not consider replacement of the energy resource.

7.2.1 ALTERNATIVES CONSIDERED AS REASONABLE

FENOC believes that coal-fired and gas-fired generation capacity are feasible alternatives to nuclear power generating capacity, based on current (and expected) technological and cost factors, as compared to the other alternatives listed in the GEIS (**NRC 1996**, Section 8.1). FENOC considers the coal-fired and gas-fired technologies reasonable alternatives for purposes of this analysis to replace Davis-Besse generating capacity in the event its operating license is not renewed. FENOC considers the other technologies listed in the GEIS as not reasonable alternatives for the reasons discussed in Section 7.2.2.

The GEIS further notes that natural gas combined-cycle plants are particularly efficient and are used as base-load facilities (**NRC 1996**, Section 8.3.10). The specific coal-generating technologies that would represent viable alternatives are less certain, particularly in view of potentially higher air emissions compared to natural gas firing. For example, large-capacity integrated gasification combined-cycle (IGCC) and fluidized-bed-combustion (FBC) technologies (atmospheric and pressurized) are at or near commercial viability and could prove to be appropriate replacements. However, modern pulverized coal plants with advanced, clean-coal technology air emission controls represent currently proven technology and are economically competitive and commercially available in large-capacity unit sizes that could effectively replace Davis-Besse. Therefore, FENOC uses a representative plant of this type for purposes

*910 MWe is used for calculation convenience instead of 908 Mwe, as noted in Section 3.1.2.

of impact evaluation, noting that air emission impacts of IGCC and FBC options may be lower than modern pulverized coal, but would be higher than the gas-fired combined-cycle alternative (**USDOE 1999**, Pages 5-7).

The NRC has noted that, while there are many methods available for generating electricity and many combinations of alternative power generation sources that could provide base-load capacity, such an expansive consideration of alternatives would be too unwieldy (**NRC 1996**, Section 8.1).

7.2.1.1 Representative Coal-Fired Generation

For purposes of this analysis, FENOC assumed development of a modern pulverized coal-fired power plant with state-of-the-art emission controls similar to that described in its license renewal application, Appendix E (Environmental Report), for the Beaver Valley Power Station (**FENOC 2007**, Section 7.2.2.2). In defining the Davis-Besse coal-fired alternative, FENOC has used site-specific input as appropriate.

The representative plant would consist of commercially available standard-sized units, with a nominal net output of approximately 910 MWe, and would be designed to meet applicable standards with respect to control of air and wastewater emissions. As a minimum, FENOC assumed that the plant would feature low nitrogen oxide burners with overfire air to minimize formation of nitrogen oxides, and selective catalytic reduction for post-combustion nitrogen oxide control. Emissions of particulate matter and mercury would be limited by use of a fabric filter (baghouse), and sulfur oxide emissions would be controlled using a wet scrubber using limestone as the reagent.

Table 7.2-1 lists the basic specifications for the representative plant.

The Davis-Besse site would not be a viable location for the representative plant as a result of space limitations (see Section 7.3.1, Land Use). Land area requirements for a coal-fired plant of similar capacity to Davis-Besse would be approximately 1.7 acres per MWe (**NRC 1996**, Section 8.3.9), or 1,547 acres for a 910 MWe plant. The needed land area, therefore, far exceeds the 954-acre Davis-Besse site, most of which is occupied by marshland that is leased to the U.S. Government as a national wildlife refuge (Section 2.1).

Therefore, FENOC assumed for the analysis that the representative coal-fired plant would be located elsewhere at a greenfield or (preferably) brownfield site close to a commercially, navigable waterway or existing railway. A navigable waterway location would be highly desirable from a technical and economic perspective, considering the relative abundance of cooling water and low fuel cost afforded by barge transportation of coal and limestone. FENOC further assumed for the analysis that the representative coal-fired plant would use closed-cycle cooling with a natural draft cooling tower.

Lastly, FENOC assumed for the analysis that the environmental impacts associated with siting, design, and operation of the plant would be subject to comprehensive review under Ohio Power Siting Board (OPSB) rules or a comparable process.

7.2.1.2 Representative Gas-Fired Generation

For purposes of this analysis, FENOC assumed development of a modern natural gas-fired combined-cycle plant based on a commercially available design similar to that described in its license renewal application, Appendix E (Environmental Report), for the Beaver Valley Power Station (**FENOC 2007**, Section 7.2.2.1). In defining the Davis-Besse gas-fired alternative, FENOC has used site-specific input as appropriate.

The representative plant would consist of commercially available standard-sized units, with a nominal net output of approximately 910 MWe, and would be designed to meet applicable standards with respect to control of air and wastewater emissions. As a minimum, FENOC assumed that the plant would use natural gas as its only fuel and feature dry low-NO_X burners to minimize formation of nitrogen oxides during combustion and selective catalytic reduction for post-combustion nitrogen oxide control. Emissions of particulate matter and carbon monoxide would be limited through proper combustion controls.

Table 7.2-2 lists the basic specifications for the representative plant.

The Davis-Besse site is uncertain as a viable location for the representative plant due to space limitations. Land area requirements for a gas-fired plant of similar capacity to Davis-Besse, for example, would be approximately 0.11 acres per MWe (**NRC 1996**, Table 8.1), or 100 for a 910 MWe plant. Of the 954 acres of land occupied by the Davis-Besse site, 733 acres is occupied by marshland that is leased to the U.S. Government as a national wildlife refuge (Section 2.1). The remaining 221 acres is mostly occupied by Davis-Besse structures. Therefore, FENOC assumed for the analysis that the representative gas-fired plant would be located elsewhere at a greenfield or (preferably) brownfield site, but has not identified a specific site. However, primary considerations for a cost-competitive site include close proximity to adequate natural gas supply, transmission infrastructure, cooling water, and sufficient land suitable for development. For this analysis, FENOC assumed, based on FirstEnergy experience in gas-fired plant siting, that northwestern Ohio would be a realistic general area to locate the new plant (**FENOC 2007**, Section 7.2.2.1). FENOC further assumed for the analysis that the representative gas-fired plant would use closed-cycle cooling with mechanical draft cooling towers.

Lastly, FENOC assumed for the analysis that the environmental impacts associated with siting, design, and operation of the plant would be subject to comprehensive review under Ohio Power Siting Board (OPSB) rules or a comparable process.

7.2.2 Alternatives Considered as Not Reasonable

The following alternatives were considered as not reasonable replacement base-load power generation for one or more reasons as listed in Section 7.2.2.1 and Section 7.2.2.2. Although several of the alternatives could be considered in combination for replacement power generation at multiple sites, they do not generally provide base-load generation, and would entail greater environmental impacts.

7.2.2.1 Alternatives Not Requiring New Generating Capacity

This section discusses the economic and technical feasibility of supplying replacement energy without constructing new base-load generating capacity. Specific alternatives include:

- Conservation measures (including implementing demand side management (DSM) actions);
- Delayed retirement of existing non-nuclear plants; and
- Purchased power from other utilities equivalent to the output of Davis-Besse (i.e., eliminating the need for license renewal).

Conservation Programs

There is a variety of conservation technologies (e.g., DSM) that could be considered as potential alternatives to generating electricity at Davis-Besse. Examples include:

- Conservation Programs—homeowner agreements to limit energy consumption; educational programs that encourage the wise use of electricity.
- Energy Efficiency Programs– discounted residential rates for homes that meet specific energy efficiency standards; programs providing residential energy audits and encouraging efficiency upgrades; incentive programs used to encourage customers to replace older inefficient appliances or equipment with newer versions that are more efficient.
- Load Management Programs – programs that encourage customers to switch load to customer-owned standby generators during periods of peak demand; programs that encourage customers to allow a portion of their load to be interrupted during periods of peak demand.

On a national basis, DSM has shown great potential in reducing peak demand (maximum power requirement of a system at a given time). In 2008, a peak load reduction of 32,741 MWe was achieved nationally, which is an increase of 8.2% from 2007; however, since these DSM costs increased by 47.4%. DSM costs can vary significantly from year to year because of business cycle fluctuations and regulatory changes. Since costs are reported as they occur, while program effects may appear in future years, DSM costs and effects may not always show a direct relationship. Since 2003, nominal DSM expenditures have increased at 22.9% average annual growth rate. During the same period, actual peak load reductions have grown at a 6.2% average annual rate from, 22,904 MW to 32,741 MW (**EIA 2010**, Page 9).

In Ohio, as part of Senate Bill 221, utilities must implement energy efficiency programs that, beginning in 2009, achieve energy savings of at least 0.3% of the utility's three-year average annual kilowatt-hour (kWh) sales, with energy savings increasing to 22.5% by the end of 2025. Peak demand reductions of 1% in 2009 and increasing to 7.75% by the end of 2018 are also required. (**FirstEnergy 2009a**, Page 100) However, since these DSM-induced load reductions typically are considered in load forecasts, the reductions do not offset the projected power demands that are expected to be supplied with the power generated by Davis-Besse.

Although FENOC believes that energy generation savings can increase from DSM practices, it would be unrealistic to increase those energy savings to completely and consistently replace the Davis-Besse generating capability. The variability in associated costs also makes DSM a less desirable option. Consequently, FENOC does not see DSM as a practicable offset for the base-load capacity of Davis-Besse.

Delayed Retirement

Extending the lives of existing non-nuclear generating plants beyond the time they were originally scheduled to be retired, as described in the GEIS (**NRC 1996**, Section 8.3.13), does not represent a realistic option with respect to FirstEnergy's generating assets. Also, FENOC is not knowledgeable of retirement plans of other regional electric power suppliers. Even without retiring any generating units, FirstEnergy expects to require additional capacity in the near future. Therefore, even if a substantial portion of its capacity were scheduled for retirement and could be delayed, some of the delayed retirement would be needed just to meet load growth.

Approximately 56% of FirstEnergy's generating capacity consists of coal-fired plants which, due to a lower cost of generation, are used at capacity factors higher than other fossil-fuel generating units (**FirstEnergy 2008b**). Virtually all of FirstEnergy's non-nuclear base-load generating capability is from coal firing. These coal-fired plants were developed in the 1980s or earlier and represent the only plants in FirstEnergy's portfolio that would have any potential for continued operation to replace the base-load generation represented by Davis-Besse. However, older plants that do become candidates for retirement generally represent less efficient generation and pollution control technologies than are available in more modern plants, and continued operation typically would require substantial upgrades to be economically competitive and meet applicable environmental standards. In many cases, it is unlikely that such upgrades would be economically viable. FENOC believes that the environmental impacts of implementing such upgrades and operating the upgraded plants are bounded by the assessments presented in Section 7.3 for the gas-fired and coal-fired alternatives.

For these reasons, the delayed retirement of non-nuclear generating units is not considered by FENOC as a reasonable alternative to the renewal of Davis-Besse's license.

Purchased Power

Each of the states (Ohio, Pennsylvania, and New Jersey) in which FirstEnergy serves load have undertaken electric industry restructuring initiatives that promote competition in retail energy markets by allowing participation of non-utility suppliers. Retail customers historically served by the regulated operating subsidiaries of FirstEnergy now have the option to choose between FirstEnergy-affiliated suppliers and other state-qualified energy suppliers. (**FENOC 2007**, Section 7.2.3.2)

In theory, purchased power is a feasible alternative to Davis-Besse license renewal. There is no assurance, however, that sufficient capacity or energy would be available during the entire license renewal time frame to replace the approximately 910 MWe of base-load generation. In addition, even if power to replace Davis-Besse capacity were to be purchased, FENOC assumes that the generating technology used to produce the purchased power would be one of those described in the GEIS. Thus, the environmental impacts of purchased power would still occur, but would be located elsewhere within the region.

As a result, FENOC has determined that purchased power would not be a reasonable alternative to replace power lost in the event the Davis-Besse operating license is not renewed.

7.2.2.2 Alternatives Requiring New Generating Capacity

The following conventional power plant types are evaluated in this section as potential alternatives to license renewal:

- New Nuclear Reactor
- Petroleum Liquids (Oil)

In addition, with the passage of Ohio's Senate Bill 221 in 2008, at least 25% of electricity supply for retail customers must come from renewable and advanced energy resources by 2025 **OHPUCO 2009**, Pages 3 and 4). Accordingly, the following alternative energy sources are evaluated.

- Hydropower
- Wind
- Solar
- Geothermal
- Biomass (Wood Waste)
- Municipal Solid Waste
- Other Biomass-Derived Fuels (Energy Crops)
- Fuel Cells

Criteria used to determine if the potential energy alternatives represent a reasonable alternative include whether the alternative is developed and proven, can provide generation of approximately 910 MWe of electricity as a base-load supply, is economically feasible, and does not impact the environment more than Davis-Besse.

New Nuclear Reactor

Increased interest in the development of advanced reactor technology has been expressed by members of both industry and government. With energy demands forecasted to increase and public opposition to new carbon-fueled power plants, some companies are pursuing permits and licenses to build and operate new nuclear reactors to meet the country's future energy needs. As of June 2010, for example, 18 applications, for 28 units, for combined licenses have been submitted to the NRC for review (**NRC 2010**).

Nonetheless, there is ongoing uncertainty with respect to future electric demand due to the potential impacts of policy changes that could be enacted to limit or reduce greenhouse gas emissions. The downturn in the world economy also has had a significant impact on energy demand as well. The recovery of the world's financial markets is especially important for the energy supply outlook, because the capital-intensive nature of most large energy projects makes access to financing a critical necessity. (**EIA 2010**, Pages 5). Moreover, the economics of new nuclear plants remain uncertain with escalating fuel and construction costs emerging as forces which could affect this option.

In consideration of the extended schedule for construction of a new nuclear reactor, access to capital, and the schedule for the new reactor licensing process, construction of a new nuclear reactor at the Davis-Besse site or at an alternative site is not feasible prior to the period of extended operation for Davis-Besse, i.e., in this case, 2017.

Therefore, a new nuclear reactor is not considered a reasonable alternative to renewal of Davis-Besse's operating license..

Petroleum Liquids (Oil)

Oil-fired generation has experienced a significant decline since the early 1970s. Increases in world oil prices have forced utilities to use less expensive fuels (**NRC 1996**, Section 8.3.11). From 2002 to 2008, for example, the average cost of petroleum for power generation increased by more than a factor of three (**EIA 2010**, Table 3.5).

This high cost of oil has prompted a steady decline in its use for electricity generation. Within Ohio, for example, oil-fired units produce only 0.2% of power generation (**NEI 2008**). Increasing domestic concerns over oil security also will intensify the move away from oil-fired electricity generation.

Therefore, FENOC does not consider oil-fired generation a viable alternative to renewal of Davis-Besse's operating license.

Hydropower

Considering the FirstEnergy transmission and distribution territory, Ohio and Pennsylvania have a combined potential for 1,758 MWe of additional undeveloped hydroelectric capacity, with Ohio contributing 57 MWe (**INEEL 1998**, Table 4). Thus, hydropower is a feasible alternative to Davis-Besse license renewal in theory.

However, as noted in the GEIS, hydropower's percentage of United States generating capacity is expected to decline because the facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses (**NRC 1996**, Section 8.3.4). For example, the GEIS estimated that land requirements for hydroelectric power are approximately 1 million acres per 1,000 MWe. Replacement of the Davis-Besse generating capacity would therefore require flooding a substantial amount of land (910,000 acres). Consequently, even if the capacity for development were available in Ohio-Pennsylvania, there would be large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Davis-Besse.

As a result, developing a hydropower base-load capacity of approximately 910 MWe is not considered by FENOC to be a reasonable alternative to renewal of Davis-Besse's operating license.

Wind Power

Areas suitable for wind energy applications must be wind-power Class 3 or higher (**NREL 1986**, Chapter 1). Coastal regions along Lake Erie in northwestern Ohio have an estimated wind power of Class 3, increasing to Class 5 over offshore areas (**NREL 1986**, Chapter 3) and some Class 6 areas mid-lake (**USDOE 2009a**). The rest of the state, however, is devoid of Class 3 or higher wind-power areas. Pennsylvania is mostly a wind power Class 1 region, although some areas, particularly along ridgelines, may provide wind classes ranging from 4 to 6. West Virginia is also mostly a wind power Class 1 region, with Class 2 and higher resources along highlands and ridges in the east-central part of the state. The total wind generation capacity for the three-state region in 2008 was 698 MWe. (**USDOE 2009a**)

Thus, wind power in coastal Ohio along Lake Erie and along ridgelines in Pennsylvania and West Virginia is a feasible alternative to Davis-Besse license renewal in theory. However, wind power by itself is not suitable for large base-load capacity. As discussed in the GEIS, wind has a high degree of intermittency and average annual capacity factors for wind plants are relatively low, less than 30 percent (**NRC 1996**, Section 8.3.1). Wind power in conjunction with energy storage mechanisms might serve as a means of providing base-load power. But current energy storage technologies are too expensive for wind power to serve as a large base-load generator. (**NRC 2009b**, Section 8.2.5.2)

Environmentally, wind turbine generators produce no air emissions, consume no water for cooling, result in zero wastewater discharges, require no drilling, mining or transportation of fuel, and produce no hazardous or solid wastes other than used lubrication oil that can be recycled. However, the amount of land needed for operation can be significant. An estimated 214 square miles of land are needed to generate 910 MWe of power (**NRC 1996**, Section 8.3.1), although much of the land could be collocated with other resources (e.g., solar energy production, or agriculture). Noise produced by the rotor blades, visual impacts, and bird and bat fatalities are also of some concern (**EERE 2008**).

Considering that wind conditions are variable, energy storage technologies do not currently allow supply to more closely match demand, and large land requirements and associated aesthetic impacts, FENOC does not consider a utility-scale commercial wind power project a reasonable alternative to Davis-Besse license renewal.

Solar Power

Solar power technologies, both photovoltaic (PV) and thermal, depend on the availability and strength of sunlight. As such, it is an intermittent source of energy, requiring energy storage or a supplemental power source to provide electric power at night. Solar resource availability in Ohio, western Pennsylvania, and northern West Virginia is low compared to other parts of the United States. The three-state region, for example, has about 3.3 kWh per square meter per day of solar radiation, which is less than half of that available in the southwestern United States (**NRC 1996**, Figure 8.2).

The land requirement for solar technology is large. As noted in the GEIS, it requires 14 to 35 acres for every 1 MWe generated, depending on the solar technology (**NRC 1996**, Sections 8.3.2 and 8.3.3). At a minimum, it would require approximately 12,740 acres to replace the 910 MWe produced by Davis-Besse. In addition, although solar technologies produce no air pollution, little or no noise, and require no transportable fuels, many solar power technologies are still in the demonstration phase of development and cannot be considered competitive with fossil or nuclear-based technologies in grid-connected applications, due to high costs per kilowatt of capacity (**NRC 1996**, Section 8.3.2). Lastly, since the output of solar generated power is dependent on the availability of sunlight, supplemental energy sources would be required to meet the base-load capacity of Davis-Besse.

For the reasons noted, FENOC does not consider solar power to be a reasonable alternative to renewal of Davis-Besse's operating license.

Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for base-load power where available (**NRC 2009b** Section 8.2.5.5). However, geothermal electric generation is limited by the geographical availability of geothermal resources. As illustrated by Figure 8.4 in the GEIS, no feasible eastern location for geothermal capacity exists to serve as an alternative to Davis-Besse (**NRC 1996**, Section 8.3.5). As a result, FENOC does not consider geothermal energy to be a reasonable alternative to renewal of the Davis-Besse operating license.

Biomass Energy

Biomass is any organic material made from plants or animals. Agricultural and wood wastes such as forestry residues, particularly paper mill residues, are the most common biomass resources used for generating electricity. Regionally, eastern Ohio and most of Pennsylvania provide the largest biomass resources (**EERE 2009a, b**). The costs of these fuels, however, are highly variable and very site specific (**NRC 1996**, Section 8.3.6).

Most biomass plants use direct-fired systems by burning biomass feedstocks to produce steam directly for conventional steam turbine conversion technology. Although the technology is relatively simple to operate, it is expensive and inefficient. Conversion efficiencies of wood-fired power plants are typically 20-25%, with capacity factors of around 70-80%. As a result, biomass plants at modest scales (≤50 MWe) make economic sense if there is a readily available supply of low-cost wood wastes and residues nearby so that feedstock delivery costs are minimal. (**NRC 1996**, Section 8.3.6)

The construction impacts of a wood-fired plant would be similar to those for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, biomass and wood-waste plants require large areas for fuel storage and processing. They also create impacts to land and water resources, primarily associated with soil disturbance and runoff, in addition to air emissions. However, unlike coal-fired plants, biomass and wood-waste plants have very low levels of sulfur oxide emissions. (**NRC 1996**, Section 8.3.6)

FirstEnergy is retrofitting units 4 and 5 of the R.E. Burger plant in Shadyside, Ohio, for biomass capability. When completed, the units will be one of the largest biomass facilities in the United States capable of producing up to 312 MWe (**FirstEnergy 2009b**). Nevertheless, due to the relatively small scale of other potential projects and uncertainties in securing long-term fuel supplies, biomass is not considered by FENOC to be a reasonable alternative to replace Davis-Besse's base-load power generation.

Municipal Solid Waste

Municipal solid waste (MSW) facilities that convert waste to energy use technology comparable to steam-turbine technology for wood waste plants, although the capital costs are greater due to the need for specialized separation and handling equipment (**NRC 1996**, Section 8.3.7). The decision to burn MSW for energy is typically made due to insufficient landfill space, rather than energy considerations.

There are 89 operational MSW energy conversion plants in the United States (**USEPA 2009a**), none of which were located in Ohio as of 2007 (**WTE 2007**). These plants generate approximately 2,500 MWe, or about 0.3% of total national power generation (**USEPA 2009a**). At an average capacity of about 28 MWe, numerous MSW-fired power plants would be needed to replace the base-load capacity of Davis-Besse.

Construction impacts for a waste-to-energy plant are estimated to be similar to those for a coal-fired plant. Air emissions are potentially harmful. Increased construction costs for new plants and economic factors (i.e., strict regulations and public opposition) may limit the growth of MSW energy generation (**NRC 1996**, Section 8.3.7; **USEPA 2009a**).

For reasons stated, MSW is not considered by FENOC to be a reasonable alternative to renewal of Davis-Besse's operating license.

Other Biomass-Derived Fuels

In addition to biomass energy such as wood and municipal solid-waste fuels, there are other concepts for biomass-fired electric generators, including direct burning of energy crops, conversion to liquid biofuels, and biomass gasification. The GEIS indicated that none of these technologies had progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant (**NRC 1996**, Section 8.3.8). After recently re-evaluating current technologies, the NRC staff believes other biomass-fired alternatives are still unable to reliably replace base-load capacity (**NRC 2009b**, Section 8.2.5.8). For this reason, FENOC does not consider biomass-derived fuels to be a reasonable alternative to renewal of Davis-Besse's operating license.

Fuel Cells

Fuel cells are electrochemical devices that generate electricity without combustion and without water and air pollution. Fuel cells began supplying electric power for the space program in the 1960s. Today, they are being developed for more commercial applications. The U.S. Department of Energy (USDOE) is currently partnering with several fuel cell manufacturers to develop more practical and affordable designs for the stationary power generation sector. If successful, fuel cell power generation should prove to be efficient, reliable, and virtually pollution free. At present, progress has been slow and costs are high. The most widely marketed fuel cell is currently about $4,500 per kilowatt (kW) compared to $800 to $1,500 per kW for a diesel generator and about $400 per kW or less for a natural gas turbine. By the end of this decade, the USDOE goal is to reduce costs to as low as $400 per kW. (**USDOE 2009b**).

However, fuel cells presently are not economically or technologically competitive with other alternatives for base-load capacity. Therefore, FENOC does not consider fuel cells to be a reasonable alternative to renewal of Davis-Besse's operating license.

Combination of Alternatives

Individual evaluation of renewable and advanced energy resources shows that, by themselves, these energy resources are not considered by FENOC to be reasonable alternatives to renewal of Davis-Besse's operating license. When considered in various combinations with generation equivalent to that of Davis-Besse, these same renewable and advanced energy resources still fail to be reasonable alternatives to renewal of Davis-Besse's operating license.

For example, consider a mix of 25 percent of renewable and advanced energy resources, such as wind, hydroelectric, geothermal, solar, and biomass, with 75 percent natural gas generation to replace the baseload 908 MWe of the Davis-Besse plant.

This mix of energy resources would result in an increased uncertainty in energy output due to the fluctuation of wind and solar resources. The environmental impacts associated with the large amount of land required for siting the various resources would likely exceed those associated with continued operation of Davis-Besse. And, the air quality impacts of operation of the natural gas plant greatly exceed those associated with continued operation of Davis-Besse. Therefore, FENOC believes that various combinations of renewable and advanced energy resources with generation equivalent to that of Davis-Besse are not reasonable alternatives to renewal of Davis-Besse's operating license.

Table 7.2-1 Coal-Fired Alternative Emission Control Characteristics

Characteristic	Basis
Net capacity = 910 MW	Equivalent to Davis-Besse.
Capacity factor = 80%	From **FENOC 2007**, Table 7.2-2
Firing mode: subcritical, tangential, dry-bottom pulverized coal	Widely demonstrated, reliable, economical; tangential firing minimizes NO_X emissions (**FENOC 2007**, Table 7.2-2)
Fuel type = bituminous coal	Type used in FirstEnergy Ohio River plants (**FENOC 2007**, Table 7.2-2)
Fuel heating value = 12,285 Btu/lb	FirstEnergy Bruce Mansfield Plant average (**FENOC 2007**, Table 7.2-2)
Heat rate = 9,800 Btu/kWh at full load	FirstEnergy experience (**FENOC 2007**, Table 7.2-2)
Fuel sulfur content = 3.52 wt% ; 2.86 lb/MMBtu	FirstEnergy Bruce Mansfield Plant average (**FENOC 2007**, Table 7.2-2)
Fuel ash content = 11.88 wt%	FirstEnergy Bruce Mansfield Plant average (**FENOC 2007**, Table 7.2-2)
Uncontrolled SO_X emissions = 130 lb/ton coal	USEPA estimate calculated as 38 x wt% sulfur in coal (**FENOC 2007**, Table 7.2-2)
Uncontrolled NO_X emissions = 10 lb/ton coal	USEPA estimate (**FENOC 2007**, Table 7.2-2)
Uncontrolled CO emission = 0.5 lb/ton coal	USEPA estimate (**FENOC 2007**, Table 7.2-2)
Uncontrolled PM emission = 120 lb/ton coal	USEPA estimate calculated as 10 x wt% ash in coal (**FENOC 2007**, Table 7.2-2)
Uncontrolled PM_{10} emission = 27 lb/ton coal	USEPA estimate calculated as 2.3 x wt% of ash in coal (**FENOC 2007**, Table 7.2-2)
CO_2 emissions = 6,000 lb/ton	Approximate average for bituminous coal combustion (**FENOC 2007**, Table 7.2-2)
SO_X control = wet limestone flue gas desulphurization (95% removal)	Best available technology for minimizing SO_X emissions (**FENOC 2007**, Table 7.2-2)
NOX control = low NOX burners, overfire air, selective catalytic reduction (95% reduction)	Best available technology for minimizing NO_X emissions (**FENOC 2007**, Table 7.2-2)
Particulate control = fabric filters (99.9% removal)	Best available technology for minimizing particulate emissions (**FENOC 2007**, Table 7.2-2)

Btu = British thermal unit
CO = carbon monoxide
CO_2 = carbon dioxide
ft^3 = cubic feet
kWh = kilowatt-hour
lb = pound
MMBtu = million Btu
MW = megawatt
NO_X = nitrogen oxides
PM = particulate matter
PM_{10} = PM with diameter less than 10 microns
SO_X = sulfur oxides
USEPA = U.S. Environmental Protection Agency
wt% = percent by weight

Table 7.2-2: Gas-Fired Alternative Emission Control Characteristics

Characteristic	Basis
Net capacity = 910 MW	Equivalent to Davis-Besse.
Capacity factor = 80%	From **FENOC 2007**, Table 7.2-1
Fuel type = natural gas	Assumed
Heat rate = 6,500 Btu/kWh	FENOC Estimate (**FENOC 2007**, Table 7.2-1)
Fuel heating value = 1,025 Btu/ft^3	From **FENOC 2007**, Table 7.2-1
Fuel sulfur content = 0.2 grains/100 scf (0.00068 wt%)	From **FENOC 2007**, Table 7.2-1
SO_2 emissions = 0.00064 lb/MMBtu (0.94 x wt% sulfur in fuel)	USEPA estimate for natural gas-fired turbines (**FENOC 2007**, Table 7.2-1)
NO_X emissions (assuming dry low-NO_X combustors) = 0.099 lb/MMBtu	USEPA estimate for best available NO_X combustion control (**FENOC 2007**, Table 7.2-1)
NO_X post-combustion control: selective catalytic reduction (90% reduction)	USEPA estimate for best available NO_X post-combustion control (**FENOC 2007**, Table 7.2-1)
CO emissions (assuming dry low-NO_X combustors) = 0.015 lb/MMBtu	USEPA estimate (**FENOC 2007**, Table 7.2-1)
PM emissions (all PM_{10}) = 0.0019 lb/MMBtu	USEPA estimate (**FENOC 2007**, Table 7.2-1)
CO_2 emissions = 110 lb/MMBtu	USEPA estimate (**FENOC 2007**, Table 7.2-1)

Btu = British thermal unit
CO = carbon monoxide
CO_2 = carbon dioxide
ft^3 = cubic feet
kWh = kilowatt-hour
lb = pound
MMBtu = million Btu
MW = megawatt
NO_X = nitrogen oxides
PM = particulate matter
PM_{10} = PM with diameter less than 10 microns
scf = standard cubic feet
SO_X = sulfur oxides
USEPA = U.S. Environmental Protection Agency
wt% = percent by weight

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7.3 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

Environmental impacts are evaluated in this section for the coal- and gas-fired generation alternatives determined by FENOC to be reasonable in Section 7.2.1 compared to renewal of Davis-Besse's operating license.

The impacts are characterized as being SMALL, MODERATE, or LARGE. The definitions of these impact descriptions are the same as presented in the introduction to Chapter 4, which in turn are consistent with the criteria established in 10 CFR Part 51, Appendix B to Subpart A, Table B-1, Footnote 3. FENOC believes the environmental impacts associated with the construction and operation of new generating capacity at a greenfield site would exceed those for the same type plants located at Davis-Besse or at another existing disturbed site, i.e., brownfield site.

The new generating plants addressed in Section 7.2.1 would not be constructed only to operate for the period of extended operation of Davis-Besse. Therefore, FENOC assumes for this analysis a typical design life of 40 years for the coal-fired plant, 30 years for the combined-cycle natural gas-fired plant, and considers impacts associated with operation for the entire design life of the units in this analysis.

Chapter 8 presents a summary comparison of the environmental impacts of license renewal and the alternatives discussed in this section.

7.3.1 COAL-FIRED GENERATION

This section presents the impact evaluation for the representative coal-fired generation alternative. As discussed in Section 7.2.1.1, FENOC assumed for purposes of this analysis that the representative plant would be located at a greenfield or (preferably) brownfield site along commercially navigable waterway or existing rail way. This assumption is a result of the space limitation at the Davis-Besse site.

<u>Land Use</u>

Land area requirements for a coal-fired plant of similar capacity to Davis-Besse, for example, would be approximately 1.7 acres per MWe (**NRC 1996**, Table 8.1), or 1,547 acres for a 910 MWe plant. This amount of land use will include plant structures and associated infrastructure. Additional acres would be needed offsite for transmission lines and possibly rail lines, depending on the location of the site relative to the nearest inter-tie connection or rail spur. This acreage could amount to a considerable loss of natural habitat or agricultural land for the plant site alone dependent upon whether a greenfield or brownfield site was used, excluding that required for mining and other fuel-cycle impacts. Some portion of the impacts could be mitigated by constructing new transmission line in existing rights-of-way (ROW) to as great an extent as possible.

Land-use changes also would occur offsite in an undetermined coal-mining area to supply coal for the plant. For example, the GEIS estimated that approximately 22 acres of land per MWe would be affected for mining the coal and disposing of the waste to support a coal-fired plant during its operational life (**NRC1996**, Section 8.3.9). Therefore, for the 910 MWe plant used in this analysis, approximately 20,020 acres of land would be needed. Partially offsetting this offsite land use would be the elimination of the need for uranium mining and processing to supply fuel for Davis-Besse. The GEIS estimated that approximately one acre per MWe would be affected for mining and processing the uranium during the operating life of a nuclear power plant (**NRC1996**, Section 8.3.12). Therefore, for Davis-Besse uranium mining and processing, approximately 910 acres of land would be required, resulting in offsite mining net land use of 19,110 acres for the representative coal-fired generation alternative.

In consideration of the above, FENOC considers that land use impacts associated with a coal-fired plant at an alternate site would depend on the location of the plant and be MODERATE to LARGE.

Water Use and Quality – Surface Water

Construction-phase impacts on water quality of greatest potential concern include erosion and sedimentation associated with land clearing and grading operations at the plant site and waste disposal site, and suspension of bottom sediments during construction of cooling water intake and discharge structures and facilities for barge delivery of coal and limestone. However, land clearing and grading activities would be subject to stormwater protections in accordance with the NPDES program, and work in waterways would be regulated by the USACE under the CWA Section 404 and Section 10 of the Rivers and Harbors Act. These activities would also be subject to corresponding state and local regulatory controls, as applicable. In addition, these adverse effects would be localized and temporary. As a result, FENOC considers that impacts on surface water quality associated with construction of the representative plant at an alternative site would be SMALL.

FENOC expects that potential impacts on water quality and use associated with operation of the representative plant would be similar to impacts associated with Davis-Besse operation. Cooling water and other wastewater discharges would be regulated by an NPDES permit, regardless of location. Cooling water intake, evaporative losses, and discharge flows for the representative coal-fired plant, assumed to use a closed-cycle cooling system, would be similar to or lower than those resulting from Davis-Besse operation (see Chapter 4). As a result, FENOC considers that impacts on surface water quality associated with operation of the representative plant at an alternative site would be SMALL.

In view of the environmental review afforded under OPSB rules or a similar program, FENOC considers the impacts of surface water use and quality from construction and operation of the representative plant at an alternative site would be SMALL.

Water Use and Quality – Ground Water

Impacts will depend on whether the plant will use ground water for any purposes, as well as the characteristics of local aquifers. Effects to ground water quality can also depend on waste-management and coal-storage practices, although proper disposal and material handling should reduce the likelihood of an effect, as would recycling a greater percentage of waste products. Regardless of location, FENOC believes it highly unlikely that a coal-fired power plant at an alternate site will rely on ground water for plant cooling, and that ground water and waste-management regulations will limit impacts to SMALL.

Air Quality

Air quality impacts of coal-fired generation differ considerably from those of nuclear generation. A coal-fired plant emits sulfur oxides (SO_x), nitrogen oxides (NO_x), particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. Additionally, there are substantial emissions of carbon dioxide (CO_2), a greenhouse gas, although future developments such as carbon capture and storage and co-firing with biomass have the potential to reduce the carbon footprint of coal-fired electricity generation (**POST 2006**). Coal also contains other constituents (e.g., mercury, beryllium) that are potentially emitted as hazardous air pollutants, which are also of concern from a human health standpoint (**NRC 1996**, Section 8.3.9).

As noted in Section 7.2.1.1, FENOC has assumed a plant design that includes controls to minimize emissions of regulated air pollutants effectively. Based on emission factors, estimated efficiencies for emission controls, and assumed design parameters listed in Table 7.2-1, operation of the plant would result in the following annual air emissions for criteria pollutants:

- Sulfur dioxide = 8,267 tons
- Nitrogen oxides = 5,087 tons
- Carbon monoxide = 636 tons
- Total filterable particulates = 153 tons
- PM_{10} = 34.3 tons.

The annual emissions of carbon dioxide, which is currently unregulated, would be approximately 7.63 million tons. See Table 7.3-1 for details.

FENOC expects that these emissions would result in a decrease in local air quality compared to operation of a nuclear plant. However, FENOC anticipates that both sulfur dioxide and nitrogen oxide emissions will be subject to cap and trade programs (**FENOC 2007**, Section 7.2.1.3). As a result, the plant would not be expected to add to regional sulfur dioxide emissions and may not add to regional nitrogen oxide emissions, at least during the ozone season (**FENOC 2007**, Section 7.3.2, Air Quality). The representative plant would add to regional concentrations of other pollutants, including the criteria pollutants carbon monoxide and particulates; hazardous air pollutants; and carbon dioxide, which is a greenhouse gas.

Subject to regulatory controls, FENOC anticipates that the overall air quality would be noticeable, but not destabilizing. As a result, FENOC considers that the impacts to air quality from operation of the representative plant at an alternative site would be MODERATE.

Ecological Resources

Onsite and offsite land disturbances form the basis for impacts to terrestrial ecology. Constructing a coal-fired plant at an alternate site could alter onsite ecological resources because of the need to convert about 1,547 acres of land at the site to industrial use for the plant, coal storage, and ash and scrubber sludge disposal (see the Land Use subsection above). Coal-mining operations will also affect terrestrial ecology in offsite mining areas, although some of this land is likely already disturbed by mining operations.

Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Impacts, however, will vary based on the degree to which the proposed plant site is already disturbed. On a previous industrial site, impacts to terrestrial ecology will be minor, unless substantial transmission line ROWs, a lengthy rail spur, or additional roads need to be constructed through undisturbed or less-disturbed areas. Any onsite or offsite waste disposal by landfilling will also affect terrestrial ecology at least through the time period when the disposal area is reclaimed.

During construction, impacts to aquatic ecology are likely. Regardless of where the plant is constructed, site disturbance will likely increase erosion and sedimentation runoff into nearby waterways, increasing turbidity. While site procedures and management practices may limit this effect, the impact will likely be noticeable. This is particularly true when intake and outfall structures are constructed alongside or in the body of water, as well as when any ROWs, roads, or rail lines require in-stream structures to support stream crossings. Noise and disturbance from construction, in addition to increased turbidity, may have a noticeable effect. Required regulatory permits, however, will help to mitigate these impacts.

During operations, the cooling water system would have a potential impact to aquatic communities. However, this system would be designed and operated in compliance with the CWA, including NPDES limitations to ensure appropriate protection of aquatic communities from thermal discharges and cooling water intakes. The cooling water intake and discharge flows would be comparable to or less than for Davis-Besse, the impact from which is considered to be SMALL (see Chapter 4). Therefore, associated impacts at a comparable site on commercially navigable waterway would also be expected to be SMALL.

Management of runoff from coal piles will also be necessary. However, subject to regulatory oversight, as afforded under OPSB rules or a similar program, FENOC considers the impacts to ecological resources from construction and operation of the representative plant at an alternative site may be noticeable, but not destabilizing.

On this basis, FENOC considers that the overall impact to ecological resources of constructing a coal-fired plant with a closed-cycle cooling system at an alternate site would be MODERATE.

Human Health

Coal-fired power generation introduces worker risk from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, worker and public risk from disposal of coal combustion wastes, and public risk from inhalation of stack emissions. For example, the GEIS noted that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but the GEIS does not identify the significance of these impacts (**NRC 1996**, Section 8.3.9). In addition, the coal-fired alternative also introduces the risk of coal pile fires and attendant inhalation risks, though these types of events are relatively rare (**NRC 2009b**, Section 8.2.1, Human Health).

Regulatory agencies, including the USEPA, USOSHA, and state agencies, set air emission standards requirements for workers and the public based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health.

Given these extensive health-based regulatory controls, FENOC considers that operating the representative coal-fired plant at an alternate site would be SMALL.

Socioeconomics

The peak workforce during construction of the coal-fired plant alternative is estimated to range between 1.2 to 2.5 workers per MWe and the workforce required during operation is estimated to be 0.25 workers per MWe (**NRC 1996**, Section 8.3.9, Table 8.1 and

Table 8.2). For a plant with a capacity of 910 MWe, workforces of approximately 1,092 to 2,275 construction workers and 228 permanent employees would be required.

Potential impacts from construction of the coal-fired alternative would be highly location dependent. As noted in the GEIS, socioeconomic impacts are expected to be larger at a rural site than at an urban site, because more of the peak construction work force would need to move to the area to work (**NRC 1996**, Section 8.3.9). Not considering impacts of terminating Davis-Besse operations, socioeconomic impacts at a remote rural site could be LARGE, while impacts at a site in the vicinity of a more populated metropolitan area (e.g., Toledo) could be SMALL to MODERATE. FENOC assumed that the OPSB or comparable review process, including application of appropriate mitigation found to be needed as a result, would ensure that these construction impacts would not be destabilizing to local communities.

At most alternate sites, coal and lime would be delivered by barge, although delivery is feasible for a location near a railway. Transportation impacts would depend upon the site location. Socioeconomic impacts associated with rail transportation would be MODERATE to LARGE. Barge delivery of coal and lime/limestone would have SMALL socioeconomic impacts.

As noted in Section 4.17, communities in Ottawa County, particularly those within the tax jurisdiction of Carroll Township and the Carroll-Benton-Salem School District, would experience losses in both employment and tax revenues due to Davis-Besse closure, assuming the plant is constructed outside the area.

Based on the above, FENOC considers that the overall socioeconomic impacts of construction and operation of the representative coal-fired plant at an alternate site would be MODERATE.

Waste Management

The representative coal-fired plant would produce substantial solid waste, especially fly ash and scrubber sludge. Based on emission factors and controls scaled from Beaver Valley (**FENOC 2007**, Section 7.3.2 and Table 7.2-2)[*], the plant annual waste generation amounts would be approximately 300,000 tons/year of ash and 470,100 tons of flue gas desulphurization waste (dry basis), consisting primarily of hydrated calcium sulfate (gypsum) and excess limestone reactant. Although these wastes represent potentially usable products, FENOC assumed the total waste generated would be disposed of at an offsite landfill. Based on a fill depth of 30 feet and scaling from Beaver Valley (**FENOC 2007**, Section 7.3.2), approximately 644 acres would be required for the landfill over an assumed plant operating life of 40 years.

[*] The scale factor for coal is the ratio of total electric capability, 910 MWe/1980 Mwe, or 0.460.

Disposal of the waste could noticeably affect land use and ground water quality. In addition, the December 2008 failure of the dike used to contain fly ash at the Tennessee Valley Authority Kingston Fossil Plant in Roane County, Tennessee, and subsequent cleanup, highlight other waste management issues (**USEPA 2009b**). However, environmental impacts related to the location, design, and operational aspects of waste disposal for the plant would be subject to regulatory review under OPSB rules or similar programs. As a result, FENOC believes that with proper disposal siting, coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources.

On this basis, FENOC considers that waste management impacts from operation of the representative coal-fired plant at an alternate site would be MODERATE.

Aesthetics

Potential aesthetic impacts of construction and operation of the representative coal-fired plant include visual impairment resulting from the presence of a large industrial facility, including 500-foot-high stacks, and cooling towers up to approximately 500 feet high with associated condensate plumes. The stacks and condensate plumes from the cooling towers could be visible some distance from the plant. There would also be an aesthetic impact if construction of a new transmission line or rail spur were needed. Similarly, noise impacts associated with rail delivery of coal and lime/limestone if used would be most significant for residents living in the vicinity of the facility and along the rail route.

These impacts, however, are highly site-specific. Site locations could reduce the aesthetic impact of a coal-fired generation, for example, if siting were in an area that was already industrialized versus locating at largely undeveloped sites.

In view of the environmental review afforded under OPSB rules or a similar program, FENOC considers that the impacts to aesthetics from construction and operation of the representative plant at an alternative site would depend on location and be SMALL to MODERATE.

Cultural Resources

FENOC assumed that the representative coal-fired plant, associated infrastructure (e.g., roads, transmission corridors, rail lines, or other rights-of-way), and associated waste disposal site would be located with consideration of cultural resources afforded under OPSB or comparable rules. FENOC further assumed that appropriate measures would be taken to recover or provide other mitigation for loss of any resources discovered during onsite or offsite construction.

On this basis, FENOC considers that the potential impact on cultural resources from construction and operation of the representative plant at an alternative site would be SMALL.

7.3.2 GAS-FIRED GENERATION

This section presents the impact evaluation for the representative gas-fired generation alternative. As discussed in Section 7.2.1.2, FENOC assumed for purposes of this analysis that the representative plant would be located at a greenfield or (preferably) brownfield site in northwestern Ohio. This assumption is a result of the space limitation at the Davis-Besse site.

Land Use

Land-use requirements for gas-fired plants are relatively small, at about 100 acres for a 910 MWe plant (Section 7.2.1.2). An estimated 240 – 270 additional acres would be needed offsite at a greenfield location for new gas and electric transmission lines (**FENOC 2007**, Section 7.3.1, Land Use) and increased land-related impacts, which in turn would be location-specific.

Land use in northwestern Ohio is predominantly rural agricultural cropland with scattered rural residences and woodlots. Located in a rural area, the change in land use would be locally apparent and could include displacement of cropland, which is highly productive for corn, wheat, and soybeans relative to other areas of the state; however, substantial buffer with respect to highly incompatible land uses (e.g., residential use) could be provided and destabilization of overall land use would not be expected. If the plant were located in an area designated for industrial use, associated land-use impacts would not be significant. Agricultural practices could continue along most of the area occupied by offsite rights-of-way. (**FENOC 2007**, Section 7.3.1, Land Use)

Regardless of where the natural gas-fired plant is built, additional land would be required for natural gas wells and collection stations. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for Davis-Besse. The GEIS estimated that approximately one acre per MWe would be affected for mining and processing the uranium during the operating life of a nuclear power plant (**NRC 1996**, Section 8.3.12). Therefore, for Davis-Besse uranium mining and processing, approximately 910 acres of land would be required, resulting in a net gain in reclaimed land for the representative natural gas-fired generation alternative.

In view of the environmental review afforded under OPSB rules or a similar program, FENOC considers that the overall impacts of land use from construction and operation of the representative plant at an alternative site would depend on plant location and be SMALL to MODERATE.

Water Use and Quality – Surface Water

Cooling water intake, evaporative losses, and discharge flows for the plant would be less than that of Davis-Besse, primarily because less power would be derived from a steam cycle (**FENOC 2007**, Section 7.2.2.1).

During operation, cooling water and wastewater discharges would be regulated under the federal CWA and corresponding state programs by an NPDES permit. Construction activities would be similarly regulated to ensure protection of water resources. In addition, impacts on water use and quality would be subject to scrutiny in the planning stage under OPSB or similar governing authority rules.

Overall, FENOC considers that the impacts from construction and operation of the representative plant at an alternative site on surface water use and quality would be SMALL.

Water Use and Quality – Ground Water

Impacts will depend on whether the plant will use ground water for any purposes, as well as the characteristics of local aquifers. Regardless of location, FENOC assumes that a gas-fired power plant at an alternate site will not rely on ground water for plant cooling, and that regulations for ground water use for potable water will limit impacts to SMALL.

Air Quality

Natural gas is a relatively clean-burning fuel with nitrogen oxides being the primary focus of combustion emission controls. As noted in the GEIS, air quality impacts for all natural gas technologies are generally less than for fossil technologies of equal capacity because fewer pollutants are emitted (**NRC 1996**, Section 8.3.10).

As noted in Section 7.2.1.2, FENOC has assumed a plant design that includes controls to minimize emissions of regulated air pollutants effectively. Based on emission factors, estimated efficiencies for emission controls, and assumed design parameters listed in Table 7.2-2, operation of the plant would result in the following annual air emissions for criteria pollutants:

- Sulfur dioxide = 13.3 tons
- Nitrogen oxides = 205 tons
- Carbon monoxide = 311 tons
- Total filterable particulates = 39.4 tons

The annual emissions of carbon dioxide, which is currently unregulated, would be approximately 2.28 million tons. See Table 7.3-2 for details.

FENOC expects that these emissions may result in a noticeable reduction in local air quality. However, FENOC anticipates that both sulfur dioxide and nitrogen oxide emissions will be subject to cap and trade programs (**FENOC 2007**, Section 7.2.1.3). As a result, the plant would not be expected to add to regional sulfur dioxide emissions and may not add to regional nitrogen oxide emissions, at least during the ozone season (**FENOC 2007**, Section 7.3.1, Air Quality). The representative plant would add to regional concentrations of other pollutants, including the criteria pollutants carbon monoxide and particulates; hazardous air pollutants such as mercury; and carbon dioxide, which is presently unregulated.

Subject to regulatory controls, FENOC anticipates that the overall air quality would be noticeable, but not destabilizing. As a result, FENOC considers that the impacts to air quality from operation of the representative plant at an alternative site would be MODERATE, but smaller than those of coal-fired generation.

Ecological Resources

As noted in the Land Use subsection above, development of the representative combined-cycle natural gas-fired plant may require approximately 100 acres for the plant site and approximately 240 – 270 additional acres for offsite infrastructure. Although the GEIS noted that land-dependent ecological impacts from construction from gas-fired plants would be smaller than for other fossil fuel technologies of equal capacity (**NRC 1996**, Section 8.3.10), the type and quality of terrestrial habitat that would be displaced is location-specific.

However, FENOC considers it likely that most of the area required for construction would consist of agricultural cropland with relatively low habitat value. Stream crossings and wetland disturbance, if any, would be subject to provisions of a USACE permit (CWA Section 404) and relevant state and local requirements. (**FENOC 2007**, Section 7.3.1, Ecology)

The most significant potential impacts to aquatic communities relate to operation of the cooling water system. However, the cooling system for the plant would be designed and operated in compliance with the CWA, including NPDES limitations for physical and chemical parameters of potential concern and provisions of CWA Sections 316(a) and 316(b), which are respectively established to ensure appropriate protection of aquatic communities from thermal discharges and cooling water intakes. Also, the siting, design, and operation of the plant would be subject to the environmental protections under OPSB rules.

Overall, FENOC expects that development of the representative natural gas-fired plant would likely have little noticeable impact on ecological resources of the area. As a result, FENOC considers that the overall impacts to ecology resources from construction and operation of the representative plant at an alternative site would depend on plant location and be SMALL to MODERATE.

Human Health

The GEIS cites risk of accidents to workers and public health risks (e.g., cancer, or emphysema) from the inhalation of toxics and particulates associated with air emissions as potential risks to human health associated with the gas-fired generation alternative (**NRC 1996**, Table 8.2). However, regulatory requirements imposed on facility design, construction, and operations under the authority of the Occupational Safety and Health Act, Clean Air Act, and related statutes are designed to provide an appropriate level of protection to workers and the public. Additionally, regulatory agencies, including the USEPA, USOSHA, and state agencies, set air emission standards requirements for workers and the public based on human health impacts.

Given the extensive health-based regulatory control, FENOC considers that operating the representative gas-fired plant at an alternate site, regardless of plant location, would be SMALL.

Socioeconomics

Major sources of potential socioeconomic impacts from the representative gas-fired generation alternative include temporary increases in jobs, economic activity, and demand for housing and public services in communities surrounding the site during the construction period. Countering these increases are losses in permanent jobs, tax revenues, and economic activity attributable to gas-fired plant operation and termination of operations of Davis-Besse.

The estimated number of peak construction workers expected to build a gas-fired plant with a capacity of 910 MWe is 1,092 – 2,275 (**NRC 1996**, Tables 8.1). To operate the plant would require 137 workers (**NRC 1996**, Tables 8.2). Although northwestern Ohio is predominantly rural, most areas are within commuting distance of the metropolitan areas like Toledo and Cleveland, Ohio. Considering the proximity of these sources of labor and services, FENOC expects that most of the construction workforce would commute and relatively few would relocate into the area, and associated socioeconomic impacts during construction would be SMALL.

Communities in Ottawa County, however, particularly those within the taxing jurisdiction of Carroll Township and the Benton-Carroll-Salem School District, would experience losses in both employment and tax revenues due to Davis-Besse closure that could constitute MODERATE impact (see Section 4.17).

FENOC believes that these impacts, although noticeable, would not be destabilizing. As a result, FENOC considers that the overall socioeconomic impact of construction and operation of the representative gas-fired at an alternative site would be MODERATE.

Waste Management

Gas-fired generation would result in minimal waste generation, producing minor (if any) impacts (**NRC 1996**, Section 8.3.10). As a result, FENOC considers waste management impacts from the operation of the representative plant at an alternative site would be SMALL.

Aesthetics

Potential aesthetic impacts of construction and operation of a gas-fired plant include visual impairment resulting from the presence of a large industrial facility, including multiple exhaust stacks at least 150 feet high, and mechanical-draft cooling towers with associated condensate plumes. Considering the flat topography in northwestern Ohio, the stacks and condensate plumes would likely be visible for several miles from the site; new transmission lines constructed to connect the plant to the grid would also be relatively visible for the same reason, though would not be out of character for the rural northwestern Ohio landscape. (**FENOC 2007**, Section 7.3.1, Aesthetics) FENOC expects that the plant likely would be located in a rural area, and assumed that adequate buffer and vegetation screens would be provided at the plant site as needed to moderate visual and noise impacts.

In view of the environmental review afforded under OPSB rules, FENOC considers that the impacts to aesthetics from construction and operation of the representative plant at an alternative site would depend on location and be SMALL to MODERATE.

Cultural Resources

FENOC assumed that the representative gas-fired plant and associated gas-supply pipeline and transmission line would be located with consideration of cultural resources under OPSB or comparable program rules. FENOC further assumed that appropriate measures would be taken to avoid, recover, or provide other mitigation for loss of any resources discovered during onsite or offsite construction.

On this basis, FENOC concludes that the potential adverse impact on cultural resources of the representative plant at an alternative site, regardless of location, would be SMALL.

Table 7.3-1: Air Emissions from Coal-Fired Alternative

Parameter[1]	Calculation	Result
Annual Coal Consumption	$\text{Total Gross Capability} \times \frac{\text{Heat Rate}}{\text{Heat Value}} \times \text{Conversion Factors} \times \text{Capacity Factor}$	tons/year
	$\frac{910\ \text{MW} \times 9{,}800\ \text{Btu}}{\text{kW x hr}\ 12{,}285\ \text{Btu}} \times \frac{\text{lb}}{\text{MW}} \times \frac{1{,}000\ \text{kW}}{\text{year}} \times \frac{8{,}760\ \text{hr}}{\text{year}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times 0.80$	2,543,644
Emissions	Coal Consumption x Uncontrolled Emissions x Conversion Factors x [100 – removal efficiency (%)][2]	tons/year
SO_x	$\frac{2{,}543{,}644\ \text{tons}}{\text{year}} \times \frac{130\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100-95}{100}$	8,267
NO_X	$\frac{2{,}543{,}644\ \text{tons}}{\text{year}} \times \frac{10\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100-60}{100}$	5,087
CO	$\frac{2{,}543{,}644\ \text{tons}}{\text{year}} \times \frac{0.5\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}}$	636
PM	$\frac{2{,}543{,}644\ \text{tons}}{\text{year}} \times \frac{120\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100-99.9}{100}$	152.6
PM_{10}	$\frac{2{,}543{,}644\ \text{tons}}{\text{year}} \times \frac{27\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} \times \frac{100-99.9}{100}$	34.34
CO_2	$\frac{2{,}543{,}644\ \text{tons}}{\text{year}} \times \frac{6{,}000\ \text{lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\ \text{lb}}$	7,630,933

Btu = British thermal units
CO = carbon monoxide
CO_2 = carbon dioxide
hr = hour
kW = kilowatt
lb = pound
MW = megawatt
NO_X = nitrogen oxides
PM = total filterable particulate matter
PM_{10} = PM having a diameter less than 10 microns
SO_X = sulfur oxides

Notes:
(1) Source: Table 7.2-1
(2) There are no emission controls for CO and CO_2.

Table 7.3-2: Air Emissions from Gas-Fired Alternative

Parameter[1]	Calculation	Result
Annual Gas Heat Input	Gross Capability × Heat Rate × Conversion Factors × Capacity Factor	MMBtu/year
	$910\text{ MW} \times \frac{6{,}500\text{ Btu}}{\text{kW}-\text{hr}} \times \frac{1{,}000\text{ kW}}{\text{MW}} \times \frac{8{,}760\text{ hr}}{\text{year}} \times 0.80$	41,452,320
Emissions	Annual Gas Heat Input x Uncontrolled Emissions x Conversion Factors x [100 – removal efficiency (%)] [2]	tons/year
SO_2	$\frac{41{,}452{,}320}{\text{year}} \times \frac{0.00064\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}}$	13.3
NO_X	$\frac{41{,}452{,}320}{\text{year}} \times \frac{0.099\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{100-90}{100}$	205
CO	$\frac{41{,}452{,}320}{\text{year}} \times \frac{0.015\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}}$	311
PM (all PM_{10})	$\frac{41{,}452{,}320}{\text{year}} \times \frac{0.019\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}}$	39.4
CO_2	$\frac{41{,}452{,}320}{\text{year}} \times \frac{110\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}}$	2,279,878

Btu = British thermal units
CO = carbon monoxide
CO_2 = carbon dioxide
hr = hour
kW = kilowatt
lb/MMBtu = pounds per million British thermal units
MW = megawatt
NO_X = nitrogen oxides
PM = particulate matter
PM_{10} = PM having a diameter less than 10 microns
SO_X = sulfur oxides (mainly SO_2)

Notes:

(1) Source: Table 7.2-2
(2) There are no emission controls for SO_2, CO, PM, and CO_2.

7.4 REFERENCES

Note to reader: This list of references identifies web pages and associated URLs where reference data were obtained. Some of these web pages may likely no longer be available or their URL addresses may have changed. FENOC has maintained hard copies of the information and data obtained from the referenced web pages.

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8.0 COMPARISON OF ENVIRONMENTAL IMPACT OF LICENSE RENEWAL WITH THE ALTERNATIVES

Regulatory Requirement: 10 CFR 51.45(b)(3)

"To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form." as adopted by 10 CFR 51.53(c)(2)."

FENOC presents its evaluations of the environmental impacts of Davis-Besse license renewal in Chapter 4 and reasonable alternatives in Chapter 7. In this chapter, FENOC provides a comparative summary of these impacts.

Table 8.0-1 summarizes environmental impacts of the proposed action (license renewal) and the alternatives, for comparison purposes. The environmental impacts compared in Table 8.0-2 are those that are either Category 2 issues for the proposed action or are issues that the GEIS (**NRC 1996**) identified as major considerations in an alternatives analysis. For example, although the NRC concluded that air quality impacts from the proposed action would be small (Category 1), the GEIS identified major human health concerns associated with air emissions from alternatives (Section 7.2.2). Therefore, Table 8.0-1 compares air quality impacts from the proposed action to the alternatives. Table 8.0-2 is a more detailed comparison of the alternatives.

As shown in Table 8.0-1 and Table 8.0-2, environmental impacts of the proposed action (Davis-Besse license renewal) are expected to be SMALL for all impact categories evaluated. In contrast, FENOC expects that environmental impacts in some impact categories would be MODERATE or MODERATE to LARGE for the no-action alternative (NRC decision not to renew Davis-Besse operating license), considered with or without development of replacement generation facilities.

As a result, FENOC concludes that the environmental impacts of the continued operation of Davis-Besse, providing approximately 910 MWe of base-load power generation through 2037, are superior to impacts associated with the best case among reasonable alternatives. Davis-Besse continued operation would create significantly less environmental impact than the construction and operation of new base-load generation capacity. Additionally, Davis-Besse continued operation will have a significant positive economic impact on the communities surrounding the station.

Table 8.0-1: Impacts Comparison Summary

Impact[2]	Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives[1]	
			With Coal-Fired Generation	With Gas-Fired Generation
Land Use	SMALL	SMALL	MODERATE to LARGE	SMALL to MODERATE
Water Quality	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL	SMALL	MODERATE	MODERATE[3]
Ecological Resources	SMALL	SMALL	MODERATE	SMALL to MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL	MODERATE	MODERATE
Waste Management	SMALL	SMALL	MODERATE	SMALL
Aesthetics	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Cultural Resources	SMALL	SMALL	SMALL	SMALL

Notes:

(1) Environmental impacts associated with the construction and operation of new coal-fired or gas-fired generating capacity at a greenfield site would exceed those for a coal-fired or gas-fired plant located at a brownfield, i.e., existing disturbed site.

(2) From 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 3:
- SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- MODERATE - Environmental effects are sufficient to alter noticeably, but not destabilize, any important attribute of the resource.
- LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

(3) Moderate, but less than with coal-fired generation.

Table 8.0-2: Impacts Comparison Detail

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives[1], [2]	
		With Coal-Fired Generation	**With Gas-Fired Generation**
Alternative Descriptions			
Davis-Besse license renewal for 20 years, followed by decommissioning	Decommissioning following expiration of current Davis-Besse license. Adopting by reference, as bounding Davis-Besse decommissioning, GEIS description (**NRC 1996**, Section 7.1).	New construction at greenfield (but preferably brownfield) site.	New construction at greenfield (but preferably brownfield) site.
		Pulverized coal units, 910-MW (equivalent to Davis-Besse); capacity factor 0.80.	Combined-cycle units, 910-MW (equivalent to Davis-Besse); capacity factor 0.80.
		Closed-cycle cooling with 500-foot-tall natural-draft cooling towers.	Closed-cycle cooling with mechanical-draft cooling towers.
		Coal and limestone delivery via waterway or rail.	Delivery of natural gas via a new 10-mile-long pipeline.
		Air emission controls: Particulates: fabric filter (99.9% removal) Sulfur oxide: wet limestone scrubber (95% removal) Nitrogen oxide: low-NO_X burners, overfire air, selective catalytic reduction (95% removal).	Air emission controls: Nitrogen oxides: dry low-NO_X burners; selective catalytic reduction (90% removal). Particulate matter and carbon monoxide emissions limited through proper combustion controls.
		Emissions dispersed via 500-foot-tall stacks.	Exhaust dispersed via 150-foot-tall stacks.
825 permanent and 60 contract workers (Section 3.4).		Estimated workforce: Construction: 1,092 – 2,275; Operation: 228	Estimated workforce: Construction: 1,092 – 2,275; Operation: 137

Table 8.0-2: Impacts Comparison Detail
(continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives(1), (2)	
		With Coal-Fired Generation	With Gas-Fired Generation
Land Use Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 52, 53).	SMALL – Adopting by reference applicable NRC impact conclusions in the GEIS Section 8.4 and Supplement 1 to NUREG-0586.	MODERATE to LARGE – 1,547 acres required for the powerblock and associated facilities; assumed 10 miles of 345-kV transmission line on a 150-foot right-of-way; 22 acres/MW for mining and disposal (Section 7.3.1).	SMALL to MODERATE – 100 acres for facility and 240 to 270 additional acres for gas pipeline and electric transmission lines (Section 7.3.2).
Water Quality Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 1-3, 6-11 and 31). Five Category 2 water quality issues do not apply: Section 4.1, Issue 13; Section 4.6, Issue 34; Section 4.5, Issue 33; Section 4.7, Issue 35; and Section 4.8, Issue 39.	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 89) in the GEIS Chapter 7 and Section 8.4, and in Supplement 1 to NUREG-0586.	SMALL – Construction impacts minimized by regulatory controls; operation-phase impacts similar to those of Davis-Besse; cooling water and wastewater discharges subject to regulatory controls (Section 7.3.1).	SMALL – Construction impacts minimized by regulatory controls; cooling water and wastewater discharges subject to regulatory controls (Section 7.3.2).
Air Quality Impacts			
SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 51). One Category 2 issue does not apply: Section 4.11, Issue 50.	SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issue 88) in the GEIS Chapter 7 and Section 8.4, and in Supplement 1 to NUREG-0586.	MODERATE – 8,267 tons SO_X/year 5,087 tons NO_X/year 636 tons CO/year 153 tons PM/year 34.3 tons PM_{10}/year 7.63×10^6 tons CO_2/year (Section 7.3.1).	MODERATE – 13.3 tons SO_2/year 205 tons NO_X/year 311 tons CO/year 39.4 tons PM/year 2.28×10^6 tons CO_2/year (Section 7.3.2).

Table 8.0-2: Impacts Comparison Detail
(continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives[1], [2]	
		With Coal-Fired Generation	**With Gas-Fired Generation**
Ecological Resource Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 14-24,28-30, 41-43, and 45-48). Three Category 2 issues do not apply: Section 4.2, Issue 25; Section 4.3, Issue 26; Section 4.4, and Issue 27.	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 90) in the GEIS Chapter 7 and Section 8.4, and in Supplement 1 to NUREG-0586.	MODERATE – Potential loss or alteration of more than 1,500 acres of habitat (e.g., transmission, waste disposal landfill); facilities siting would be subject to regulatory controls limiting impacts to ecological resources, including wetlands and threatened or endangered species. Impact on aquatic habitats and biota from dredging (e.g., for intake and discharge structures and, if applicable, barge terminal), cooling water withdrawal, and discharge would be subject to regulatory controls (Section 7.3.1).	SMALL to MODERATE – Approximately 100 acres onsite and 240 to 270 acres offsite of largely agricultural land would be converted to industrial use for plant site and offsite infrastructure, respectively; facilities siting would be subject to regulatory controls limiting impacts to ecological resources, including wetlands and threatened or endangered species. Potential for impacts to aquatic resources from construction and operation (e.g., cooling water withdrawal and discharge) reduced by best management practices and regulatory controls (Section 7.3.2).
Threatened or Endangered Species Impacts			
SMALL – Federally and state threatened or endanagered species are protected through company and plant procedures. (Section 4.10, Issue 49)	SMALL – Not an impact evaluated by the GEIS.	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats.	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats.

Table 8.0-2: Impacts Comparison Detail
(continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives[1],[2]	
		With Coal-Fired Generation	With Gas-Fired Generation
Human Health Impacts			
SMALL – Adopting by reference Category 1 issues (Table A-1, Issues 54-56, 58, 61, 62). One Category 2 issue does not apply: Section 4.12, Issue 57. Risk due to transmission-line induced currents minimal due to conformance with consensus code (Section 4.13, Issue 59).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 86) in the GEIS Chapter 7 and Section 8.4, and in Supplement 1 to NUREG-0586.	SMALL – Some risk of cancer and emphysema from air emissions and risk of accidents to workers, as the NRC notes in the GEIS. Assumed that regulatory controls would reduce risks to acceptable levels (Section 7.3.1).	SMALL – Similar to the coal-fired alternative (Section 7.3.2).
Socioeconomic Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 64, 67). Two Category 2 issues do not apply: Section 4.16, Issue 66 and Section 4.17.1, Issue 68. Location in high population area with no growth controls minimizes potential for housing impacts (Section 4.14, Issue 63).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 91) in the GEIS Chapter 7 and Section 8.4, and in Supplement 1 to NUREG-0586.	MODERATE – Reduction in permanent work force and tax base at Davis-Besse would adversely affect surrounding communities. Construction and operational impacts would depend upon the site location. Regulatory controls and appropriate mitigation would ensure that impacts are not destabilizing (Section 7.3.1).	MODERATE – Reduction in permanent work force and tax base at Davis-Besse would adversely affect surrounding communities. Impacts from construction would be mitigated by siting plant within commuting distance of large metropolitan areas (Section 7.3.2).

Table 8.0-2: Impacts Comparison Detail
(continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives[(1), (2)]	
		With Coal-Fired Generation	With Gas-Fired Generation
Capacity of public water supply as well as education and transportation infrastructures minimizes potential for related impacts (Section 4.15, Issue 65; Section 4.16, Issue 66; and Section 4.18, Issue 70). Plant tax payments range from <10% to nearly 20% of local jurisdictions tax revenues (Section 4.17.2, Issue 69).			
Waste Management Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 77-85).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 87) in the GEIS Chapter 7 and Section 8.4, and in Supplement 1 to NUREG-0586.	MODERATE – Annual waste of approximately 300,000 tons ash and 470,000 tons flue gas desulphurization waste, requiring disposal offsite in a 644-acre landfill over an assumed 40-year plant life (Section 7.3.1).	SMALL – Solid waste is minimal (Section 7.3.2).
Aesthetic Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 73, 74).	SMALL – Adopting by reference conclusions in the GEIS Section 8.4 and Supplement 1 to NUREG-0586.	SMALL to MODERATE – Highly dependent on location. Stacks, cooling tower plumes likely would be visible for several miles. Operation of waste disposal site would have adverse impact potential (Section 7.3.1).	SMALL to MODERATE – Highly dependent on location. Stacks, cooling tower plumes would be visible offsite (Section 7.3.2).

Table 8.0-2: Impacts Comparison Detail
(continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives[(1), (2)]	
		With Coal-Fired Generation	With Gas-Fired Generation
Cultural Resource Impacts			
SMALL –License renewal does not require additional land disturbance (Section 4.19, Issue 71).	SMALL – Adopting by reference conclusions in the GEIS Section 8.4 and Supplement 1 to NUREG-0586.	SMALL – Siting of plant and offsite infrastructure (e.g., transmission line, natural gas pipeline) would be subject to regulatory review, and mitigation measures would be implemented (Section 7.3.1).	SMALL – Same as the coal-fired alternative (Section 7.3.2).

Btu = British thermal unit
CO = carbon monoxide
CO_2 = carbon dioxide
ft^3 = cubic foot
GEIS = Generic Environmental Impact Statement (NRC 1996)
kWh = kilowatt hour
lb = pound
MM = million
MW = megawatt
NO_X = nitrogen oxides
PM = particulate matter
PM_{10} = particulates having diameter less than 10 microns
SO_X = sulfur oxides

Notes:

(1) Environmental impacts associated with the construction and operation of new coal-fired or gas-fired generating capacity at a greenfield site would exceed those described in the table for a coal-fired or gas-fired plant located at a brownfield, i.e., existing disturbed site.

(2) From 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 3:
- SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
- LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

8.1 REFERENCES

NRC 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), NUREG-1437, Volumes 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1996.

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9.0 STATUS OF COMPLIANCE

This chapter lists and discusses the compliance status of the requirements in connection with the proposed action as well as the alternatives.

9.1 PROPOSED ACTION

Regulatory Requirement: 10 CFR 51.45(d) and 51.53(c)(2)

"The environmental report shall list all Federal permits, licenses, approvals and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection.

Table 9.1-1 lists the various federal and state environmental permits, licenses, approvals, or other entitlements that FENOC has obtained for current Davis-Besse site operations. As needed, FENOC intends to seek timely renewal of these authorizations during the current license period and throughout the period of extended operation with the objective of ensuring compliance with the provisions of these authorizations and applicable environmental standards and requirements. Because the NRC regulatory focus is prospective, Table 9.1-1 does not include authorizations that FENOC obtained for past activities that did not include continuing obligations.

Before preparing the application for license renewal, FENOC conducted an assessment to identify any new and significant environmental information (Section 5.2). The assessment included interviews with FENOC subject-matter experts, review of Davis-Besse environmental documentation, and communication with state and federal environmental protection agencies. Based on the most recent assessments, FENOC concludes that Davis-Besse is in conformance with applicable environmental standards and requirements.

Table 9.1-2 lists additional environmental consultations related to NRC renewal of the Davis-Besse license to operate. As indicated, FENOC anticipates needing relatively few such authorizations and consultations. These items are discussed in more detail below.

Threatened or Endangered Species

Section 7 of the *Endangered Species Act* (16 USC 1531 et seq.) requires federal agencies to ensure that agency action is not likely to jeopardize any species that is listed, or proposed for listing as endangered, or threatened. Depending on the action involved, the Act requires consultation with the USFWS regarding effects on non-marine species, the National Marine Fisheries Service (NMFS) for marine species, or both. USFWS and NMFS have issued joint procedural regulations at 50 CFR Part 402, Subpart B, that address consultation, and FWS maintains the joint list of threatened or endangered species at 50 CFR Part 17. Additionally, the Ohio Department of Natural Resources (ODNR) maintains a list of endangered species in the state (Ohio Revised Code 1531.25).

Although not required of an applicant by federal law or NRC regulation, FENOC has solicited comment from federal and state resource agencies regarding potential effects that Davis-Besse license renewal might have on species of concern. Attachment C includes copies of FENOC correspondence with USFWS, NMFS, and ODNR.

USFWS determined that the Davis-Besse license renewal project will not impact federally listed species and will have minimal environmental impacts, as no change in operation or extent of the facility is proposed. However, the USFWS noted that a bald eagle (*Haliaeetus leucocephalus*) nest exists on the Davis-Besse property. Although the bald eagle was removed from the Federal list of endangered and threatened species in July 2007 due to recovery, this species continues to be afforded protection by the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. To avoid disturbing nesting and young eagles, USFWS requested that no activity occur within 660 feet of the nest between January 1 and July 31, when the nesting eagles are most vulnerable. FENOC plans to incorporate the USFWS requirement into station procedures. (**USFWS 2009**)

NMFS stated that no threatened or endangered species listed by NMFS are known to occur in Lake Erie and that no Essential Fish Habitat (EFH), as designated under the Magnuson-Steven Fisheries Management and Conservation Act, occurs in the vicinity of Davis-Besse. As a result, NMFS noted that no further coordination with NMFS on the effects of Davis-Besse license renewal is necessary. (**NMFS 2010**)

ODNR reported that the project is within the range of the Indiana bat *(Myotis sodalis),* a state and federally endangered species, and listed a number high value trees that protect its habitat. ODNR requires that if such trees occur within the project area, these trees must be conserved. In addition, if suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. If no tree removal is proposed, the project is not likely to impact this species. FENOC plans to incorporate the ODNR requirement into station procedures. (**ODNR 2009a**)

ODNR also reported that the project is within the range of 15 other state, federal, or both endangered or threatened species (**ODNR 2009a**). However, ODNR determined that the Davis-Besse license renewal project is not likely to impact these species (see Section 4.10.2). Nevertheless, because the location of bald eagle activity frequently changes, a status update must be obtained from ODNR prior to any construction activity. This requirement is in addition to the USFWS request that no activity occur within 660 feet of the nest between January 1 and July 31. FENOC plans to incorporate the ODNR requirement into station procedures. Otherwise, ODNR is not aware of any threatened or endangered species in the vicinity of Davis-Besse.

Historic Preservation

Section 106 of the *National Historic Preservation Act* (16 USC 470 et seq.) requires federal agencies having the authority to license any undertaking to, prior to issuing the license, take into account the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking. Council regulations provide for the State Historic Preservation Officer (SHPO) to have a consulting role (36 CFR 800.7). Although not required of an applicant by federal law or NRC regulation, FENOC invited comment on the proposed action by the Ohio Historic Preservation Office. Copies of the correspondence are included in Attachment C. In the opinion of the OHPO, license renewal will not affect historic properties (**OHPO 2010**).

Water Quality (401) Certification

Federal Clean Water Act Section 401 requires an applicant for a federal license who conducts an activity that might result in a discharge into navigable waters to provide the licensing agency a certification from the state that the discharge will comply with applicable Clean Water Act requirements (33 USC 1341).

In 2006, the Ohio Environmental Protection Agency, Division of Surface Water, issued a renewal to the Davis-Besse National Pollutant Discharge Elimination System (NPDES) permit (**OEPA 2006**). NRC has indicated in the GEIS (**NRC 1996**, Section 4.2.1.1) that issuance of a NPDES permit implies certification by the state. FENOC is applying to NRC for license renewal to continue Davis-Besse operations. Consistent with the GEIS, FENOC is providing Davis-Besse's NPDES permit approval letter and cover sheet as evidence of state water quality (401) certification (see Attachment B).

Coastal Zone Management Program Compliance

The *Coastal Zone Management Act* (16 USC 1451 et seq.) imposes requirements on applicants for a federal license to conduct an activity that could affect a state's coastal zone. The Act requires the applicant to certify to the licensing agency that the proposed activity would be consistent with the state's federally approved coastal zone management program [16 USC 1456(c)(3)(A)]. The Act further requires that the license applicant provide its certification to the federal licensing agency and a copy to the applicable state agency [15 CFR 930.57(a)].

The NRC's office of Nuclear Reactor Regulation has issued guidance to its staff regarding compliance with the Act. This guidance acknowledges that Ohio has an approved Coastal Management Program (**NRC 2004**). Davis-Besse, located in Ottawa County, is within the Ohio Coastal Management Program. Accordingly, FENOC has contacted the Ohio Department of Natural Resources, Coastal Management Program. Copies of the correspondence are included in Attachment C. A copy of the certification of consistency is included in Attachment D.

Table 9.1-1: Environmental Authorizations for Current Davis-Besse Operations

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Authorized
Federal Authorizations					
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10CFR50.10	License to operate	NPF-3	Issued: 4/22/1977 Expires: 4/22/2017	Operation of Davis-Besse
U.S. Nuclear Regulatory Commission	10 CFR Part 72	Requirements to store spent nuclear fuel and high-level radioactive waste	Certificate Number 1004	Issued: 1/23/1995 Expires: 1/31/2015	Use of radioactive waste cask Model Number NUHOMS-24P
U.S. Department of Transportation	49 CFR Part 107, Subpart G	Hazardous material registration	042009 450 002RT	Issued: 5/19/2009 Expires: 6/30/2012 (Renewed Triennially)	Transportation of hazardous materials
U.S. Environmental Protection Agency	RCRA [42 U.S.C. s/s 321 et seq. (1976)]	Notification of regulated waste activity	EPA ID# OHD000720508	Issued: -- Expires: Indefinite	Generation and accumulation of hazardous waste
State and Local Authorizations					
Ohio Environmental Protection Agency, Division of Surface Water	Federal Water Pollution Control Act, as amended (33 U.S.C Section 1251 et seq.); Ohio Water Pollution Control Act (Ohio Revised Code Section 6111)	National Pollutant Discharge Elimination System (NPDES) Permit	Ohio Permit No. 2IB00011*ID	Issued: 9/1/2006 Expires: 4/30/2011 (every 5 years)	Treatment of wastewater and effluent discharge to surface receiving waters (Toussaint River and Lake Erie)

Table 9.1-1: Environmental Authorizations for Current Davis-Besse Operations
(continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Authorized
Ohio Environmental Protection Agency, Division of Surface Water	Federal Water Pollution Control Act, as amended (33 U.S.C Section 1251 et seq.); Ohio Water Pollution Control Act (Ohio Revised Code Section 6111)	NPDES construction stormwater permit	Ohio Permit No. 2GC02563*AG	Issued: 12/21/2009 Expires: Upon project completion	Construction of Switchyard project and control-discharge of stormwater in Ottawa County, Carroll Township
Ohio Environmental Protection Agency, Division of Air Pollution Control	Clean Air Act, 40 U.S.C. 1857 et seq.; Ohio Air Pollution Control Act (Ohio Administrative Code Chapter 3745-31)	Permit to operate an air contaminant source	Permit Application No. 0362000091B001	Issued: Annual reporting Expires: Indefinite	Operation of station auxiliary boiler
Ohio Environmental Protection Agency, Division of Hazardous Waste Management	Ohio Administrative Code Chapter 3745-52-41	Report of regulated waste activity	EPA ID# OHD000720508	Issued: Annual reporting Expires: Indefinite	Generation, accumulation, and off-site disposal of hazardous waste
Ohio Department of Natural Resources, Division of Wildlife	Ohio Revised Code Section 1531.08	Scientific collection permit	Permit #10-21	Issued: Annually Expires: 3/15/2011	Collection of wildlife specimens for Radiological Environmental Monitoring Program (REMP)

Table 9.1-1: Environmental Authorizations for Current Davis-Besse Operations
(continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Authorized
Ohio Department of Natural Resources, Division of Water Resources	Ohio Revised Code Section 1521.16	Water withdrawal and use registration and file annual report	Registration # 00598	Issued: 1/1/1990 Expires: Indefinite	Withdraw and use of more than 100,00 gallons of water daily from all sources
Ohio Department of Health	Ohio Administrative Code 3701: 1-38-03(C); Ohio Revised Code 3748.06 and 3748.07	X-Ray generating equipment registration	Registration # 17-M-07181-005	Issued: Biennially Expires: 5/31/2012	Operation of X-ray generation equipment
Ohio Department of Commerce, Division of State Fire Marshal	Ohio Administrative Code 1301: 7-9-04	Underground storage tank registration	Certificate # 62000072	Issued: Annually Expires: 6/30/2011	Registration of underground diesel storage tanks T00001, T00002, and T00003
Tennessee Department of Environment and Conservation	Tennessee Code Annotated 68-202-206	License to deliver radioactive waste	Tennessee Delivery License # T-OH003-LO9	Issued: Annually Expires: 12/31/2010	Shipment of radioactive material to a licensed disposal-processing facility within the State of Tennessee

Table 9.1-2: Environmental Consultations Related to License Renewal

Agency	Authority	Activity
U.S. Fish and Wildlife Service & National Marine Fisheries Service	Endangered Species Act Section 7 (16 USC 1531)	Requires federal agency issuing a license to consult with US Fish and Wildlife Service (USFWS) regarding terrestrial and freshwater species, and National Marine Fisheries Service (NMFS) regarding marine species (including anadromous fishes).
Ohio Historic Preservation Office	National Historic Preservation Act, Section 106 (16 USC 470)	Requires federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO), who must concur that license renewal will not affect any sites listed or eligible for listing.
Ohio Environmental Protection Agency, Division of Surface Water	Clean Water Act (CWA), Section 401 (33 USC 1341)	State issuance of NPDES permit, which constitutes 401 certification that discharge would comply with CWA standards.
Ohio Department of Natural Resources, Coast Management Program	Coastal Zone Management (16 USC 1451)	Requires an applicant to provide certification to the federal agency issuing the license that license renewal would be consistent with the federally-approved state coastal zone management program. Based on its review of the proposed activity, the state must concur with or object to the applicant's certification.

9.2 ALTERNATIVES

Regulatory Requirement: 10 CFR 51.45(d) and 51.53(c)(2)

"…The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements."

The coal- and gas-fired generation alternatives, and purchased power alternatives discussed in Section 7.2.1 could be constructed and operated to comply with applicable environmental quality standards and requirements. FENOC notes, however, that increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in many locations.

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9.3 REFERENCES

NRC 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), NUREG-1437, Volumes 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1996.

NRC 2004. Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues, NRR Office Instruction No. LIC-203, Revision 1, U.S. Nuclear Regulatory Commission, May 24, 2004.

NMFS 2010. Northeast Region, National Marine Fisheries Service, National Oceanic Atmospheric Adminsitration, U.S. Department of Commence, NMFS letter, M.A. Colligan to B. Allen (FENOC) January 15, 2010, Gloucester, Massachusetts.

ODNR 2009a. Ohio Department of Natural Resources, Division of Wildlife, ODNR letter, J. Navarro to B. Allen (FENOC), December 22, 2009, Columbus, Ohio.

ODNR 2009b. Ohio Department of Natural Resources, Division of Wildlife, ODNR e-mail, B. Mitch to C.I. Custer (FENOC), December 22, 2009, Columbus, Ohio.

OEPA 2006. National Pollutant Discharge Elimination System (NPDES) Permit for Davis-Besse Nuclear Power Station, EPA ID No. OH0003786, Permit No. 21B0011*ID, Ohio Environmental Protection Agency, Division of Surface Water, August 14 and September 8, 2006.

OHPO 2010. Ohio Historic Preservation Office, Ohio Historical Society, OHPO letter, N.J. Young to C.I. Custer (FENOC), March 23, 2010.

USFWS 2009. U.S. Fish and Wildlife Service, U.S. Department of Interior, USFES letter, M.K. Knapp to B. Allen (FENOC), TAILS #3142002010-TA-0132, December 16, 2009, Columbus, Ohio.

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Attachment A:

NRC National Environmental Policy Act Issues For License Renewal

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A.1 NRC NATIONAL ENVIRONMENTAL POLICY ACT ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER

FirstEnergy Nuclear Operating Company (FENOC) has prepared this environmental report in accordance with the requirements of U.S. Nuclear Regulatory Commission (NRC) regulation 10 CFR 51.53. NRC included in the regulation a list of National Environmental Policy Act (NEPA) issues for license renewal of nuclear power plants. Table A-1 lists these 92 issues and identifies the section of the environmental report in which an applicable issue is addressed. For organization and clarity, FENOC has assigned a number to each issue and uses the issue numbers throughout the environmental report.

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues

Issue[1]	Category	Section of this Environmental Report	GEIS Cross Reference[2] (Section/Page)
Surface Water Quality, Hydrology, and Use (for all plants)			
1. Impacts of refurbishment on surface water quality	1	4.0	3.4.1/3-4
2. Impacts of refurbishment on surface water use	1	4.0	3.4.1/3-1
3. Altered current patterns at intake and discharge structures	1	4.0	4.2.1.2.1/4-5
4. Altered salinity gradients	1	NA	4.2.1.2.2/4-5 Issue applies to a plant feature, discharge to saltwater, that Davis-Besse does not have.
5. Altered thermal stratification of lakes	1	4.0	4.2.1.2.3/4-6
6. Temperature effects on sediment transport capacity	1	4.0	4.2.1.2.3/4-8
7. Scouring caused by discharged cooling water	1	4.0	4.2.1.2.3/4-6
8. Eutrophication	1	4.0	4.2.1.2.3/4-9
9. Discharge of chlorine or other biocides	1	4.0	4.2.1.2.4/4-10
10. Discharge of sanitary wastes and minor chemical spills	1	4.0	4.2.1.2.4/4-10
11. Discharge of other metals in waste water	1	4.0	4.2.1.2.4/4-10
12. Water use conflicts (plants with once-through cooling systems)	1	NA	4.2.1.3/4-13 Issue applies to a plant feature, once-through cooling, that Davis-Besse does not have.
13. Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	2	NA, and discussed in Section 4.1	4.3.2.1/4-29 Issue applies to features, cooling ponds or water withdrawals from a small river, that Davis-Besse does not have.

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue[(1)]	Category	Section of this Environmental Report	GEIS Cross Reference[(2)] (Section/Page)
Aquatic Ecology (for all plants)			
14. Refurbishment impacts to aquatic resources	1	4.0	3.5/3-5
15. Accumulation of contaminants in sediments or biota	1	4.0	4.2.1.2.4/4-10
16. Entrainment of phytoplankton and zooplankton	1	4.0	4.2.2.1.1/4-15
17. Cold shock	1	4.0	4.2.2.1.5/4-18
18. Thermal plume barrier to migrating fish	1	4.0	4.2.2.1.6/4-19
19. Distribution of aquatic organisms	1	4.0	4.2.2.1.6/4-19
20. Premature emergence of aquatic insects	1	4.0	4.2.2.1.7/4-20
21. Gas supersaturation (gas bubble disease)	1	4.0	4.2.2.1.8/4-21
22. Low dissolved oxygen in the discharge	1	4.0	4.2.2.1.9/4-23
23. Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	1	4.0	4.2.2.1.10/4-24
24. Stimulation of nuisance organisms (e.g., shipworms)	1	4.0	4.2.2.1.11/4-25
Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)			
25. Entrainment of fish and shellfish in early life stages for plants with once-through and cooling pond heat dissipation systems	2	NA, and discussed in Section 4.2	4.2.2.1.1/4-16 Issue applies to a plant feature, once-through cooling or a cooling pond, that Davis-Besse does not have.
26. Impingement of fish and shellfish for plants with once-through and cooling pond heat dissipation systems	2	NA, and discussed in Section 4.3	4.2.2.1.2/4-16 Issue applies to a plant feature, once-through cooling or a cooling pond, that Davis-Besse does not have.

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue[1]	Category	Section of this Environmental Report	GEIS Cross Reference[2] (Section/Page)
27. Heat shock for plants with once-through and cooling pond heat dissipation systems	2	NA, and discussed in Section 4.4	4.2.2.1.4/4-17 Issue applies to a plant feature, once-through cooling or a cooling pond, that Davis-Besse does not have.
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)			
28. Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems	1	4.0	4.3.3/4-33
29. Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems	1	4.0	4.3.3/4-33
30. Heat shock for plants with cooling-tower-based heat dissipation systems	1	4.0	4.3.3/4-33
Groundwater Use and Quality			
31. Impacts of refurbishment on groundwater use and quality	1	4.0	3.4.2/3-5
32. Groundwater use conflicts (potable and service water; plants that use < 100 gpm)	1	4.0	4.8.1.1/4-116
33. Groundwater use conflicts (potable, service water, and dewatering; plants that use > 100 gpm)	2	NA, and discussed in Section 4.5	4.8.1.2/4-117 Issue applies to an operational feature, annual average groundwater withdrawals greater than 100 gpm, that Davis-Besse does not have.
34. Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river)	2	NA, and discussed in Section 4.6	4.8.1.3/4-117 Issue applies to a feature, withdrawals from a small river; that Davis-Besse does not have.
35. Groundwater use conflicts (Ranney wells)	2	NA, and discussed in Section 4.7	4.8.2.2/4-120 Issue applies to a feature, Ranney wells, that Davis-Besse does not have.

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue[1]	Category	Section of this Environmental Report	GEIS Cross Reference[2] (Section/Page)
36. Groundwater quality degradation (Ranney wells)	1	NA	4.8.2.2/4-120 Issue applies to a feature, Ranney wells, that Davis-Besse does not have.
37. Groundwater quality degradation (saltwater intrusion)	1	NA	4.8.2.1/4-119 Issue applies to a feature, location in estuary or oceanic areas, that Davis-Besse does not have.
38. Groundwater quality degradation (cooling ponds in salt marshes)	1	NA	4.8.3/4-121 Issue applies to a feature, cooling ponds, that Davis-Besse does not have.
39. Groundwater quality degradation (cooling ponds at inland sites)	2	NA, and discussed in Section 4.8	4.8.3/4-121 Issue applies to a feature, cooling ponds at inland sites, that Davis-Besse does not have.
Terrestrial Resources			
40. Refurbishment impacts to terrestrial resources	2	4.0	3.6/3-6
41. Cooling tower impacts on crops and ornamental vegetation	1	4.0	4.3.4/4-34
42. Cooling tower impacts on native plants	1	4.0	4.3.5.1/4-42
43. Bird collisions with cooling towers	1	4.0	4.3.5.2/4-45
44. Cooling pond impacts on terrestrial resources	1	NA	4.4.4/4-58 Issue applies to a feature, cooling ponds, that Davis-Besse does not have.
45. Power line right-of-way management (cutting and herbicide application)	1	4.0	4.5.6.1/4-71
46. Bird collisions with power lines	1	4.0	4.5.6.2/4-74

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue(1)	Category	Section of this Environmental Report	GEIS Cross Reference(2) (Section/Page)
47. Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	1	4.0	4.5.6.3/4-77
48. Floodplains and wetlands on power line right-of-way	1	4.0	4.5.7/4-81
Threatened or Endangered Species (for all plants)			
49. Threatened or endangered species	2	4.10	3.9/3-48 (refurbishment) 4.1/4-1 (renewal term)
Air Quality			
50. Air quality during refurbishment (non-attainment and maintenance areas)	2	NA, and discussed in Section 4.11	3.3/3-2 Issue applies to areas that Davis-Besse is not located near.
51. Air quality effects of transmission lines	1	4.0	4.5.2/4-62
Land Use			
52. Onsite land use	1	4.0	3.2/3-1
53. Power line right-of-way land use impacts	1	4.0	4.5.3/4-62
Human Health			
54. Radiation exposures to the public during refurbishment	1	4.0	3.8.1/3-27.
55. Occupational radiation exposures during refurbishment	1	4.0	3.8.2/3-42.
56. Microbiological organisms (occupational health)	1	4.0	4.3.6/4-48
57. Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	2	NA, and discussed in Section 4.12	4.3.6/4-48 Issue applies to features – cooling pond, cooling lake, or discharges to a small river – that Davis-Besse does not have.
58. Noise	1	4.0	4.3.7/4-49
59. Electromagnetic fields, acute effects (electric shock)	2	4.13	4.5.4.1/4-66

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue[1]	Category	Section of this Environmental Report	GEIS Cross Reference[2] (Section/Page)
60. Electromagnetic fields, chronic effects	NA	4.0	4.5.4.2/4-67 The categorization and impact finding definitions do not apply to this issue.
61. Radiation exposures to public (license renewal term)	1	4.0	4.6.2/4-87
62. Occupational radiation exposures (license renewal term)	1	4.0	4.6.3/4-95
Socioeconomics			
63. Housing impacts	2	4.14	3.7.2/3-10 (refurbishment) 4.7.1/4-101 (renewal term)
64. Public services: public safety, social services, and tourism and recreation	1	4.0	Refurbishment 3.7.4/3-14 (public services) 3.7.4.3/3-18 (safety) 3.7.4.4/3-19 (social) 3.7.4.6/3-20 (tourism & rec.) Renewal Term 4.7.3/4-104 (public services) 4.7.3.3/4-106 (safety) 4.7.3.4/4-107 (social) 4.7.3.6/4-107 (tourism & rec.)
65. Public services: public utilities	2	4.15	3.7.4.5/3-19 (refurbishment) 4.7.3.5/4-107 (renewal term)
66. Public services: education (refurbishment)	2	4.16	3.7.4.1/3-15)
67. Public services: education (license renewal term)	1	4.17	4.7.3.1/4-106
68. Offsite land use (refurbishment)	2	4.17.1	3.7.5/3-20
69. Offsite land use (license renewal term)	2	4.17.2	4.7.4/4-107
70. Public services: transportation	2	4.18	3.7.4.2/3-17 (refurbishment) 4.7.3.2/4-106 (renewal term)
71. Historic and archaeological resources	2	4.19	3.7.7/3-23 (refurbishment) 4.7.7/4-114 (renewal term)
72. Aesthetic impacts (refurbishment)	1	4.0	3.7.8/3-24.
73. Aesthetic impacts (license renewal term)	1	4.0	4.7.6/4-111

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue[1]	Category	Section of this Environmental Report	GEIS Cross Reference[2] (Section/Page)
74. Aesthetic impacts of transmission lines (license renewal term)	1	4.0	4.5.8/4-83
Postulated Accidents			
75. Design basis accidents	1	4.0	5.3.2/5-11 (design basis) 5.5.1/5-114 (summary)
76. Severe accidents	2	4.20	5.3.3/5-12 (probabilistic analysis) 5.3.3.2/5-19 (air dose) 5.3.3.3/5-49 (water) 5.3.3.4/5-65 (groundwater) 5.3.3.5/5-96 (economic) 5.4/5-106 (mitigation) 5.5.2/5-114 (summary)
Uranium Fuel Cycle and Waste Management			
77. Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	1	4.0	6.1/6-1 (intro) 6.2.1/6-8/6-8 (background) 6.2.2.1/6-8 (effluents) 6.2.2.3/6-20 (dose) 6.2.3/6-22 (sensitivity) 6.2.4/6-27 (conclusions) 6.6/6-87 (summary)
78. Offsite radiological impacts (collective effects)	1	4.0	6.1/6-1 (intro) 6.2.2.1/6-8 (effluents) 6.2.3/6-22 (sensitivity) 6.2.4/6-27 (conclusions)
79. Offsite radiological impacts (spent fuel and high-level waste disposal)	1	4.0	6.1/6-1 (intro) 6.2.2.1/6-8 (effluents) 6.2.3/6-22 (sensitivity) 6.2.4/6-27 (conclusions)
80. Nonradiological impacts of the uranium fuel cycle	1	4.0	6.2.2.6/6-20 (land use) 6.2.2.7/6-20 (water use) 6.2.2.8/6-21 (fossil fuel) 6.2.2.9/6-21 (chemical)
81. Low-level waste storage and disposal	1	4.0	6.4.2/6-36 (low-level definition) 6.4.3/6-37 (low-level volume) 6.4.4/6-48 (renewal effects)
82. Mixed waste storage and disposal	1	4.0	6.4.5/6-63

Table A-1. Davis-Besse Environmental Report Discussion of License Renewal NEPA Issues
(continued)

Issue[1]	Category	Section of this Environmental Report	GEIS Cross Reference[2] (Section/Page)
83. Onsite spent fuel	1	4.0	6.4.6/6-70
84. Nonradiological waste	1	4.0	6.5/6-86 (wastes) 6.6/6-87 (summary)
85. Transportation	1	4.0	6.3/6-31, as revised by Addendum 1, August 1999.
Decommissioning			
86. Radiation doses (decommissioning)	1	4.0	7.3.1/7-15
87. Waste management (decommissioning)	1	4.0	7.3.2/7-19 (impacts) 7.4/7-25 (conclusions)
88. Air quality (decommissioning)	1	4.0	7.3.3/7-21 (air) 7.4/7-25 (conclusion)
89. Water quality (decommissioning)	1	4.0	7.3.4/7-21 (water) 7.4/7-25 (conclusion)
90. Ecological resources (decommissioning)	1	4.0	7.3.5/7-21 (ecological) 7.4/7-25 (conclusion)
91. Socioeconomic impacts (decommissioning)	1	4.0	7.3.7/7-24 (socioeconomic) 7.4/7-25 (conclusion)
Environmental Justice			
92. Environmental justice	NA	2.6.2 and 4.21	Not in GEIS

Notes:

(1) Source: 10 CFR Part 51, Subpart A, Appendix A, Table B-1. (Issue numbers added to facilitate discussion.)

(2) Source: Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437).

NEPA = National Environmental Policy Act.
NA = Not Applicable

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Attachment B:

National Pollutant Discharge Elimination System Permit

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OhioEPA

State of Ohio Environmental Protection Agency

RAIC06-0049

STREET ADDRESS:
Lazarus Government Center
122 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-3184
www.epa.state.oh.us

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

September 8, 2006

Re: Ohio EPA Permit No. 2IB00011*ID
Application No. OH0003786
Facility: Davis-Besse Nuclear Power Station

RECEIVED
SEP 12 2006
DBNPS

FirstEnergy Nuclear Operating Company
5501 North State Route 2
Oak Harbor OH 43449

Ladies and Gentlemen:

We propose to make to following minor modifications to the above referenced permit.

Page	Correction
3	Revise Total Residual Chlorine notes for final outfall 2IB00011001.
7	Revise Total Residual Chlorine notes for final outfall 2IB00011004.

If you consent to these changes, please sign below and incorporate the corrected pages into your permit. The proposed minor modifications will become effective on the date we receive this signed letter from you at the following address: Ohio Environmental Protection Agency, Division of Surface Water, Permit Administration Section, P. O. Box 1049, Columbus, Ohio 43266-0149.

Sincerely,

Patti L. Smith

Patti L. Smith, Supervisor
Permit Processing Unit
Division of Surface Water

PLS/dks

Enclosure

CERTIFIED MAIL

I consent to the minor modification.

[signature] *Name* — Vice President *Title*

10/5/06 *Date*

**** Total Residual Chlorine or Total Residual Oxidants may not be discharged from any single generating unit for more than 2 hours per day. If it is necessary to discharge TRC or TRO for more than two hours, the discharge shall be treated with a dehalogenating agent dosed to achieve levels of 0.038 mg/l TRC or 0.01 mg/l TRO as appropriate. (1) Total Residual Oxidants reflects the use of bromine compounds. Bromine can be used separately or in combination with chlorine. These limits are effective when bromine is used. Discharge limitations for TRO may be met using a dehalogenation agent, if necessary. Dehalogenation shall then be achieved by using stoichiometric calculations to determine the amount of dehalogenating agent necessary to completely eliminate the residual.

***** Dissolved Oxygen: In addition to the monitoring requirements noted above, sampling shall be performed daily by grab sample during discharge of hydrazine.

****** Water Temperature: Report daily average.

******* Total Residual Chlorine & Total Residual Oxidants shall be monitored daily (during treatment event) except on days when plant is not normally staffed. Report "AN" on the monthly report form for those days.

(2) Report on days when bromine compounds are used with or without chlorine. On days when no bromine compounds are used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(3) Report on days when ONLY chlorine compounds are used (i.e. no bromine compounds. On days when bromine or a combination of bromine and chlorine IS used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(4) Monitor when discharging.

- See Part II for other requirements.

and/or bromination. The daily grab samples for TRC and TRO shall represent the maximumm concentration discharged during chlorination and/or bromination.

** Measure TRO, TRC, and Cl/Br duration on days when using treatment.

*** Grab sample for TRO and TRC will be taken during treatment event.

**** Asbestos, See Part II, Other Requirements, Item O.

*****Total Residual Chlorine or Total Residual Oxidants may not be discharged from any single generating unit for more than 2 hours per day. If it is necessary to discharge TRC or TRO for more than two hours, the discharge shall be treated with a dehalogenating agent dosed to achieve levels of 0.038 mg/l TRC or mg/l TRO, as appropriate.

(1) Total Residual Oxidants reflects the use of bromine compounds. Bromine can be used separately or in combination with chlorine. These limits are effective when bromine is used. Discharge limitations for TRO may be met using a dehalogenation agent, if necessary. Dehalogenation shall then be achieved by using stoichiometric calculations to determine the amount of dehalogenating agent necessary to completely eliminate the residual.

(2) Report on days when bromine compounds are used with or without chlorine. On days when no bromine compounds are used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(3) Report on days when ONLY chlorine compounds are used (i.e. no bromine compounds. On days when bromine or a combination of bromine and chlorine IS used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(4) Daily monitoring is required for the parameters during discharge from the circulating water system (i.e., Cooling Tower Basin Drain).

OhioEPA

State of Ohio Environmental Protection Agency

RAIC 06-0047

STREET ADDRESS:
Lazarus Government Center
122 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-3184
www.epa.state.oh.us

MAILING ADDRESS
P.O. Box 1049
Columbus, OH 43216-1049

August 14, 2006

Re: Ohio EPA Permit No. 2IB00011*ID
Facility Name: Davis-Besse Nuclear Power Station

RECEIVED
AUG 16 2006
DBNPS

FirstEnergy Nuclear Operating Company
5501 North State Route 2
Oak Harbor, OH 43449

Ladies and Gentlemen:

Transmitted herewith is one copy of the final National Pollutant Discharge Elimination System permit referenced above.

You are hereby notified that this action of the Director is final and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and shall set forth the action complained of and the grounds upon which the appeal is based. It must be filed with the Environmental Review Appeals Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of $70.00 which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Directors within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
309 South Fourth Street, Room 222
Columbus, Ohio 43215

Sincerely,

Patti L. Smith

Patti L. Smith, Supervisor
Permit Processing Unit
Division of Surface Water

PLS/kep

Enclosure

CERTIFIED MAIL

Ohio EPA Invoice/Receipt

Date Printed: August 11, 2006

Revenue ID: 568806

Please include this Revenue ID with all correspondence.

Organization ID: 12148

Information: FirstEnergy Corp
76 S Main St
Akron, OH 44308-

Due Date: September 16, 2006

Amount Due: $1,625.00

Effective Date: September 01, 2006

Revenue Description: DSW- NPDES Permit Issuance

Program Name: NPDES Permitting

Reason: NPDES Permit Issuance 2IB00011*ID-Davis Besse Nuclear Power Plant

For some Revenues, Interest and/or Penalties may be charged for late payment.

Next Interest Date (if applicable): October 16, 2006

Next Penalty Date (if applicable):

Remittance Advice **Detach Here - Please Return This Portion With Your Payment**

Organization ID: 12148

Information: FirstEnergy Corp
76 S Main St
Akron, OH 44308-

Due Date: Sep 16, 2006

Amount Due: $1,625.00

Secondary Type/Id: SNPDE / 2IB00011

Revenue Type: PTONI

Amount Enclosed: $________________

Please write this number on your check. Revenue ID: 568806
Make check or money order payable to "Treasurer, State of Ohio"

Remit to: **Ohio Environmental Protection Agency - OFA**
Department L-2711
Columbus, OH 43260-2711

For Ohio EPA use only

Check ID: ____________________

Check Date: ____________________

Check Number: ____________________

Check Amount: $____________________

12148	FirstEnergy Corp	162500	PTONI	568806

Application No. OH0003786

Issue Date: August 14, 2006

Effective Date: September 1, 2006

Expiration Date: April 30, 2011

Ohio Environmental Protection Agency
Authorization to Discharge Under the
National Pollutant Discharge Elimination System

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq., hereinafter referred to as the "Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Section 6111),

FirstEnergy Nuclear Operating Company

is authorized by the Ohio Environmental Protection Agency, hereinafter referred to as "Ohio EPA," to discharge from the Davis-Besse Nuclear Power Station located at 5501 North State Route 2, Oak Harbor, Ohio, Ottawa County and discharging to Lake Erie, Navarre Marsh and the Toussaint River in accordance with the conditions specified in Parts I, II, and III of this permit.

This permit is conditioned upon payment of applicable fees as required by Section 3745.11 of the Ohio Revised Code.

This permit and the authorization to discharge shall expire at midnight on the expiration date shown above. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA no later than 180 days prior to the above date of expiration.

Joseph P.Koncelik
Director

Total Pages: 26

Page 2
2IB00011*ID

Part I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from outfall 2IB00011001. See Part II, OTHER REQUIREMENTS, for locations of effluent sampling.

Table - Final Outfall - 001 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00011 - Water Temperature - F	-	-	-	-	-	-	-	1/Day	Continuous	All
00300 - Dissolved Oxygen - mg/l	-	6.0	-	-	-	-	-	1 / 2 Weeks	Grab	All
00400 - pH - S.U.	9.0	6.5	-	-	-	-	-	1/Day	Grab	All
01119 - Copper, Total Recoverable - ug/l	-	-	-	-	-	-	-	1/Quarter	Composite	Quarterly
34044 - Oxidants, Total Residual - mg/l	0.05	-	-	-	-	-	-	When Disch.	Grab	All
50050 - Flow Rate - MGD	-	-	-	-	-	-	-	1/Day	24hr Total Estimate	All
50060 - Chlorine, Total Residual - mg/l	0.2	-	-	-	-	-	-	When Disch.	Grab	All
78739 - Chlorination/Bromination Duration - Minutes	120	-	-	-	-	-	-	When Disch.	24hr Total	All

Notes for station 2IB00011001:

* The Total Residual Chlorine (TRC) and Total Residual Oxidants (TRO) limits are the maximum allowed at the outfall at any time. Analyses are to be performed by amperometric titration, Orion Residual Chlorine Electrode, or other approved methods during chlorination and/or bromination. The daily grab samples for TRC and TRO shall represent the maximum concentration discharged during chlorination and/or bromination.

** Measure for TRO, TRC, and Cl/Br duration on on days when using treatment.

*** Grab sample for TRO and TRC will be taken during treatment event.

**** Total Residual Chlorine or Total Residual Oxidants may not be discharged from any single generating unit for more than 2 hours per day. (1) Total Residual Oxidants reflects the use of bromine compounds. Bromine can be used separately or in combination with chlorine. These limits are effective when bromine is used. Discharge limitations for TRO may be met using a dehalogenation agent, if necessary. Dehalogenation shall then be achieved by using stoichiometric calculations to determine the amount of dehalogenating agent necessary to completely eliminate the residual.

***** Dissolved Oxygen: In addition to the monitoring requirements noted above, sampling shall be performed daily by grab sample during discharge of hydrazine.

****** Water Temperature: Report daily average.

******* Total Residual Chlorine & Total Residual Oxidants shall be monitored daily (during treatment event) except on days when plant is not normally staffed. Report "AN" on the monthly report form for those days.

(2) Report on days when bromine compounds are used with or without chlorine. On days when no bromine compounds are used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(3) Report on days when ONLY chlorine compounds are used (i.e. no bromine compounds. On days when bromine or a combination of bromine and chlorine IS used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(4) Monitor when discharging.

- See Part II for other requirements.

Part I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from outfall 2IB00011002. See Part II, OTHER REQUIREMENTS, for locations of effluent sampling.

Table - Final Outfall - 002 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00300 - Dissolved Oxygen - mg/l	-	6.0	-	-	-	-	-	When Disch.	Grab	All
00400 - pH - S.U.	9.0	6.5	-	-	-	-	-	1/Week	Grab	All
00530 - Total Suspended Solids - mg/l	100	-	-	30	-	-	-	1/Week	Grab	All
00550 - Oil and Grease, Total - mg/l	20	-	-	15	-	-	-	1/Week	Grab	All
50050 - Flow Rate - MGD	-	-	-	-	-	-	-	1/Day	24hr Total Estimate	All

Notes for Station Number 2IB00011002:

* Dissolved Oxygen: Sampling shall be performed daily by grab sample only during discharge of hydrazine.

Page 5
2IB00011*ID

Part I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from outfall 2IB00011003. See Part II, OTHER REQUIREMENTS, for locations of effluent sampling.

Table - Final Outfall - 003 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00530 - Total Suspended Solids - mg/l	-	-	-	-	-	-	-	When Disch.	Grab	All
50050 - Flow Rate - MGD	-	-	-	-	-	-	-	When Disch.	24hr Total Estimate	All

Notes for Station Number 2IB00011003:

*Monitoring required only when discharge occurs. Flow estimation is required for any day that a discharge occurs; monitoring for suspended solids is required once per month during discharge.

Page 6
2IB00011*ID

Part I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from outfall 2IB00011004. See Part II, OTHER REQUIREMENTS, for locations of effluent sampling.

Table - Final Outfall - 004 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00400 - pH - S.U.	9.0	6.5	-	-	-	-	-	When Disch.	Grab	All
00951 - Fluoride, Total (F) - mg/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
00978 - Arsenic, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
00980 - Iron, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
00999 - Boron, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
01009 - Barium, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
01079 - Silver, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
01104 - Aluminum, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
01119 - Copper, Total Recoverable - ug/l	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly
34044 - Oxidants, Total Residual - mg/l	0.05	-	-	-	-	-	-	When Disch.	Grab	All
50050 - Flow Rate - MGD	-	-	-	-	-	-	-	When Disch.	24hr Total Estimate	All
50060 - Chlorine, Total Residual - mg/l	0.2	-	-	-	-	-	-	When Disch.	Grab	All
78739 - Chlorination/Bromination Duration - Minutes	120	-	-	-	-	-	-	When Disch.	24hr Total	All
81855 - Asbestos - Fibers/L	-	-	-	-	-	-	-	When Disch.	Grab	Quarterly

Notes for station 2IB00011004:

Flow estimation is required for any day that a discharge occurs;

* The Total Residual Chlorine (TRC) and Total Residual Oxidants (TRO) limits are the maximum allowed at the outfall at any time. Analyses are to be performed by amperometric titration, Orion Residual Chlorine Electrode, or other approved methods during chlorination

and/or bromination. The daily grab samples for TRC and TRO shall represent the maximumm concentration discharged during chlorination and/or bromination.

** Measure TRO, TRC, and Cl/Br duration on days when using treatment.

*** Grab sample for TRO and TRC will be taken during treatment event.

**** Asbestos, See Part II, Other Requirements, Item O.

*****Total Residual Chlorine or Total Residual Oxidants may not be discharged from any single generating unit for more than 2 hours per day.

(1) Total Residual Oxidants reflects the use of bromine compounds. Bromine can be used separately or in combination with chlorine. These limits are effective when bromine is used. Discharge limitations for TRO may be met using a dehalogenation agent, if necessary. Dehalogenation shall then be achieved by using stoichiometric calculations to determine the amount of dehalogenating agent necessary to completely eliminate the residual.

(2) Report on days when bromine compounds are used with or without chlorine. On days when no bromine compounds are used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(3) Report on days when ONLY chlorine compounds are used (i.e. no bromine compounds. On days when bromine or a combination of bromine and chlorine IS used, state this in the remarks section and LEAVE THE DATA AREA BLANK.

(4) Daily monitoring is required for the parameters during discharge from the circulating water system (i.e., Cooling Tower Basin Drain).

Part I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from outfall 2IB00011601. See Part II, OTHER REQUIREMENTS, for locations of effluent sampling.

Table - Internal Monitoring Station - 601 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00083 - Color, Severity - Units	-	-	-	-	-	-	-	1/Day	Estimate	All
00310 - Biochemical Oxygen Demand, 5 Day - mg/l	45	-	-	30	-	-	-	1/2 Weeks	Grab	All
00530 - Total Suspended Solids - mg/l	45	-	-	30	-	-	-	1/2 Weeks	Grab	All
01330 - Odor, Severity - Units	-	-	-	-	-	-	-	1/Day	Estimate	All
01350 - Turbidity, Severity - Units	-	-	-	-	-	-	-	1/Day	Estimate	All
50050 - Flow Rate - MGD	-	-	-	-	-	-	-	1/Day	24hr Total Estimate	All

Notes for station 2IB00011601:

*Color, Odor, Turbidity: See Part II, Item G.
**See Part II, Other Requirements, Item B for location of sampling station.

Part I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from outfall 2IB00011602. See Part II, OTHER REQUIREMENTS, for locations of effluent sampling.

Table - Internal Monitoring Station - 602 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00530 - Total Suspended Solids - mg/l	100	-	-	30	-	-	-	1 / 2 Weeks	Grab	All
00550 - Oil and Grease, Total - mg/l	20	-	-	15	-	-	-	1 / 2 Weeks	Grab	All
50050 - Flow Rate - MGD	-	-	-	-	-	-	-	1/Day	24hr Total Estimate	All

Notes for station 2IB00011602:

*See Part II, Other Requirements, Item B for location of sampling station.

Part I, B. - SLUDGE MONITORING REQUIREMENTS

1. Sludge Monitoring. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee shall monitor the treatment works' final sludge at Station Number 2IB00011588, and report to the Ohio EPA in accordance with the following table. See Part II, OTHER REQUIREMENTS, for location of sludge sampling.

Table - Sludge Monitoring - 588 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
80991 - Sludge Volume, Gallons - Gals	-	-	-	-	-	-	-	1/Year	Total	December

NOTES for Station Number 2IB00011588:

* Monitoring is required when sewage sludge is removed from the permittee's facility for transfer to a publicly owned treatment works. Monthly Operating Report (MOR) data shall be submitted in December. The total for the entire calendar year shall be reported in the data area for the first day of December. If no sewage sludge is removed from the permittee's facility during the calendar year, report "AL" in the first column of the first day in December on the 4500 Form. A signature is still required.

- See Part II, Items J. and N.

Part I, B. - INTAKE MONITORING REQUIREMENTS

1. Intake Monitoring. During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee shall monitor the Intake at Station Number 2IB00011801, and report to the Ohio EPA in accordance with the following table. See Part II, OTHER REQUIREMENTS, for location of sampling.

Table - Intake Monitoring - 801 - Final

Effluent Characteristic	Discharge Limitations							Monitoring Requirements		
	Concentration Specified Units				Loading* kg/day					
Parameter	Maximum	Minimum	Weekly	Monthly	Daily	Weekly	Monthly	Measuring Frequency	Sampling Type	Monitoring Months
00011 - Water Temperature - F	-	-	-	-	-	-	-	1/Day	Continuous	All

Part II, OTHER REQUIREMENTS

A. The wastewater treatment works must be under supervision of a Class I State certified operator as required by rule 3745-7- 02 of the Ohio Administrative Code.

B. Description of the location of the required sampling stations are as follows:

Sampling Station	Description of Location
2IB00011001	Pump station sampling port prior to discharging to Lake Erie (Lat: N 41 36' 05"; Long: W 83 04' 10")
2IB00011002	Outfall from Training Center Pond to Navarre Marsh Pool No. 3 (Lat: N 41 35' 35"; Long: W 83 05' 20")
2IB00011003	Outfall from screen wash catch basin prior to Navarre Marsh Pool No. 2 (Lat: N 41 35' 45"; Long: W 83 05' 00")
2IB00011004	Outfall to ditch @ State Route 2 (Lat: N 41 36' 02"; Long: W 83 05' 40")
2IB00011588	Sludge removed from the wastewater treatment facility and disposed of at another municipal wastewater treatment plant
2IB00011601	Sanitary sewage treatment plant effluent prior to mixing with other wastewaters. (Lat: N 41 35' 58"; Long: W 83 05' 03")
2IB00011602	Low volume wastewater settling basin overflow. (Lat: N 41 35' 59"; Long: W 83 05' 05")
2IB00011801	Intake water prior to cooling operation

C. This permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved.

1. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
2. Controls any pollutant not limited in the permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

D. All parameters, except flow, need not be monitored on days when the plant is not normally staffed (Saturdays, Sundays, and Holidays). On those days, report "AN" on the monthly report form.

E. In the event that the permittee's operation requires the use of cooling or boiler water treatment additives that are discharged to surface waters of the state, written permission must be obtained from the director of the Ohio EPA prior to use. Reporting and testing requirements to apply for permission to use additives can be obtained from the Ohio EPA, Central Office, Division of Surface Water, Water Resources Management Section. Reported information will be used to evaluate whether the use of the additive(s) at concentrations expected in the final discharge will be harmful or inimical to aquatic life.

F. Permit limitations may be revised in order to meet water quality standards after a stream use determination and waste load allocation are completed and approved. This permit may be modified, or alternatively, revoked and reissued, to comply with any applicable water quality effluent limitations.

G. If Severity Units are required for Turbidity, Odor, or Color, use the following table to determine the value between 0 and 4 that is reported.

REPORTED VALUE*	SEVERITY DESCRIPTION	TURBIDITY	ODOR	COLOR
0	None	Clear	None	Colorless
1	Mild			
2	Moderate	Light Solids	Musty	Grey
3	Serious			
4	Extreme	Heavy Solids	Septic	Black

* Interpolate between the descriptive phrases.

H. Composite samples shall be comprised of a series of grab samples collected over a 24-hour period and proportionate in volume to the wastewater flow rate at the time of sampling. Such samples shall be collected at such times and locations, and in such a fashion, as to be representative of the facility's overall performance.

I. Grab samples shall be collected at such times and locations, and in such fashion, as to be representative of the facility's performance.

J. Not later than January 31 of each calendar year, the permittee shall submit two (2) copies of a report summarizing the sludge disposal and/or reuse activities of the facility during the previous year. One copy of the report shall be sent to the Ohio EPA, Division of Surface Water, Central Office, and one copy of the report shall be sent to the appropriate Ohio EPA District Office. This report shall address:

1) Amount of sludge disposed of/reused in gallons.

2) Method(s) of disposal/reuse.

3) Summary of all analyses made on the sludge, including any priority pollutant scans that may have been performed. (If a priority pollutant scan has been conducted as a part of the pretreatment program, the most recent analysis should be submitted.)

4) Problems encountered including any complaints received. The cause or reason for the problem and corrective actions taken to solve the problem should also be included. Any incidents of interference with the method of sludge disposal shall be identified, along with the cause of interference (i.e., excessive metals concentration, contaminated sludge, etc.) and the corrective actions taken.

K. There shall be no discharge of polychlorinated biphenyl compounds.

L. Right of Entry

The permittee shall allow authorized representatives of Ohio EPA and U.S. EPA upon the presentation of credentials subject to applicable requirements under the Atomic Energy Act of 1954, as amended, and any regulations, order, license or technical specification or other requirement established or required by the Nuclear Regulatory Commission thereunder;

A. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

B. At reasonable times to have access to copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample for any pollutants. And

C. To enter upon the permittee's premisis at any reasonable time to inspect any collection, treatment , pollution management, or discharge facilities required under this permit.

M. The permittee shall take every possible measure to reduce discharge of hydrazine (used as an additive) through outfalls 2IB00011602 and 2IB00011002. In order to protect aquatic life from toxicity, hydrazine must not be discharged above 8.7 ug/l (within a discharge period of 48 hours) and above 0.39 ug/l (for a period beyond 48 hours). During discharge of hydrazine from outfalls, one detailed sample result per month from each outfall must be sent to Ohio EPA Northwest District Office (Attention: Group Leader, NPDES Permit Section). If only one outfall discharges hydrazine, sampling must be done for that outfall.

N. All disposal, use, storage, or treatment of sewage sludge by the permittee shall comply with Chapter 6111. of the Ohio Revised Code, Chapter 3745-40 of the Ohio Administrative Code, any further requirements specified in this NPDES permit, and any other actions of the Director that pertain to the disposal, use, storage, or treatment of sewage sludge by the permittee.

O. The permittee shall use analytical Method 2570B in Standard Methods, 19th Edition to satisfy asbestos monitoring requirement at outfall 2IB00011004. Results of analysis shall be reported in # of asbestos fibers/ liter.

PART III - GENERAL CONDITIONS

1. DEFINITIONS

"Daily discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

"Average weekly" discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. Each of the following 7-day periods is defined as a calendar week: Week 1 is Days 1 - 7 of the month; Week 2 is Days 8 - 14; Week 3 is Days 15 - 21; and Week 4 is Days 22 - 28. If the "daily discharge" on days 29, 30 or 31 exceeds the "average weekly" discharge limitation, Ohio EPA may elect to evaluate the last 7 days of the month as Week 4 instead of Days 22 - 28. Compliance with fecal coliform bacteria or E coli bacteria limitations shall be determined using the geometric mean.

"Average monthly" discharge limitation means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month. Compliance with fecal coliform bacteria or E coli bacteria limitations shall be determined using the geometric mean.

"85 percent removal" means the arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period.

"Absolute Limitations" Compliance with limitations having descriptions of "shall not be less than," "nor greater than," "shall not exceed," "minimum," or "maximum" shall be determined from any single value for effluent samples and/or measurements collected.

"Net concentration" shall mean the difference between the concentration of a given substance in a sample taken of the discharge and the concentration of the same substances in a sample taken at the intake which supplies water to the given process. For the purpose of this definition, samples that are taken to determine the net concentration shall always be 24-hour composite samples made up of at least six increments taken at regular intervals throughout the plant day.

"Net Load" shall mean the difference between the load of a given substance as calculated from a sample taken of the discharge and the load of the same substance in a sample taken at the intake which supplies water to given process. For purposes of this definition, samples that are taken to determine the net loading shall always be 24-hour composite samples made up of at least six increments taken at regular intervals throughout the plant day.

"MGD" means million gallons per day.

"mg/l" means milligrams per liter.

"ug/l" means micrograms per liter.

"ng/l" means nanograms per liter.

"S.U." means standard pH unit.

"kg/day" means kilograms per day.

"Reporting Code" is a five digit number used by the Ohio EPA in processing reported data. The reporting code does not imply the type of analysis used nor the sampling techniques employed.

"Quarterly (1/Quarter) sampling frequency" means the sampling shall be done in the months of March, June, August, and December, unless specificially identified otherwise in the Effluent Limitations and Monitoring Requirements table.

"Yearly (1/Year) sampling frequency" means the sampling shall be done in the month of September, unless specificially identified otherwise in the effluent limitations and monitoring requirements table.

"Semi-annual (2/Year) sampling frequency" means the sampling shall be done during the months of June and December, unless specificially identified otherwise.

"Winter" shall be considered to be the period from November 1 through April 30.

"Bypass" means the intentional diversion of waste streams from any portion of the treatment facility.

"Summer" shall be considered to be the period from May 1 through October 31.

"Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

"Sewage sludge" means a solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works as defined in section 6111.01 of the Revised Code. "Sewage sludge" includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes. "Sewage sludge" does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator, grit and screenings generated during preliminary treatment of domestic sewage in a treatment works, animal manure, residue generated during treatment of animal manure, or domestic septage.

"Sewage sludge weight" means the weight of sewage sludge, in dry U.S. tons, including admixtures such as liming materials or bulking agents. Monitoring frequencies for sewage sludge parameters are based on the reported sludge weight generated in a calendar year (use the most recent calendar year data when the NPDES permit is up for renewal).

"Sewage sludge fee weight" means the weight of sewage sludge, in dry U.S. tons, excluding admixtures such as liming materials or bulking agents. Annual sewage sludge fees, as per section 3745.11(Y) of the Ohio Revised Code, are based on the reported sludge fee weight for the most recent calendar year.

2. GENERAL EFFLUENT LIMITATIONS

The effluent shall, at all times, be free of substances:

A. In amounts that will settle to form putrescent, or otherwise objectionable, sludge deposits; or that will adversely affect aquatic life or water fowl;

B. Of an oily, greasy, or surface-active nature, and of other floating debris, in amounts that will form noticeable accumulations of scum, foam or sheen;

C. In amounts that will alter the natural color or odor of the receiving water to such degree as to create a nuisance;

D. In amounts that either singly or in combination with other substances are toxic to human, animal, or aquatic life;

E. In amounts that are conducive to the growth of aquatic weeds or algae to the extent that such growths become inimical to more desirable forms of aquatic life, or create conditions that are unsightly, or constitute a nuisance in any other fashion;

F. In amounts that will impair designated instream or downstream water uses.

3. FACILITY OPERATION AND QUALITY CONTROL

All wastewater treatment works shall be operated in a manner consistent with the following:

A. At all times, the permittee shall maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee necessary to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with conditions of the permit.

B. The permittee shall effectively monitor the operation and efficiency of treatment and control facilities and the quantity and quality of the treated discharge.

C. Maintenance of wastewater treatment works that results in degradation of effluent quality shall be scheduled during non-critical water quality periods and shall be carried out in a manner approved by Ohio EPA as specified in the Paragraph in the PART III entitled, "UNAUTHORIZED DISCHARGES".

4. REPORTING

A. Monitoring data required by this permit may be submitted in hardcopy format on the Ohio EPA 4500 report form pre-printed by Ohio EPA or an approved facsimile. Ohio EPA 4500 report forms for each individual sampling station are to be received no later than the 15th day of the month following the month-of-interest. The original report form must be signed and mailed to:

Ohio Environmental Protection Agency
Lazarus Government Center
Division of Surface Water
Enforcement Section ES/MOR
P.O. Box 1049
Columbus, Ohio 43216-1049

Monitoring data may also be submitted electronically using Ohio EPA developed SWIMware software. Data must be transmitted to Ohio EPA via electronic mail or the bulletin board system by the 20th day of the month following the month-of-interest. A Surface Water Information Management System (SWIMS) Memorandum of Agreement (MOA) must be signed by the responsible official and submitted to Ohio EPA to receive an authorized Personal Identification Number (PIN) prior to sending data electronically. A hardcopy of the Ohio EPA 4500 form must be generated via SWIMware, signed and maintained onsite for records retention purposes.

B. If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified below, the results of such monitoring shall be included in the calculation and reporting of the values required in the reports specified above.

C. Analyses of pollutants not required by this permit, except as noted in the preceding paragraph, shall not be reported on Ohio EPA report form (4500) but records shall be retained as specified in the paragraph entitled "RECORDS RETENTION".

5. SAMPLING AND ANALYTICAL METHOD

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored flow. Test procedures for the analysis of pollutants shall conform to regulation 40 CFR 136, "Test Procedures For The Analysis of Pollutants" unless other test procedures have been specified in this permit. The permittee shall periodically calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to insure accuracy of measurements.

6. RECORDING OF RESULTS

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

A. The exact place and date of sampling; (time of sampling not required on EPA 4500)

B. The person(s) who performed the sampling or measurements;

C. The date the analyses were performed on those samples;

D. The person(s) who performed the analyses;

E. The analytical techniques or methods used; and

F. The results of all analyses and measurements.

7. RECORDS RETENTION

The permittee shall retain all of the following records for the wastewater treatment works for a minimum of three years except those records that pertain to sewage sludge disposal, use, storage, or treatment, which shall be kept for a minimum of five years, including:

A. All sampling and analytical records (including internal sampling data not reported);

B. All original recordings for any continuous monitoring instrumentation;

C. All instrumentation, calibration and maintenance records;

D. All plant operation and maintenance records;

E. All reports required by this permit; and

F. Records of all data used to complete the application for this permit for a period of at least three years, or five years for sewage sludge, from the date of the sample, measurement, report, or application.

These periods will be extended during the course of any unresolved litigation, or when requested by the Regional Administrator or the Ohio EPA. The three year period, or five year period for sewage sludge, for retention of records shall start from the date of sample, measurement, report, or application.

8. AVAILABILITY OF REPORTS

Except for data determined by the Ohio EPA to be entitled to confidential status, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the appropriate district offices of the Ohio EPA. Both the Clean Water Act and Section 6111.05 Ohio Revised Code state that effluent data and receiving water quality data shall not be considered confidential.

9. DUTY TO PROVIDE INFORMATION

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking, and reissuing, or terminating the permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

10. RIGHT OF ENTRY

The permittee shall allow the Director or an authorized representative upon presentation of credentials and other documents as may be required by law to:

A. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

B. Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit.

C. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit.

D. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

11. UNAUTHORIZED DISCHARGES

A. Bypassing or diverting of wastewater from the treatment works is prohibited unless:

1. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of downtime. This condition is not satisfied if adequate back up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

3. The permittee submitted notices as required under paragraph D. of this section,

B. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

C. The Director may approve an unanticipated bypass after considering its adverse effects, if the Director determines that it has met the three conditions listed in paragraph 11.A. of this section.

D. The permittee shall submit notice of an unanticipated bypass as required in section 12. A.

E. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded if that bypass is for essential maintenance to assure efficient operation.

12. NONCOMPLIANCE NOTIFICATION

A. The permittee shall by telephone report any of the following within twenty-four (24) hours of discovery at (toll free) 1-800-282-9378:

1. Any noncompliance which may endanger health or the environment;

2. Any unanticipated bypass which exceeds any effluent limitation in the permit; or

3. Any upset which exceeds any effluent limitation in the permit.

4. Any violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in the permit.

B. For the telephone reports required by Part 12.A., the following information must be included:

1. The times at which the discharge occurred, and was discovered;

2. The approximate amount and the characteristics of the discharge;

3. The stream(s) affected by the discharge;

4. The circumstances which created the discharge;

5. The names and telephone numbers of the persons who have knowledge of these circumstances;

6. What remedial steps are being taken; and

7. The names and telephone numbers of the persons responsible for such remedial steps.

C. These telephone reports shall be confirmed in writing within five days of the discovery of the discharge and/or noncompliance and submitted to the appropriate Ohio EPA district office. The report shall include the following:

1. The limitation(s) which has been exceeded;

2. The extent of the exceedance(s);

3. The cause of the exceedance(s);

4. The period of the exceedance(s) including exact dates and times;

5. If uncorrected, the anticipated time the exceedance(s) is expected to continue, and

6. Steps being taken to reduce, eliminate, and/or prevent occurrence of the exceedance(s).

D. Compliance Schedule Events:

If the permittee is unable to meet any date for achieving an event, as specified in the schedule of compliance, the permittee shall submit a written report to the appropriate district office of the Ohio EPA within 14 days of becoming aware of such situation. The report shall include the following:

1. The compliance event which has been or will be violated;

2. The cause of the violation;

3. The remedial action being taken;

4. The probable date by which compliance will occur; and

5. The probability of complying with subsequent and final events as scheduled.

E. The permittee shall report all instances of noncompliance not reported under paragraphs A, B, or C of this section, at the time monitoring reports are submitted. The reports shall contain the information listed in paragraphs B and C of this section.

F. Where the permittee becomes aware that it failed to submit any relevant application or submitted incorrect information in a permit application or in any report to the director, it shall promptly submit such facts or information.

13. RESERVED

14. DUTY TO MITIGATE

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

15. AUTHORIZED DISCHARGES

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than, or at a level in excess of, that authorized by this permit shall constitute a violation of the terms and conditions of this permit. Such violations may result in the imposition of civil and/or criminal penalties as provided for in Section 309 of the Act and Ohio Revised Code Sections 6111.09 and 6111.99.

16. DISCHARGE CHANGES

The following changes must be reported to the appropriate Ohio EPA district office as soon as practicable:

A. For all treatment works, any significant change in character of the discharge which the permittee knows or has reason to believe has occurred or will occur which would constitute cause for modification or revocation and reissuance. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements. Notification of permit changes or anticipated noncompliance does not stay any permit condition.

B. For publicly owned treatment works:

1. Any proposed plant modification, addition, and/or expansion that will change the capacity or efficiency of the plant;

2. The addition of any new significant industrial discharge; and

3. Changes in the quantity or quality of the wastes from existing tributary industrial discharges which will result in significant new or increased discharges of pollutants.

C. For non-publicly owned treatment works, any proposed facility expansions, production increases, or process modifications, which will result in new, different, or increased discharges of pollutants.

Following this notice, modifications to the permit may be made to reflect any necessary changes in permit conditions, including any necessary effluent limitations for any pollutants not identified and limited herein. A determination will also be made as to whether a National Environmental Policy Act (NEPA) review will be required. Sections 6111.44 and 6111.45, Ohio Revised Code, require that plans for treatment works or improvements to such works be approved by the Director of the Ohio EPA prior to initiation of construction.

D. In addition to the reporting requirements under 40 CFR 122.41(l) and per 40 CFR 122.42(a), all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Director as soon as they know or have reason to believe:

1. That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis of any toxic pollutant which is not limited in the permit. If that discharge will exceed the highest of the "notification levels" specified in 40 CFR Sections 122.42(a)(1)(i) through 122.42(a)(1)(iv).

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" specified in 122.42(a)(2)(i) through 122.42(a)(2)(iv).

17. TOXIC POLLUTANTS

The permittee shall comply with effluent standards or prohibitions established under Section 307 (a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement. Following establishment of such standards or prohibitions, the Director shall modify this permit and so notify the permittee.

18. PERMIT MODIFICATION OR REVOCATION

A. After notice and opportunity for a hearing, this permit may be modified or revoked, by the Ohio EPA, in whole or in part during its term for cause including, but not limited to, the following:

1. Violation of any terms or conditions of this permit;

2. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

3. Change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

B. Pursuant to rule 3745-33-04, Ohio Administrative Code, the permittee may at any time apply to the Ohio EPA for modification of any part of this permit. The filing of a request by the permittee for a permit modification or revocation does not stay any permit condition. The application for modification should be received by the appropriate Ohio EPA district office at least ninety days before the date on which it is desired that the modification become effective. The application shall be made only on forms approved by the Ohio EPA.

19. TRANSFER OF OWNERSHIP OR CONTROL

This permit may be transferred or assigned and a new owner or successor can be authorized to discharge from this facility, provided the following requirements are met:

A. The permittee shall notify the succeeding owner or successor of the existence of this permit by a letter, a copy of which shall be forwarded to the appropriate Ohio EPA district office. The copy of that letter will serve as the permittee's notice to the Director of the proposed transfer. The copy of that letter shall be received by the appropriate Ohio EPA district office sixty (60) days prior to the proposed date of transfer;

B. A written agreement containing a specific date for transfer of permit responsibility and coverage between the current and new permittee (including acknowledgement that the existing permittee is liable for violations up to that date, and that the new permittee is liable for violations from that date on) shall be submitted to the appropriate Ohio EPA district office within sixty days after receipt by the district office of the copy of the letter from the permittee to the succeeding owner;

At anytime during the sixty (60) day period between notification of the proposed transfer and the effective date of the transfer, the Director may prevent the transfer if he concludes that such transfer will jeopardize compliance with the terms and conditions of the permit. If the Director does not prevent transfer, he will modify the permit to reflect the new owner.

20. OIL AND HAZARDOUS SUBSTANCE LIABILITY

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

21. SOLIDS DISPOSAL

Collected grit and screenings, and other solids other than sewage sludge, shall be disposed of in such a manner as to prevent entry of those wastes into waters of the state, and in accordance with all applicable laws and rules.

22. CONSTRUCTION AFFECTING NAVIGABLE WATERS

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any navigable waters.

23. CIVIL AND CRIMINAL LIABILITY

Except as exempted in the permit conditions on UNAUTHORIZED DISCHARGES or UPSETS, nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

24. STATE LAWS AND REGULATIONS

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Clean Water Act.

25. PROPERTY RIGHTS

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

26. UPSET

The provisions of 40 CFR Section 122.41(n), relating to "Upset," are specifically incorporated herein by reference in their entirety. For definition of "upset," see Part III, Paragraph 1, DEFINITIONS.

27. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

28. SIGNATORY REQUIREMENTS

All applications submitted to the Director shall be signed and certified in accordance with the requirements of 40 CFR 122.22.

All reports submitted to the Director shall be signed and certified in accordance with the requirements of 40 CFR Section 122.22.

29. OTHER INFORMATION

A. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information.

B. ORC 6111.99 provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000 per violation.

C. ORC 6111.99 states that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $25,000 per violation.

D. ORC 6111.99 provides that any person who violates Sections 6111.04, 6111.042, 6111.05, or division (A) of Section 6111.07 of the Revised Code shall be fined not more than $25,000 or imprisoned not more than one year, or both.

30. NEED TO HALT OR REDUCE ACTIVITY

40 CFR 122.41(c) states that it shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with conditions of this permit.

31. APPLICABLE FEDERAL RULES

All references to 40 CFR in this permit mean the version of 40 CFR which is effective as of the effective date of this permit.

32. AVAILABILITY OF PUBLIC SEWERS

Not withstanding the issuance or non-issuance of an NPDES permit to a semi-public disposal system, whenever the sewage system of a publicly owned treatment works becomes available and accessible, the permittee operating any semi-public disposal system shall abandon the semi-public disposal system and connect it into the publicly owned treatment works.

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Attachment C:

Agency Consultation Correspondence

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ATTACHMENT C

Table of Contents

FENOC
FirstEnergy Nuclear Operating Company

5501 North State Route 2
Oak Harbor, Ohio 43449

Barry S. Allen
Vice President - Nuclear

419-321-7676
Fax: 419-321-7582

November 12, 2009
L-09-295

Ms. Mary Knapp
Field Supervisor
U.S. Fish and Wildlife Service
Ohio Ecological Services Field Office
4625 Morse Rd., Suite 104
Columbus, OH 43230

SUBJECT:
Request for Information on Threatened or Endangered Species

FirstEnergy Nuclear Operating Company (FENOC) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for the Davis-Besse Nuclear Power Station (Davis-Besse). If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017.

As part of the license renewal process, the NRC requires (10 CFR 51.53(c)(3)(ii)(E)) license renewal applicants to assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act. The NRC also will request, under Section 7 of the Endangered Species Act (16 USC 1531), an informal consultation with your office at a later date. By contacting you early in the application process, FENOC wishes to identify any potential issues that need to be addressed or information that your office may require to expedite the NRC consultation.

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio (Attachment 1). Coordinates for the station are 41° 35' 49" north Latitude and 83° 05' 16" west Longitude. The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge (Attachment 2). Approximately 100 miles of transmission lines were constructed to connect the station to the regional electric grid.

FENOC has no plans to alter current Davis-Besse operations over the 20-year license renewal period. In addition, maintenance activities necessary to support license renewal would be limited to previously disturbed areas on site. License renewal at Davis-Besse would require neither the expansion of existing facilities nor additional land disturbance. As a result, FENOC is confident that continued operation of Davis-Besse during the license renewal period would have minimal environmental impacts.

Davis-Besse Nuclear Power Station
L-09-295
Page 2

To ensure that impacts are adequately addressed, FENOC requests information from your office regarding concerns you may have, if any, related to potential environmental impacts from continued operation of Davis-Besse, including the associated transmission lines and corridors. FENOC would appreciate receiving a letter in reply detailing any concerns you may have or confirmation that no concerns exist. Receipt of your reply by December 31, 2009, will provide us the time needed to evaluate and incorporate the information into our application.

Thank you for your attention to our request.

Please feel free to contact Mr. Clifford Custer, Davis-Besse License Renewal Project Manager, at 724-682-7139. Please address any questions or need for additional information about the environmental review to:

Mr. Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

Telephone: 724-682-7139
Email: custerc@firstenergycorp.com

Sincerely,

Barry S. Allen

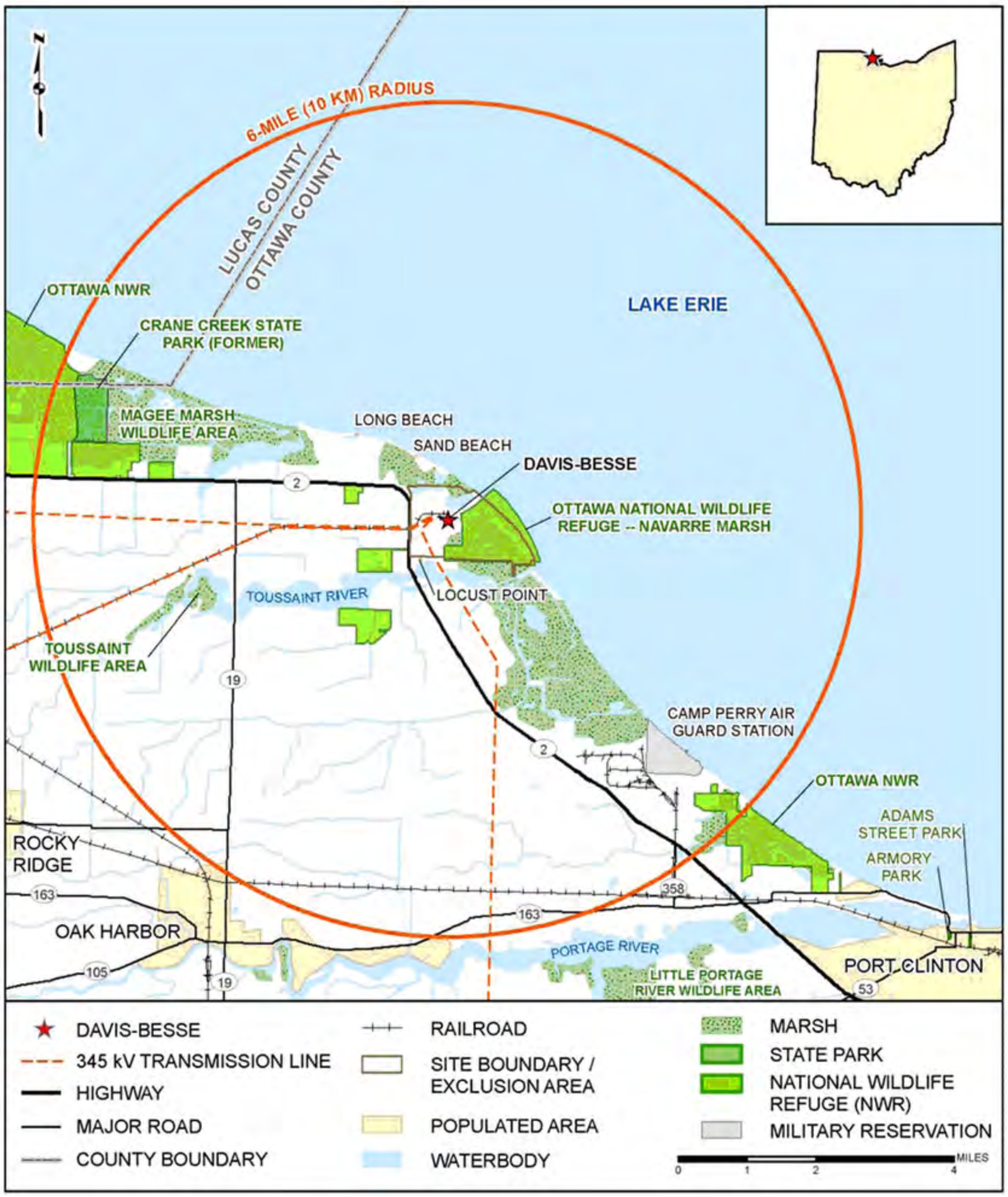
Barry S. Allen

Attachments:
1. Davis-Besse Nuclear Power Station Area Map, 6-Mile Radius
2. Davis-Besse Nuclear Power Station Site Map

cc: DB-1 NRC Senior Resident Inspector

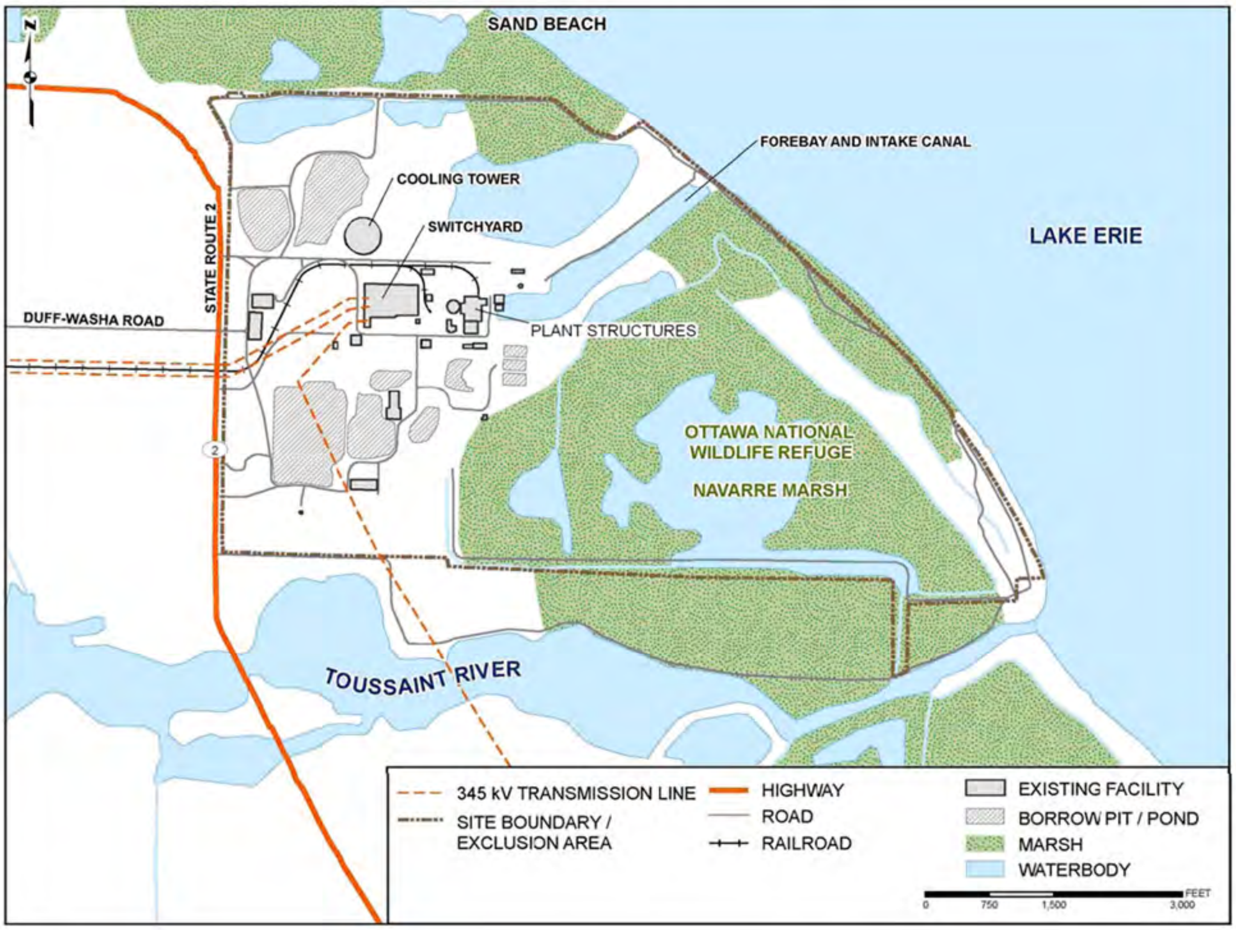
Attachment 1
L-09-295

Davis-Besse Nuclear Power Station
Area Map, 6-Mile Radius
Page 1 of 1



Attachment 2
L-09-295

Davis-Besse Nuclear Power Station Site Map
Page 1 of 1



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

BAIC-09-0037

RECEIVED
DEC 22 2009
DBNPS

December 16, 2009

TAILS # 31420-2010-TA-0132

Mr. Barry Allen
First Energy Nuclear Operating Company
5501 North State Route 2
Oak Harbor, OH 43449

Dear Mr. Allen:

This is in response to your November 12, 2009 letter requesting our review and comment on the proposed project. The project involves the renewal of the operating license for the Davis-Besse Nuclear Power Station, Ottawa County, Ohio for a 20 year term beginning in 2017 and ending in 2037. The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. government as part of Ottawa National Wildlife Refuge (Refuge). There are no current plans to alter the current operations of the facility or to disturb any land outside of previously disturbed areas. As part of the Nuclear Regulatory Commission renewal process, you have requested the U.S. Fish and Wildlife Service's assistance in assessing the impact of the license renewal on threatened and endangered species.

In general, we agree that the proposed renewal of the operating license will not impact federally listed species and will have minimal environmental impacts, as no change in operation or extent of the facility is proposed. Should you subsequently propose any activities that would result in ground disturbance, tree clearing, or habitat modification, further coordination with this office and the Refuges is requested.

ENDANGERED SPECIES COMMENTS: The project lies within the range of the Indiana bat, piping plover, Lake Erie Watersnake, Lakeside daisy, eastern prairie fringed orchid, and eastern massasauga, federally listed endangered, threatened and candidate species. Due to the project type, location, and onsite habitat, none of these species would be expected within the project area, and no impacts to these species are expected. This precludes the need for further action on this project as required by the 1973 Endangered Species Act, as amended.

MIGRATORY BIRD COMMENTS: The project area lies within the range of the bald eagle (**Haliaeetus leucocephalus**). The bald eagle was removed from the Federal list of endangered and threatened species in July 2007 due to recovery. This species continues to be afforded protection by the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. A bald eagle nest exists on the Davis-Besse property. In order to avoid disturbing nesting and young eagles, we request that no activity occur within 660 feet of the nest between January 1 and July 31, when the nesting eagles are most vulnerable. If this recommendation cannot be implemented, further coordination with this office will be necessary.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Endangered Species Act of 1973 (ESA), as amended, and are consistent with the intent of the National Environmental Policy Act of 1969 and the U. S. Fish and Wildlife

Service's Mitigation Policy. Please note that consultation under section 7 of the ESA may be warranted for this project since suitable habitat for the Indiana bat may be impacted by this project. This letter provides technical assistance only and does not serve as a completed section 7 consultation document.

Thank you for the opportunity to provide comments on this project. If you have any questions, or if we may of additional assistance, please contact Biologist Megan Seymour at extension 16 in this office.

Sincerely,

Angela L. Boyer

for Mary M. Knapp, Ph.D.
Supervisor

cc: ODNR Division of Wildlife SCEA Unit, Columbus, OH

FENOC
FirstEnergy Nuclear Operating Company

5501 North State Route 2
Oak Harbor, Ohio 43449

Barry S. Allen
Vice President - Nuclear

419-321-7676
Fax: 419-321-7582

November 12, 2009
L-09-296

Ms. Patricia Kurkul
Regional Administrator
NOAA Fisheries Service
Northeast Regional Office
55 Great Republic Drive
Gloucester, MA 01930-2276

SUBJECT:
Request for Information on Threatened or Endangered Species

FirstEnergy Nuclear Operating Company (FENOC) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for the Davis-Besse Nuclear Power Station (Davis-Besse). If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017.

As part of the license renewal process, the NRC requires (10 CFR 51.53(c)(3)(ii)(E)) license renewal applicants to assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act. The NRC also will request, under Section 7 of the Endangered Species Act (16 USC 1531), an informal consultation with your office at a later date. By contacting you early in the application process, FENOC wishes to identify any potential issues that need to be addressed or information that your office may require to expedite the NRC consultation.

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio (Attachment 1). Coordinates for the station are 41° 35' 49" north Latitude and 83° 05' 16" west Longitude. The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge (Attachment 2).

FENOC has no plans to alter current Davis-Besse operations over the 20-year license renewal period. In addition, maintenance activities necessary to support license renewal would be limited to previously disturbed areas on site. License renewal at Davis-Besse would require neither the expansion of existing facilities nor additional land disturbance. As a result, FENOC is confident that extending Davis-Besse operation will continue to have minimal environmental impacts.

Davis-Besse Nuclear Power Station
L-09-296
Page 2

To ensure that impacts are adequately addressed, FENOC requests information from your office regarding concerns you may have, if any, related to potential environmental impacts from continued operation of Davis-Besse. FENOC would appreciate receiving a letter in reply detailing any concerns you may have or confirmation that no concerns exist. Receipt of your reply by December 31, 2009, will provide us the time needed to evaluate and incorporate the information into our application.

Thank you for your attention to our request.

Please feel free to contact Mr. Clifford Custer, Davis-Besse License Renewal Project Manager, at 724-682-7139. Please address any questions or need for additional information about the environmental review to:

Mr. Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

Telephone: 724-682-7139
Email: custerc@firstenergycorp.com

Sincerely,

Barry S. Allen

Barry S. Allen

Attachments:
1. Davis-Besse Nuclear Power Station Area Map, 6-Mile Radius
2. Davis-Besse Nuclear Power Station Site Map

cc: DB-1 NRC Senior Resident Inspector

Attachment 1
L-09-296

Davis-Besse Nuclear Power Station
Area Map, 6-Mile Radius
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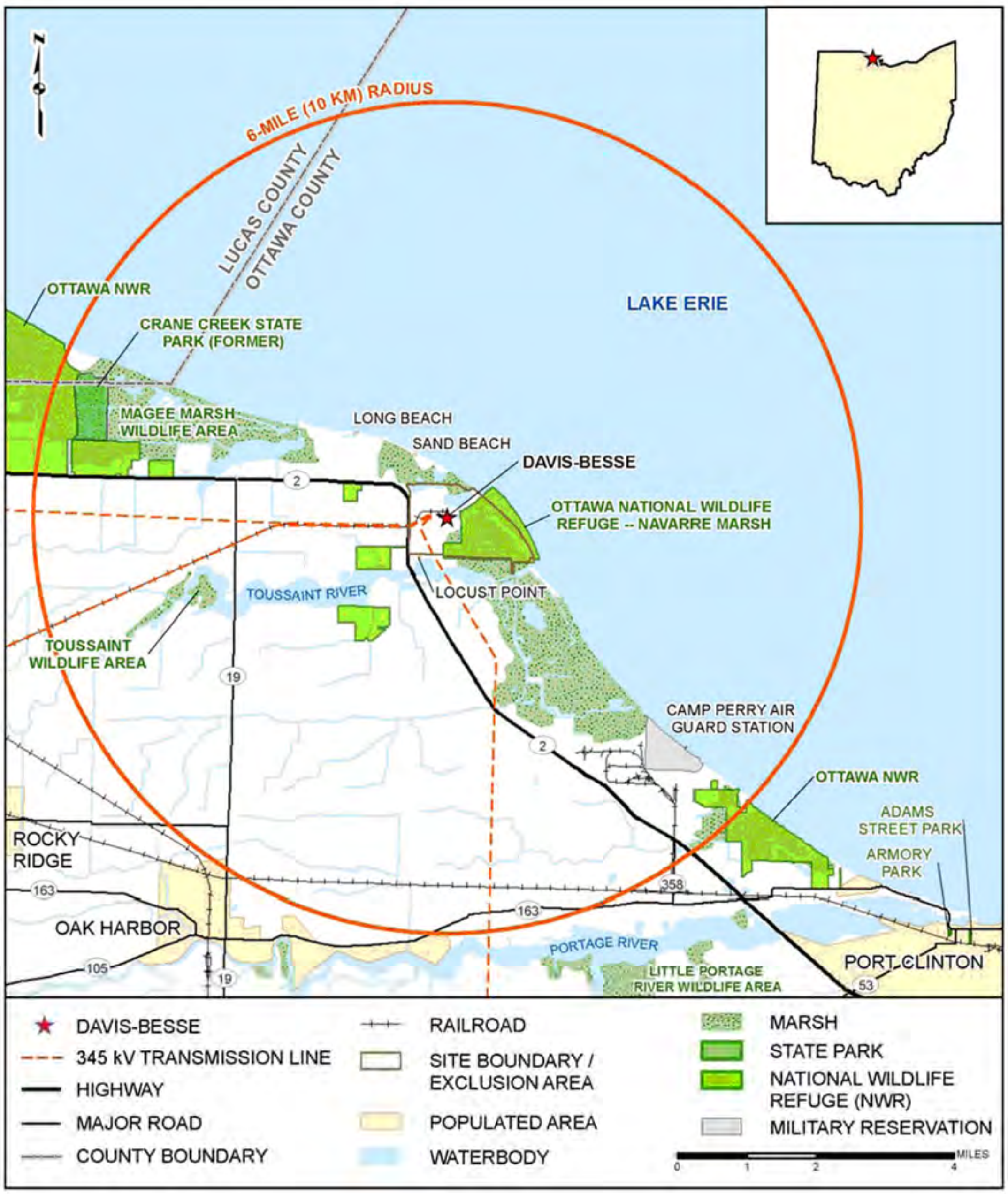

Attachment 2
L-09-296

Davis-Besse Nuclear Power Station Site Map
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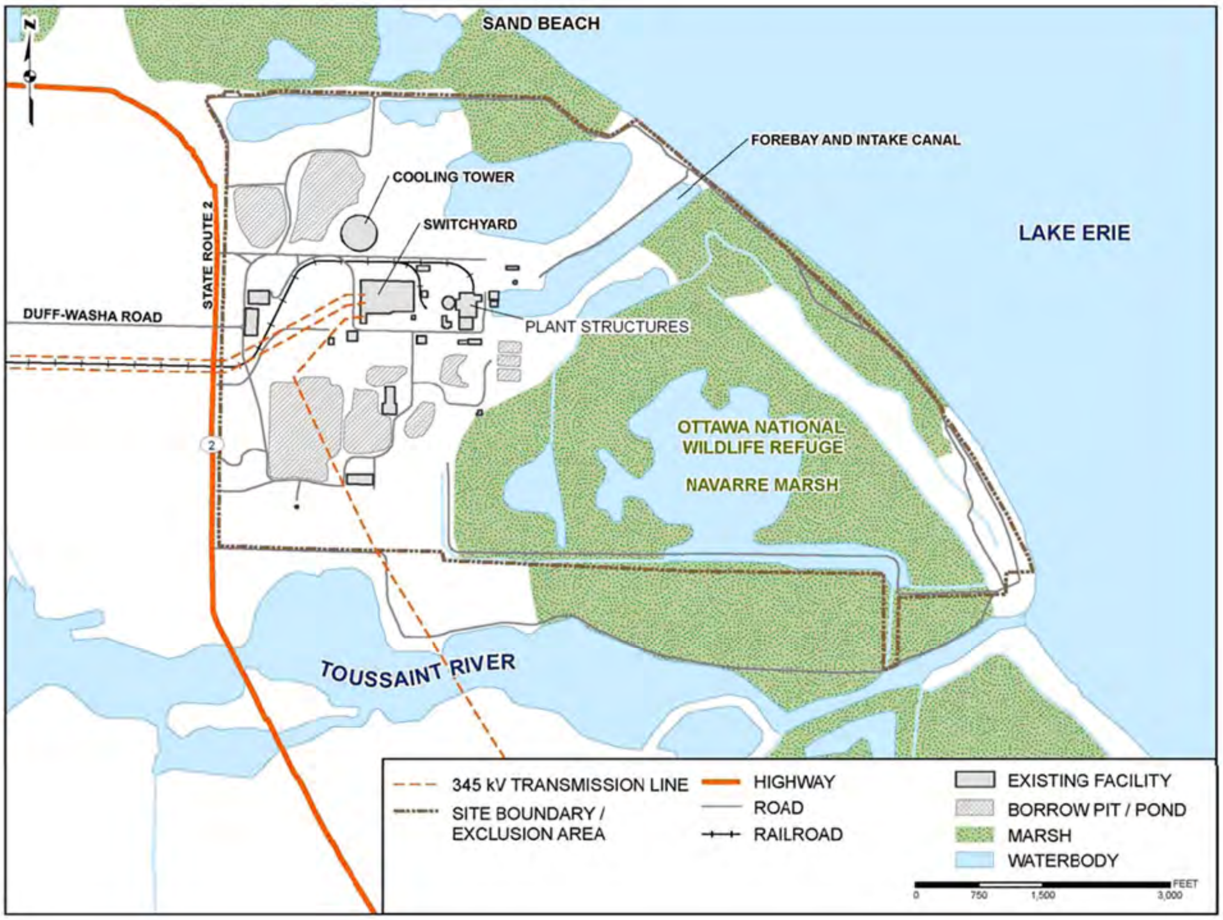

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

JAN 15 2010

Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, Ohio 43449

Dear Mr. Custer,

This is in response to a letter dated November 12, 2009 from Barry Allen regarding the preparation of an application for relicensing by the US Nuclear Regulatory Commission (NRC) for the Davis-Besse Nuclear Power Station. If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017. Your letter requested information on the presence of species listed as threatened or endangered under the jurisdiction of NOAA's National Marine Fisheries Service (NMFS) in the vicinity of the Davis-Besse facility.

The Davis-Besse facility is located on the southwestern shore of Lake Erie in Ottawa County, Ohio. No species listed by NMFS are known to occur in Lake Erie. As such, no further coordination with NMFS on the effects of the relicensing of the facility is necessary. While not specifically requested in your letter, NMFS has also reviewed the location of the facility and has determined that no Essential Fish Habitat (EFH) as designated under the Magnuson-Steven Fisheries Management and Conservation Act occurs in the vicinity of the facility. As such, no further coordination regarding impacts to EFH is necessary.

Should you have any questions regarding this correspondence or require any additional information, please contact Julie Crocker of my staff at (978)282-8480 or by e-mail (Julie.Crocker@noaa.gov).

Sincerely,

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

Cc: Chiarella, F/NER4

File Code: sec 7 2009 – no species

FENOC
FirstEnergy Nuclear Operating Company

*5501 North State Route 2
Oak Harbor, Ohio 43449*

Barry S. Allen
Vice President - Nuclear

*419-321-7676
Fax: 419-321-7582*

November 12, 2009
L-09-298

Mr. David Graham
Chief
Division of Wildlife
Ohio Department of Natural Resources
2045 Morse Rd., Bldg. G-3
Columbus, OH 43229-6693

SUBJECT:
Request for Information on Threatened or Endangered Species

FirstEnergy Nuclear Operating Company (FENOC) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for the Davis-Besse Nuclear Power Station (Davis-Besse). If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017.

As part of the license renewal process, the NRC requires (10 CFR 51.53(c)(3)(ii)(E)) license renewal applicants to assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act. The NRC also will request, under Section 7 of the Endangered Species Act (16 USC 1531), an informal consultation with your office at a later date. By contacting you early in the application process, FENOC wishes to identify any potential issues that need to be addressed or information that your office may require to expedite the NRC consultation.

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio (Attachment 1). Coordinates for the station are 41° 35' 49" north Latitude and 83° 05' 16" west Longitude. The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge (Attachment 2). Approximately 100 miles of transmission lines were constructed to connect the station to the regional electric grid.

FENOC has no plans to alter current Davis-Besse operations over the 20-year license renewal period. In addition, maintenance activities necessary to support license renewal would be limited to previously disturbed areas on site. License renewal at Davis-Besse would require neither the expansion of existing facilities nor additional land disturbance. As a result, FENOC is confident that extending Davis-Besse operation will continue to have minimal environmental impacts.

Davis-Besse Nuclear Power Station
L-09-298
Page 2

To ensure that impacts are adequately addressed, FENOC requests information from your office regarding concerns you may have, if any, related to potential environmental impacts from continued operation of Davis-Besse, including the associated transmission lines and corridors. FENOC would appreciate receiving a letter in reply detailing any concerns you may have or confirmation that no concerns exist. Receipt of your reply by December 31, 2009, will provide us the time needed to evaluate and incorporate the information into our application.

Thank you for your attention to our request.

Please feel free to contact Mr. Clifford Custer, Davis-Besse License Renewal Project Manager, at 724-682-7139. Please address any questions or need for additional information about the environmental review to:

Mr. Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

Telephone: 724-682-7139
Email: custerc@firstenergycorp.com

Sincerely,

Barry S. Allen

Attachments:
1. Davis-Besse Nuclear Power Station Area Map, 6-Mile Radius
2. Davis-Besse Nuclear Power Station Site Map

cc: DB-1 NRC Senior Resident Inspector

Attachment 1
L-09-298

Davis-Besse Nuclear Power Station
Area Map, 6-Mile Radius
Page 1 of 1

Attachment 2
L-09-298

Davis-Besse Nuclear Power Station Site Map
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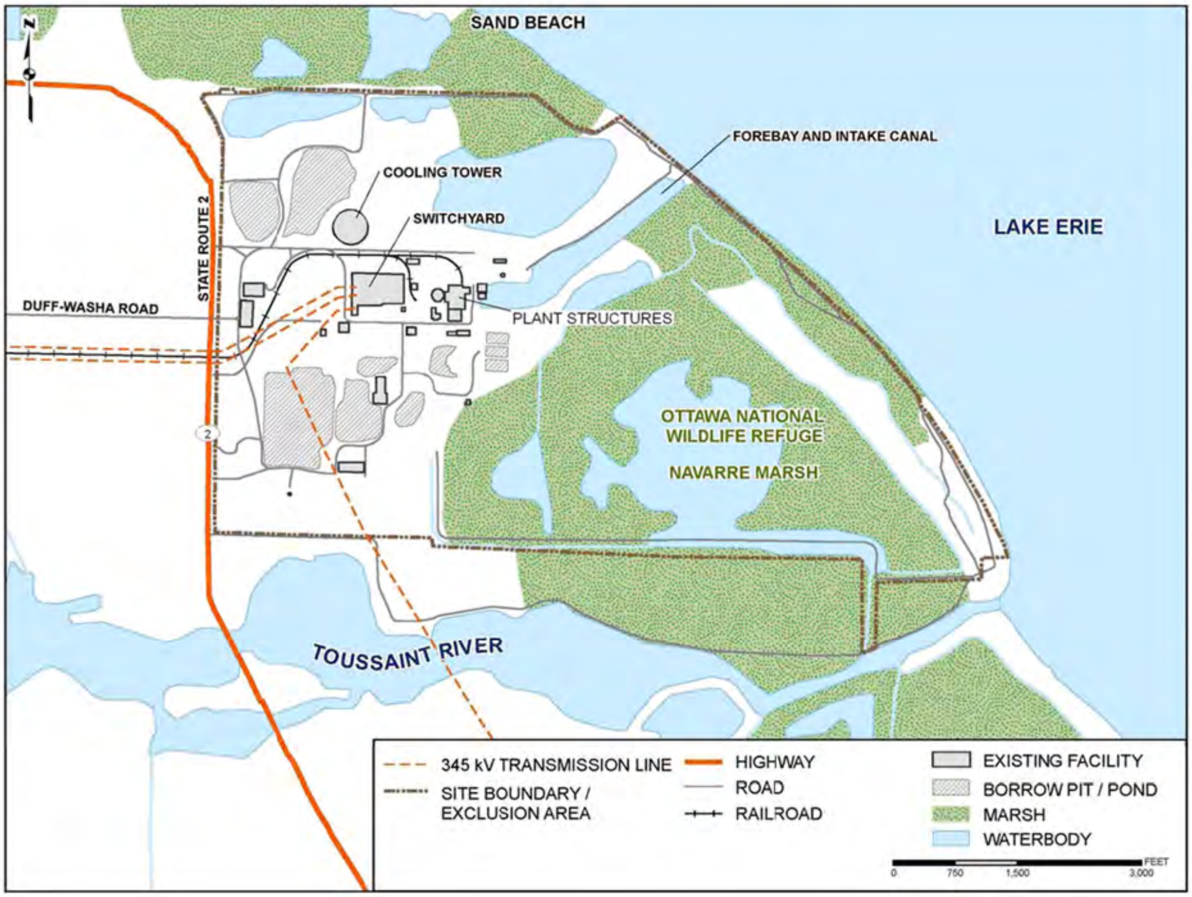

Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR | SEAN D. LOGAN, DIRECTOR

Division of Wildlife
David M. Graham, Chief
2045 Morse Rd., Bldg. G
Columbus, OH 43229-6693
Phone: (614) 265-6300

December 22, 2009

Barry S. Allen
FENOC
5501 North State Route 2
Oak harbor, OH 43449

RE: Request for Information on Threatened or Endangered Species
Renew Operating license for the Davis-Besse Nuclear Power Station

Dear Mr. Allen:

This is in response to your letter to Chief Graham dated November 12, 2009 regarding the project referenced above. In your letter you request information regarding concerns we may have, if any, related to potential environmental impacts from continued operation of Davis-Besse, including the associated transmission lines and corridors. After reviewing the information provided, the Ohio Department of Natural Resources, Division of Wildlife (DOW) has the following comments.

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. If no tree removal is proposed, the project is not likely to impact this species.

ohiodnr.com

NR-0001

PAGE TWO
Barry S. Allen
December 22, 2009

The project is within the range of the piping plover (*Charadrius melodus*), a state and federally endangered bird species. This species does not nest in the state but only utilizes stopover habitat as they migrate through the region. Therefore, the project is not likely to have an impact on this species.

The project is within the range of the Eastern massasauga (*Sistrurus catenatus*), a state endangered and a federal candidate snake species. Due to the location of the project, the project is not likely to impact this species.

The project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. The location of bald eagle activity frequently changes. Therefore, closer to the actual date of construction, the applicant must obtain an updated status of bald eagle activity in the area. To obtain any changes in status, contact Andrea Tibbels or Dave Sherman at the Ohio Department of Natural Resources, Division of Wildlife, Crane Creek Wildlife Research Station, for current information on the presence of bald eagles in the area. Andrea can be reached at (419) 898-0960 extension 25 and Dave at extension 24. If a nest is located within ½ mile of the project site, coordination with the DOW is required.

The project is within the range of the eastern pondmussel (*Ligumia nasuta*), a state endangered mussel, the spotted gar (*Lepisosteus oculatus*), a state endangered fish, and the blacknose shiner (*Notropis heterolepis*), a state endangered fish. Since no in-water work is proposed for this project, the project is not likely to impact these species.

The project is within the range of the American bittern (*Botaurus lentiginosus*), a state endangered bird, the black tern (*Chlidonias niger*), a state endangered bird, the cattle egret (*Bubulcus ibis*), a state endangered bird, the common tern (*Sterna hirundo*), a state endangered bird, the king rail (*Rallus elegans*), a state endangered bird, the loggerhead shrike (*Lanius ludovicianus*), a state endangered bird, the Northern harrier (*Circus cyaneus*), a state endangered bird, the snowy egret (*Egretta thula*), a state endangered species, the trumpeter swan (*Cygnus buccinator*), a state endangered bird. Due to the type of project proposed, the project is not likely to impact these species.

Otherwise, the Ohio Department of Natural Resources, Division of Wildlife, is not aware of any threatened or endangered species in the vicinity of this project. However, the Ohio Department of Natural Resources, Division of Natural Areas and Preserves maintains the Natural Heritage Database, the state's most comprehensive record of Ohio threatened and endangered species. If you have not already done so, it is recommended you contact the Division of Natural Areas and Preserves at (614) 265-6453. To process future projects more efficiently, I recommend you contact the Division of Natural Areas and Preserves prior to contacting the Division of Wildlife. To help expedite the process, please include the results of the Division of Natural Areas and Preserves' Natural Heritage Database request when contacting us regarding future projects.

PAGE THREE
Barry S. Allen
December 22, 2009

The Ohio Department of Natural Resources, Division of Wildlife is available to provide guidance on avoiding or minimizing impacts to any listed fauna and/or their habitat. If you should need further assistance, please feel free to contact Becky Jenkins at (614) 265-6631.

Sincerely,

JOHN NAVARRO
Program Administrator

JN/BJ/al

cc: Mr. Clifford I. Custer
Davis-Besse License Renewal Project manager
Mail Stop 3370
Davis-Besse Nuclear power Station
5501 N. State Route 2
Oak harbor, OH 43449

FENOC

FirstEnergy Nuclear Operating Company

5501 North State Route 2
Oak Harbor, Ohio 43449

Barry S. Allen
Vice President - Nuclear

419-321-7676
Fax: 419-321-7582

November 12, 2009
L-09-297

Mr. Greg Schneider
Group Manager
Ohio Natural Heritage Program
Ohio Department of Natural Resources
Division of Natural Areas and Preserves
2045 Morse Rd., Bldg. F-1
Columbus, OH 43229-6693

SUBJECT:
Request for Information on Threatened or Endangered Species

FirstEnergy Nuclear Operating Company (FENOC) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for the Davis-Besse Nuclear Power Station (Davis-Besse). If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017.

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Please feel free to contact Mr. Clifford Custer, Davis-Besse License Renewal Project Manager, at 724-682-7139. Please address any questions or need for additional information about the environmental review to:

Mr. Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

Telephone: 724-682-7139
Email: custerc@firstenergycorp.com

Sincerely,

Barry S. Allen

Barry S. Allen

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Davis-Besse Nuclear Power Station
Area Map, 6-Mile Radius
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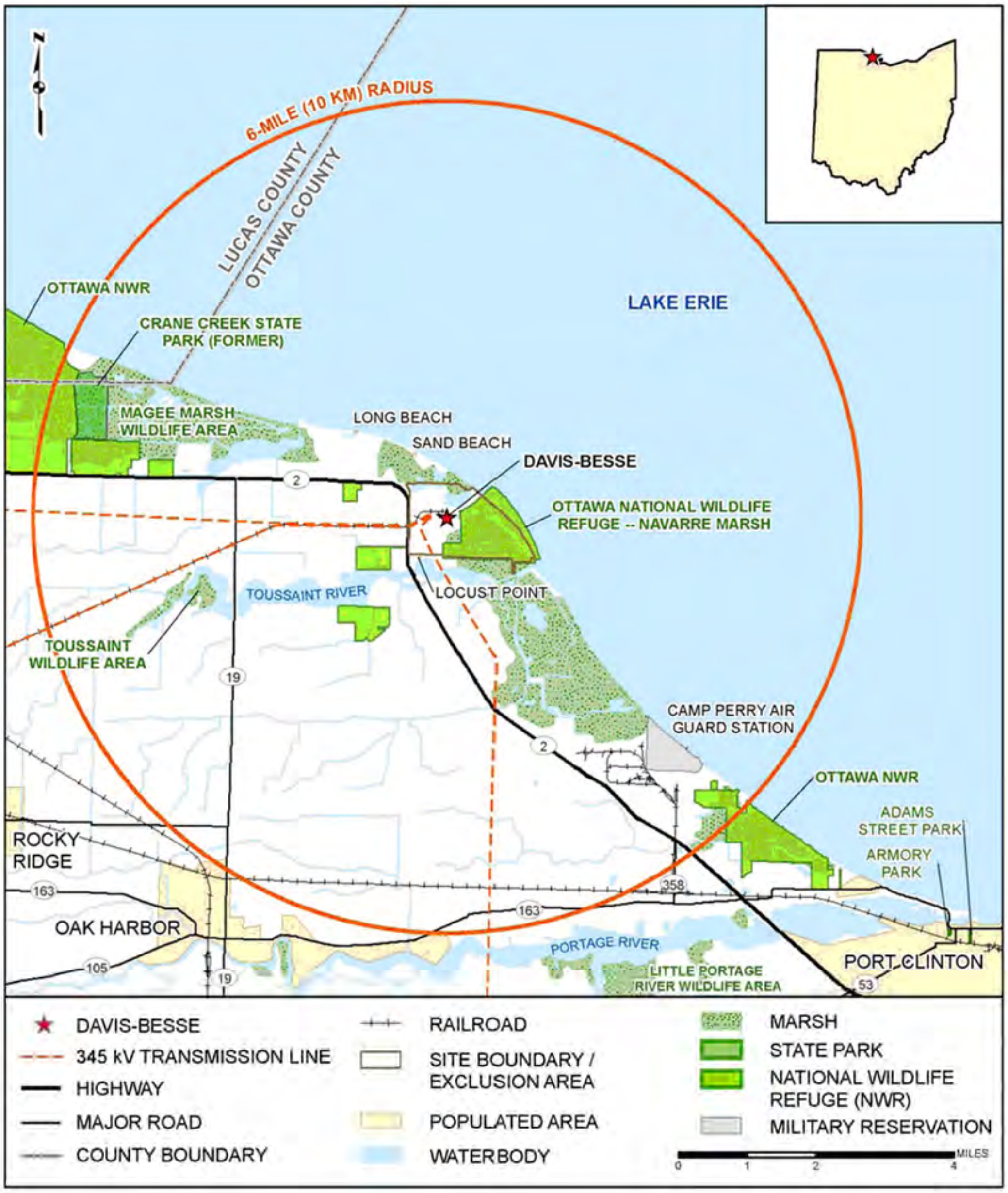

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Davis-Besse Nuclear Power Station Site Map
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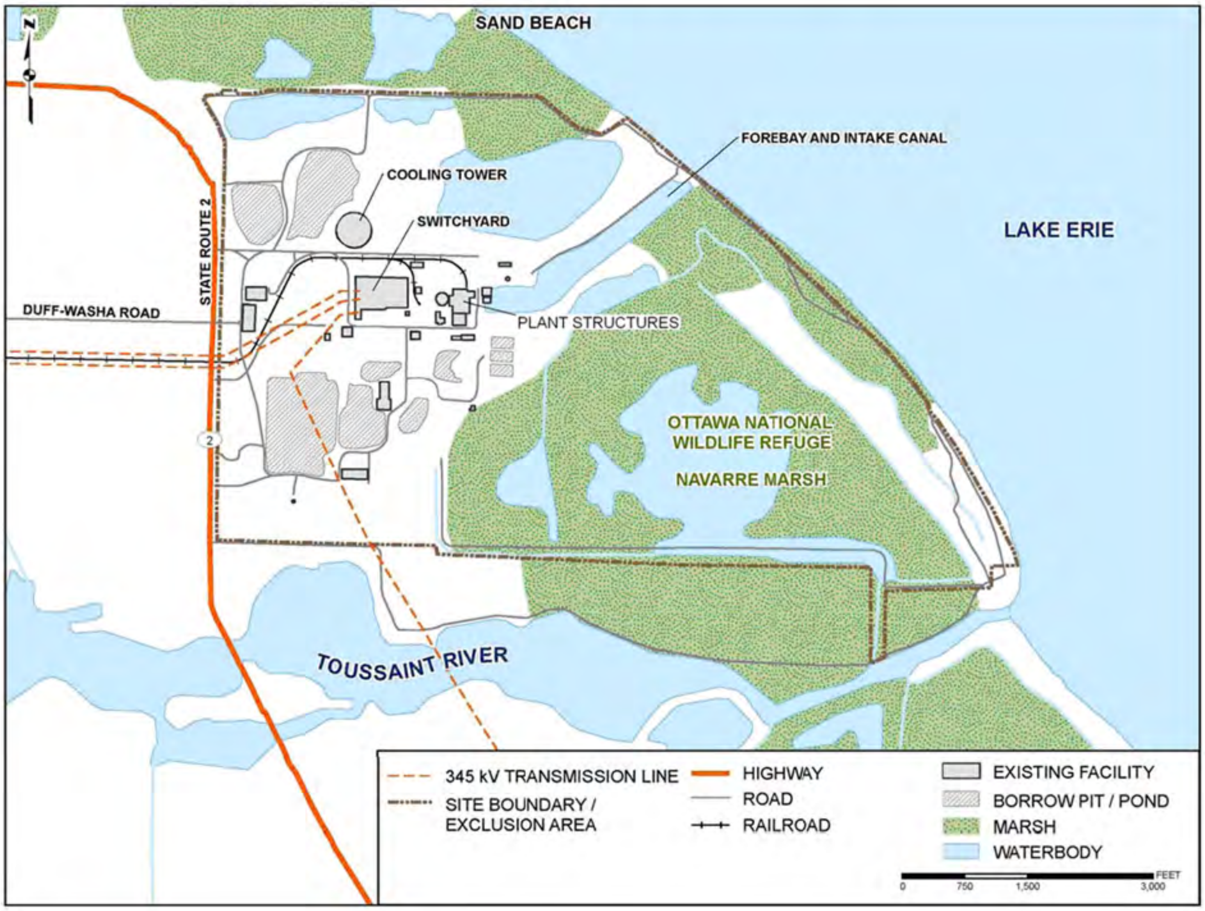

Clifford I Custer/FirstEnergy
01/04/2010 08:14 AM

To: Steven R. Dort/FirstEnergy@FirstEnergy
cc:
bcc:
Subject: Fw: 09-0417; FENOC Davis-Besse License Renewal

"Mitch, Brian" <Brian.Mitch@dnr.state.oh.us>
12/22/2009 03:13 PM

To: <custerc@firstenergycorp.com>
cc:
Subject: 09-0417; FENOC Davis-Besse License Renewal

ODNR COMMENTS TO Mr. Clifford I. Custer, Mail Stop 3370, Davis-Besse Nuclear Power Station, 5501 North State Route 2, Oak Harbor, Ohio

Project: The applicant, FirstEnergy Nuclear Operating Company, is preparing an application to the U.S. Nuclear Regulatory Commission to renew the operating license for the Davis-Besse Nuclear Power Station. As part of the license renewal process, the NRC requires license renewal applicants to assess the impact of the proposed action on threatened or endangered species.

Location: The site is located in sections 1, 2, and 6, Carroll Township, Ottawa County, Ohio.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced project. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Rare and Endangered Species: The ODNR, Division of Natural Areas and Preserves, Natural Heritage Database contains records of rare species near the site. The map included with this letter displays the locations of the records and corresponds to the attached list.

There are no state nature preserves, or scenic rivers in the vicinity of the sites. However, the site is near the Crane Creek State Park. The site is also near the Toussaint and MaGee Marsh Wildlife Areas.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area.

Fish and Wildlife: The ODNR, Division of Wildlife (DOW) has the following comments.

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. Since no tree removal is proposed, the project is not likely to impact this species.

The project is within the range of the piping plover (*Charadrius melodus*), a state and federally endangered bird species. This species does not nest in the state but only utilizes stopover habitat as they migrate through the region.

Therefore, the project is not likely to have an impact on this species.

The project is within the range of the spotted gar (*Lepisosteus oculatus*), a state endangered fish, and the blacknose shiner (*Notropis heterolepis*), a state endangered fish. Since no in-water work is proposed for this project, the project is not likely to impact these species.

The project is within the range of the cattle egret (*Bubulcus ibis*), a state endangered bird, the loggerhead shrike (*Lanius ludovicianus*), a state endangered bird, the Northern harrier (*Circus cyaneus*), a state endangered bird, the snowy egret (*Egretta thula*), a state endangered species, and the trumpeter swan (*Cygnus buccinator*), a state endangered bird. Due to the type of project proposed, the project is not likely to impact these species.

The Natural Heritage Database has a record near the project area for the lake sturgeon (*Acipenser fulvescens*), a state endangered species, the Canada darner (*Aeshna canadensis*), a state endangered species, the Northern shoveler (*anas clypeata*), a state species of special interest, the green-winged teal (*Anas crecca*), a state species of special interest, the gadwall (*Anas strepera*), a state species of special interest, the redhead (*Aythya americana*), a state species of special interest, the upland sandpiper (*Bartramia longicauda*), a state threatened species, the American bittern (*Botaurus lentiginosus*), a state endangered species, the black tern (*Chlidonias niger),* a state endangered species, the sedge wren (*Cistothorus platensis*), a state species of concern, the Cisco (*Coregonus artedi*), a state endangered species, the lake whitefish (*Coregonus clupeaformis*), a state species of concern, the purple wartyback (*Cyclonaias tuberculata),* a state species of concern, the Eastern fox snake (*Elaphe vulpina gloydi*), a state species of concern, the Blanding's turtle (*Emydoidea blandingii*), a state species of concern, the bald eagle (*Haliaeetus leucocephalus*), a state threatened species, the least bittern (*Ixobrychus exilis*), a state threatened species, the Eastern pondmussel (*Ligumia nasuta*), a state endangered species, the black sandshell (*Ligumia recta*), a state threatened species, the melanistic garter snake (*Thamnophis sirtalis),* a state species of concern, the threehorn wartyback (*Obliquaria reflexa*), a state threatened species, the sora rail (*Porzana carolina*), a state species of concern, the king rail (*Rallus elegans*), a state endangered species, the Virginia rail (*Rallus limicola*), a state species of special concern, the common tern (*Sterna hirundo*), a state endangered species, the Western meadowlark (*Sturnella neglecta*), a state species of special interest, the fawnsfoot (*Truncilla donaciformis*), a state threatened species, and the deertoe (*Truncilla truncata*), a state species of concern. Since no new site disturbance is proposed, the project is not likely to impact these species.

Coastal Management: The ODNR, Office of Costal Management comments that, pursuant to the Coastal Zone Management Act of 1972, as amended, federal licenses or permits listed in the approved Ohio Coastal Management Program Document may not be issued until ODNR has determined that the activity is consistent with the program's enforceable policies. The following is listed as being subject to Federal Consistency reviews in the Ohio Coastal Management Program Document:

· Licensing and determination of the siting, construction and operation of nuclear generating stations, fuel storage, and processing centers pur-suant to the Atomic Energy Act of 1954, Title II of the Energy Reorgani-zation Act of 1974 and the National Environmental Policy Act of 1969.

In order to commence a Federal Consistency review, the following information must be received by ODNR:

1. A Federal Consistency Certification signed by the permit applicant (not an agent or representative)

2. A copy of the application for the federal license or permit and

   a. All material relevant to a State's management program provided to the Federal agency in support of the application; and

   b. To the extent not included in paragraphs (a)(1) or (a)(1)(i) of this section, a detailed description of the proposed activity, its associated facilities, the coastal effects, and any other information relied upon by the applicant to make its certification. Maps, diagrams, and technical data shall be submitted when a written description alone will not adequately describe the proposal;

3. Information specifically identified in the management program as required necessary data and information for an applicant's consistency certification. The management program as originally approved or amended (pursuant to 15 CFR part 923, subpart H) may describe data and information necessary to assess the consistency of federal license or permit activities. Necessary data and information may include completed State or local government permit applications which are required for the proposed activity, but shall not include the issued State or local permits. NEPA documents shall not be considered necessary data

and information when a Federal statute requires a Federal agency to initiate the CZMA federal consistency review prior to its completion of NEPA compliance. States shall not require that the consistency certification and/or the necessary data and information be included in NEPA documents. Required data and information may not include confidential and proprietary material; and

4. An evaluation that includes a set of findings relating the coastal effects of the proposal and its associated facilities to the relevant enforceable policies of the management program. Applicants shall demonstrate that the activity will be consistent with the enforceable policies of the management program. Applicants shall demonstrate adequate consideration of policies which are in the nature of recommendations. Applicants need not make findings with respect to coastal effects for which the management program does not contain enforceable or recommended policies.

A copy of a Federal Consistency Certification is attached.

ODNR appreciates the opportunity to provide these comments. Please contact Brian Mitch at (614) 265-6378 if you have questions about these comments or need additional information.

Brian Mitch, Environmental Review Manager
Ohio Department of Natural Resources
Environmental Services Section
2045 Morse Road, Building F-3
Columbus, Ohio 43229-6693
Office: (614) 265-6378
Fax: (614) 262-2197
brian.mitch@dnr.state.oh.us

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09-0417_ma.pdf

#09-0417 FENOC David-Besse License Renewal

Scientific Name	Common Name	State Status	Federal Status	Last Observed
Acipenser fulvescens	Lake Sturgeon	E		1997-05
Acorus americanus	American Sweet-flag	P		1971-08-03
Aeshna canadensis	Canada Darner	E		1997-09-27
Ammophila breviligulata	American Beach Grass	T		1970-09
Anas clypeata	Northern Shoveler	SI		1983-06-30
Anas crecca	Green-winged Teal	SI		1983-08-10
Anas strepera	Gadwall	SI		1983-08-10
Anas strepera	Gadwall	SI		1983-06-12
Arabis divaricarpa	Limestone Rock Cress	E		1973-05
Astragalus canadensis	Canada Milk-vetch	T		1968-08-27
Astragalus canadensis	Canada Milk-vetch	T		1979-07-11
Aythya americana	Redhead	SI		1984-07
Bartramia longicauda	Upland Sandpiper	T		1983-08
Botaurus lentiginosus	American Bittern	E		1977
Botaurus lentiginosus	American Bittern	E		1984-05
Botaurus lentiginosus	American Bittern	E		1977
Cakile edentula	Inland Sea Rocket	P		1979-09
Cakile edentula	Inland Sea Rocket	P		1997-07-15
Carex aquatilis	Leafy Tussock Sedge	P		1990-07
Carex atherodes	Wheat Sedge	P		1990-07
Carex bebbii	Bebb's Sedge	P		2004-08-26
Carex bebbii	Bebb's Sedge	P		2003-08-21
Chlidonias niger	Black Tern	E		1984-07-08
Chlidonias niger	Black Tern	E		1984-07-14
Cistothorus platensis	Sedge Wren	SC		1984-08

E=Endangered FT=Federally Threatened SC=Special Concern T=Threatened
FE=Federally Endangered P=Potentially Threatened SI=Special Interest

Page 1 of 4

Scientific Name	Common Name	State Status	Federal Status	Last Observed
Cistothorus platensis	Sedge Wren	SC		197- (NO DATE
Coregonus artedi	Cisco	E		1976
Coregonus clupeaformis	Lake Whitefish	SC		1976 (NO DATE
Cyclonaias tuberculata	Purple Wartyback	SC		1977-06
Cyperus diandrus	Low Umbrella-sedge	P		2003-08-21
Cyperus diandrus	Low Umbrella-sedge	P		2004-08-26
Cyperus diandrus	Low Umbrella-sedge	P		1991-09-13
Cyperus schweinitzii	Schweinitz' Umbrella-sedge	T		1967-09
Cyperus schweinitzii	Schweinitz' Umbrella-sedge	T		2009-07-06
Elaphe vulpina gloydi	Eastern Fox Snake	SC		1980-06-24
Elaphe vulpina gloydi	Eastern Fox Snake	SC		1980-06
Elaphe vulpina gloydi	Eastern Fox Snake	SC		1980-08
Elaphe vulpina gloydi	Eastern Fox Snake	SC		1998-05-06
Elaphe vulpina gloydi	Eastern Fox Snake	SC		1980-07
Emydoidea blandingii	Blanding's Turtle	SC		1980-06
Emydoidea blandingii	Blanding's Turtle	SC		1997-05-16
Emydoidea blandingii	Blanding's Turtle	SC		1970-07
Emydoidea blandingii	Blanding's Turtle	SC		1980-06
Emydoidea blandingii	Blanding's Turtle	SC		1980-07
Euphorbia polygonifolia	Seaside Spurge	P		1979-09
Euphorbia polygonifolia	Seaside Spurge	P		1997-07-15
Euphorbia polygonifolia	Seaside Spurge	P		1990-08
Haliaeetus leucocephalus	Bald Eagle	T		2000-06
Haliaeetus leucocephalus	Bald Eagle	T		2000-06
Haliaeetus leucocephalus	Bald Eagle	T		2000-06
Haliaeetus leucocephalus	Bald Eagle	T		2000-06

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Scientific Name	Common Name	State Status	Federal Status	Last Observed
Haliaeetus leucocephalus	Bald Eagle	T		2000-06
Haliaeetus leucocephalus	Bald Eagle	T		2000-06
Haliaeetus leucocephalus	Bald Eagle	T		2000-06
Ixobrychus exilis	Least Bittern	T		1984-06-03
Ixobrychus exilis	Least Bittern	T		1983-08-10
Ligumia nasuta	Eastern Pondmussel	E		1978-07
Ligumia nasuta	Eastern Pondmussel	E		1978-07-08
Ligumia nasuta	Eastern Pondmussel	E		1968-07
Ligumia recta	Black Sandshell	T		1978-07-17
Ligumia recta	Black Sandshell	T		1978-07
Melanistic garter snake	Thamnophis Sirtalis	SC		1980-06-24
Melanistic garter snake	Thamnophis Sirtalis	SC		1980-06
Melanistic garter snake	Thamnophis Sirtalis	SC		1980-06
Nuphar variegata	Bullhead-lily	E		2003-08-21
Nuphar variegata	Bullhead-lily	E		2004-08-26
Obliquaria reflexa	Threehorn Wartyback	T		1977-06
Obliquaria reflexa	Threehorn Wartyback	T		1968-07
Obliquaria reflexa	Threehorn Wartyback	T		1978-07-08
Oenothera oakesiana	Oakes' Evening-primrose	P		2003-08-21
Oenothera parviflora	Small-flowered Evening-primrose	P		2003-08-21
Panicum tuckermanii	Tuckerman's Panic Grass	T		1991-09-13
Panicum tuckermanii	Tuckerman's Panic Grass	T		1991-09-13
Phragmites australis ssp. americanus	American Reed Grass	T		2003-08-21
Porzana carolina	Sora Rail	SC		1984-06
Porzana carolina	Sora Rail	SC		1984-06
Potamogeton natans	Floating Pondweed	P		1980-07

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Page 3 of 4

Scientific Name	Common Name	State Status	Federal Status	Last Observed
Potamogeton zosteriformis	Flat-stemmed Pondweed	P		2003-08-21
Potentilla paradoxa	Bushy Cinquefoil	T		1970-09
Rallus elegans	King Rail	E		1984-06
Rallus elegans	King Rail	E		1983-07
Rallus limicola	Virginia Rail	SC		1983-08
Sagittaria cuneata	Wapato	T		2004-08-26
Sagittaria cuneata	Wapato	T		1998-08-18
Sagittaria montevidensis	Southern Wapato	P		2005-07-27
Sagittaria montevidensis	Southern Wapato	P		1968-08-27
Sagittaria rigida	Deer's-tongue Arrowhead	P		1998-08-12
Sagittaria rigida	Deer's-tongue Arrowhead	P		1998-08-04
Sagittaria rigida	Deer's-tongue Arrowhead	P		2009-09-25
Sagittaria rigida	Deer's-tongue Arrowhead	P		2003-08-21
Sterna hirundo	Common Tern	E		2003
Sterna hirundo	Common Tern	E		2003
Sturnella neglecta	Western Meadowlark	SI		1997-05-18
Triplasis purpurea	Purple Sand Grass	P		2009-08-21
Triplasis purpurea	Purple Sand Grass	P		1968-09
Truncilla donaciformis	Fawnsfoot	T		1966-05
Truncilla donaciformis	Fawnsfoot	T		1977-06
Truncilla donaciformis	Fawnsfoot	T		1968-07
Truncilla donaciformis	Fawnsfoot	T		1978-07-08
Truncilla truncata	Deertoe	SC		1966-05
Truncilla truncata	Deertoe	SC		1977-06
Truncilla truncata	Deertoe	SC		1978-07-08
Truncilla truncata	Deertoe	SC		1968-07

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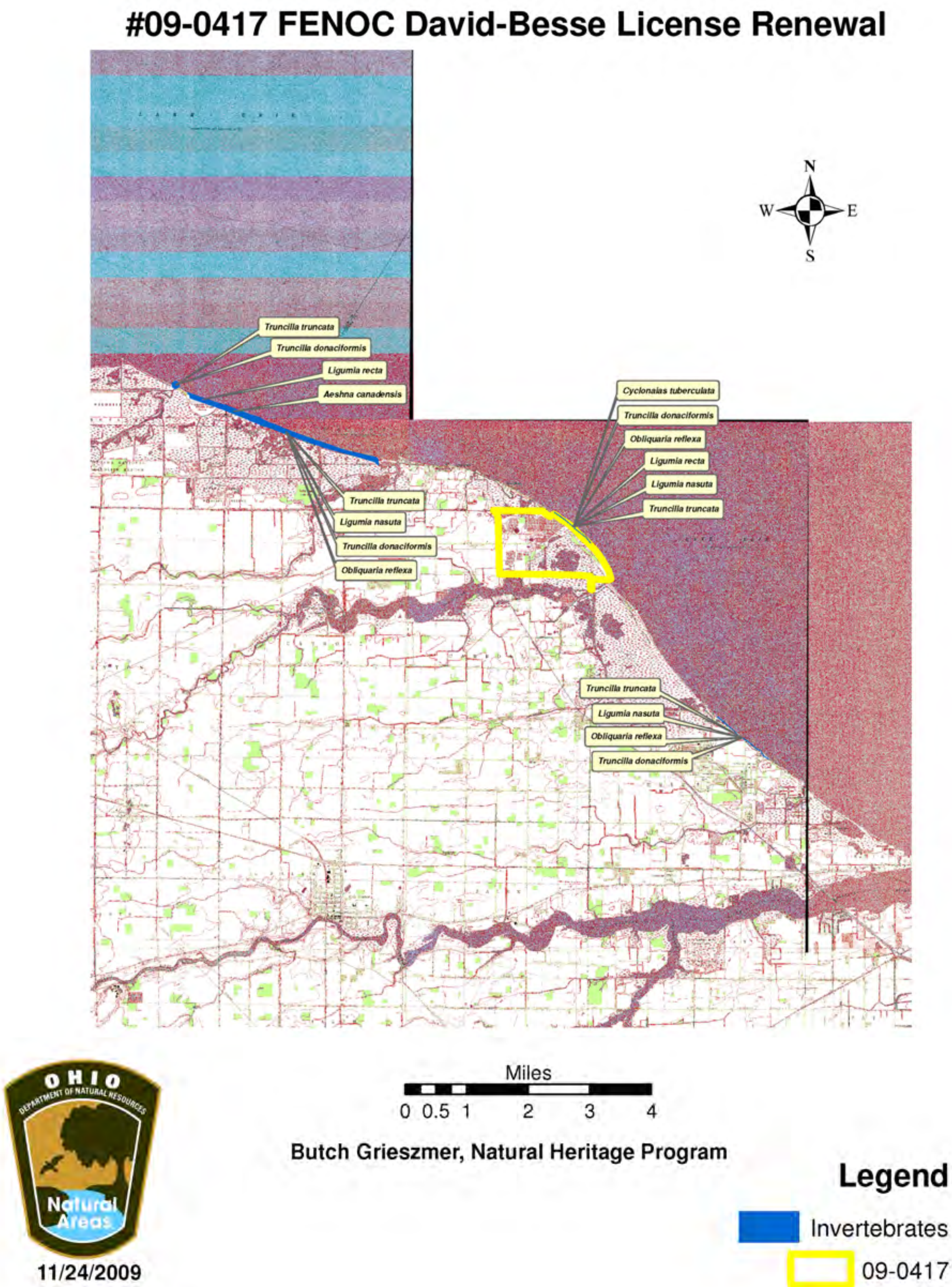
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Aeshna canadensis
Cyclonaias tuberculata
Truncilla donaciformis
Obliquaria reflexa
Ligumia recta
Ligumia nasuta
Truncilla truncata
Truncilla truncata
Ligumia nasuta
Truncilla donaciformis
Obliquaria reflexa
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OHIO
DEPARTMENT OF NATURAL RESOURCES
Natural Areas
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Legend
Invertebrates
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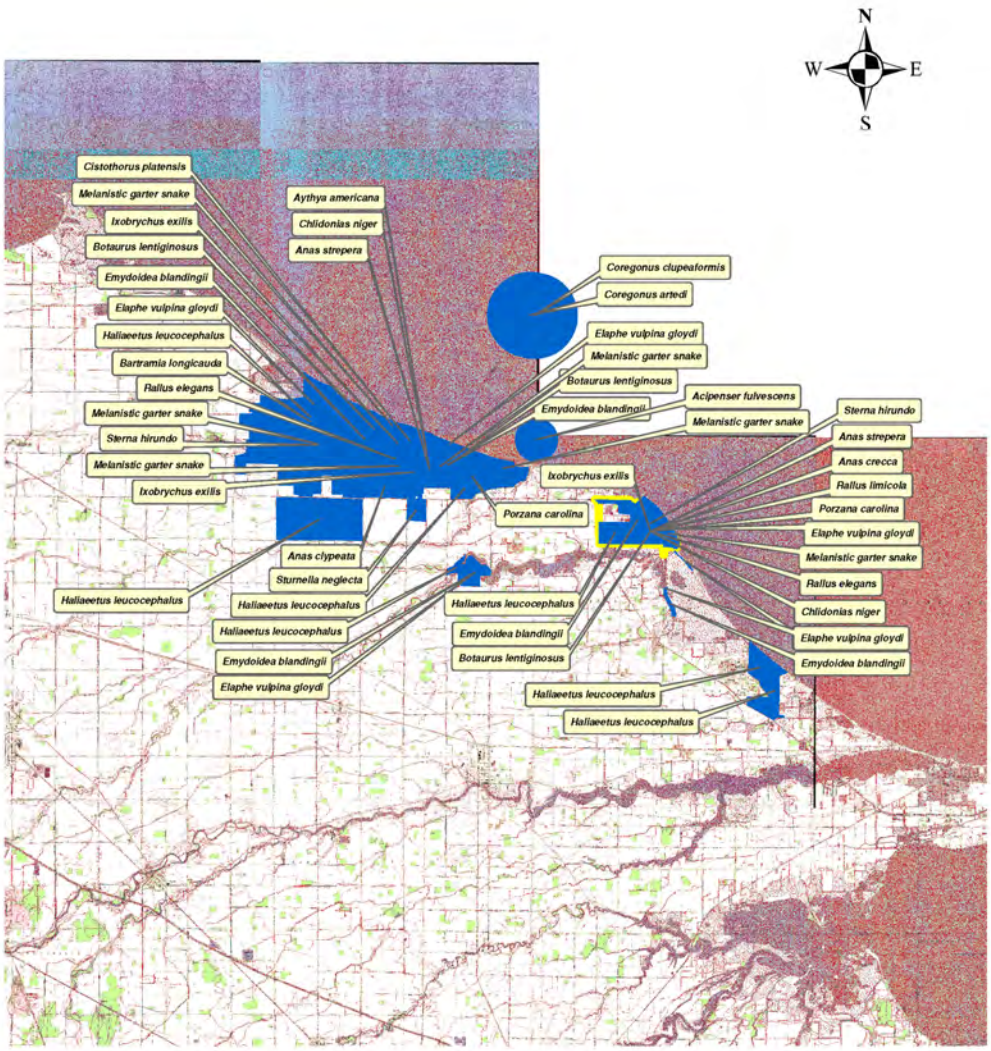

Miles

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Butch Grieszmer, Natural Heritage Program

Legend

Vertebrates

09-0417

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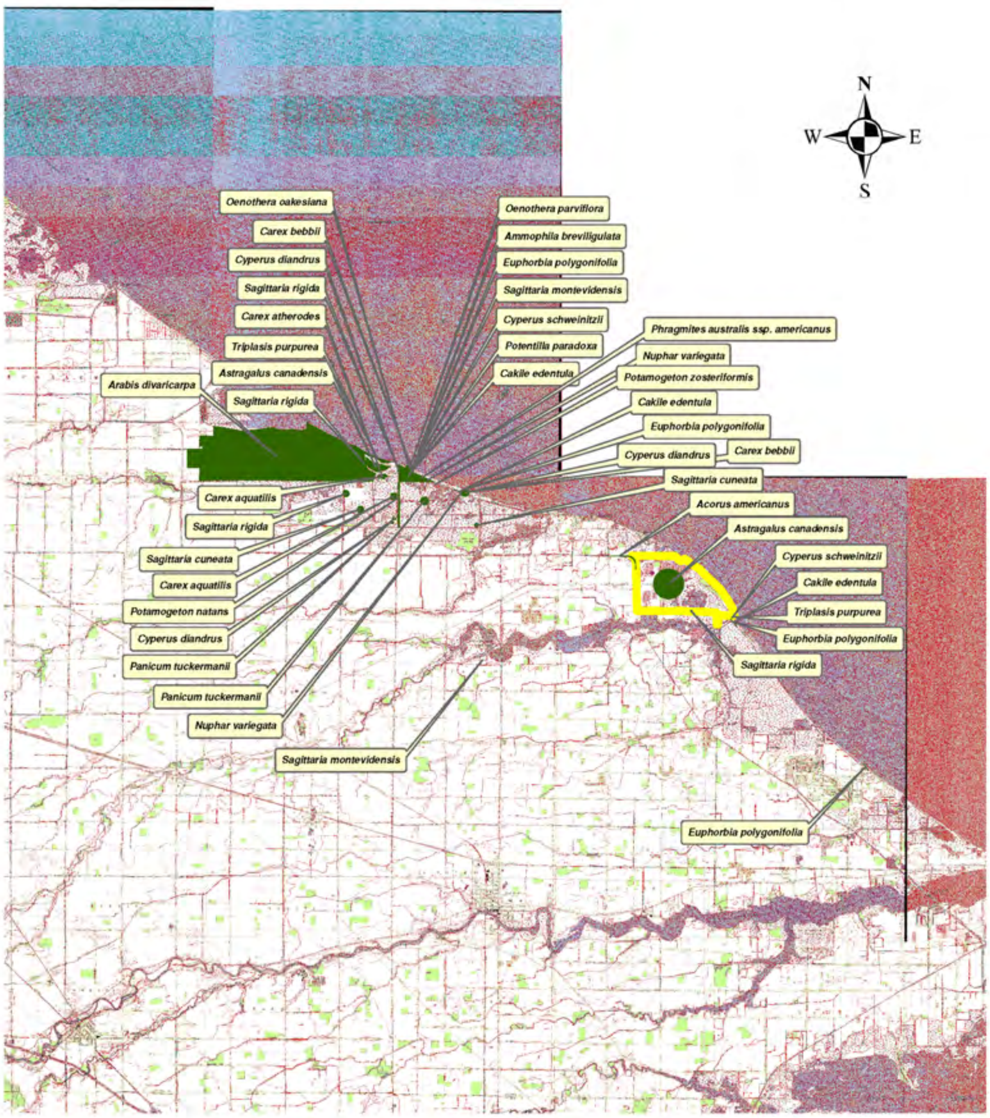
#09-0417 FENOC David-Besse License Renewal



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Butch Grieszmer, Natural Heritage Program

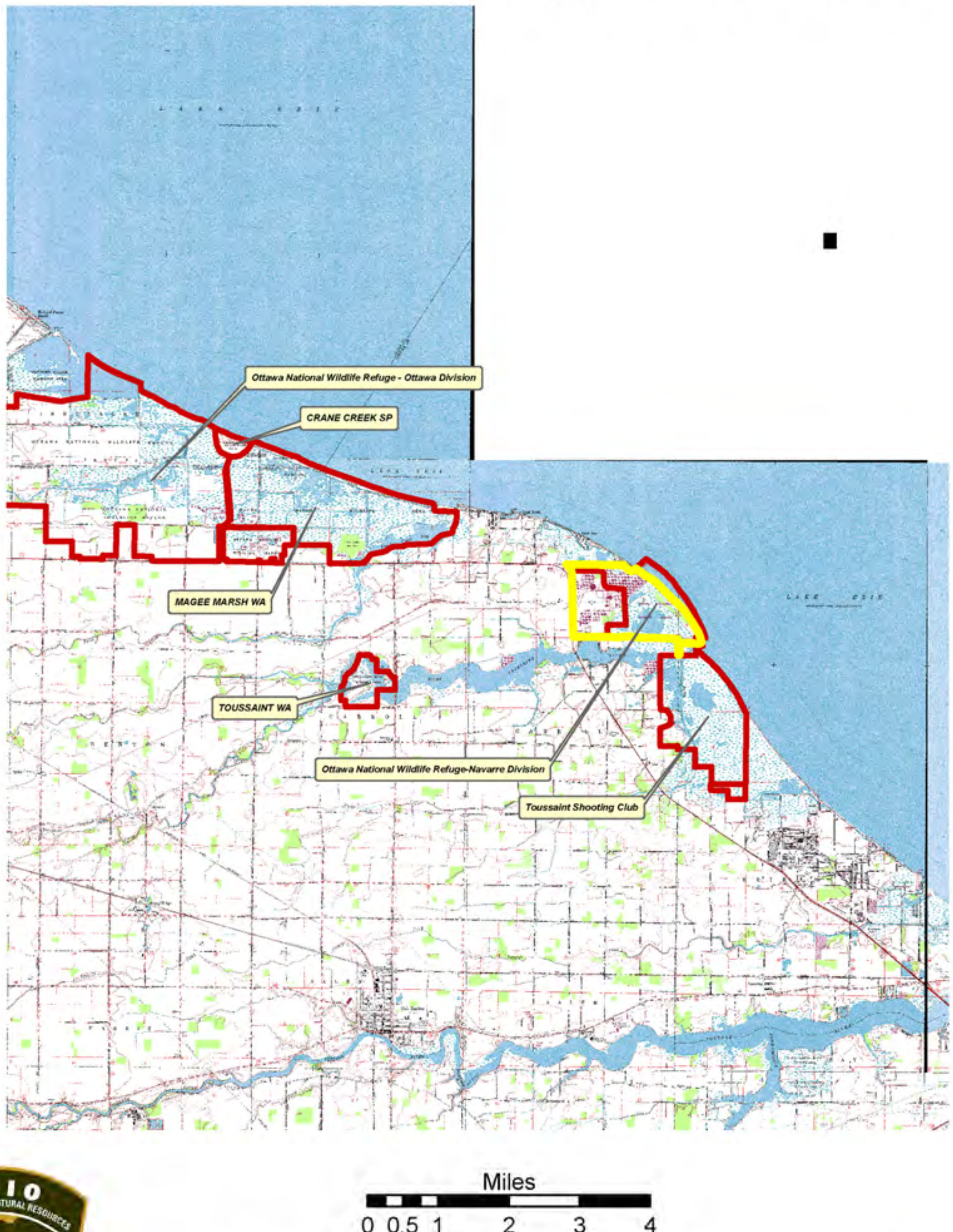
11/24/2009

Legend

Plants

09-0417

#09-0417 FENOC David-Besse License Renewal



Butch Grieszmer, Natural Heritage Program

11/24/2009

Ohio Coastal Management Program
Consistency Certification Statement

I, ______________________________, do certify that the proposed activity complies with the enforceable policies of Ohio's approved coastal management program and will be conducted in a manner consistent with such program (16 U.S.C. § 1456 and O.R.C. §1506.03).

Address: ______________________________

City: ____________________ State: __________ Zip Code: __________

Telephone Number: (_____) ______________________________

Applicant's Signature: ____________________ Date: __________

Project Name/Description: ______________________________

____

Please list all local, State, and Federal permits, licenses, leases, and/or other authorizations required for this project:

1)
2)
3)
4)
5)

Please submit an original copy of this document signed by the applicant (not an agent or representative) with your Federal permit application or submit to:

Federal Consistency Coordinator
Ohio Department of Natural Resources
Office of Coastal Management
105 West Shoreline Drive
Sandusky, Ohio 44870

FENOC
FirstEnergy Nuclear Operating Company

5501 North State Route 2
Oak Harbor, Ohio 43449

Barry S. Allen
Vice President - Nuclear

419-321-7676
Fax: 419-321-7582

November 12, 2009
L-09-300

Mr. Steven Holland, MPA
Coastal Network Section Manager
Federal Consistency Coordinator
Ohio Department of Natural Resources
Office of Coastal Management
105 W. Shoreline Drive
Sandusky, OH 44870

SUBJECT:
Coastal Zone Management (CZM) Consistency Certification

FirstEnergy Nuclear Operating Company (FENOC) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for the Davis-Besse Nuclear Power Station (Davis-Besse). If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017.

The Federal Coastal Zone Management Act (16 USC 1451, et seq.) imposes requirements on an applicant for a Federal license to conduct an activity that could affect a state's coastal zone. The Act requires an applicant to certify to the licensing agency that the proposed action would be consistent with the state's federally approved coastal zone management program. The Act also requires the applicant to provide to the state a copy of the certification statement and requires the state, at the earliest practicable time, to notify the federal agency and the applicant whether the state concurs with, or objects to, the consistency certification (16 USC 1456(c)(3)(A)). By contacting you early in the application process, FENOC wishes to identify any potential issues that need to be addressed or information that your office may require to expedite its review.

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio (Attachment 1). Coordinates for the station are 41° 35' 49" north Latitude and 83° 05' 16" west Longitude. The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge (Attachment 2).

FENOC has no plans to alter current Davis-Besse operations over the 20-year license renewal period. In addition, maintenance activities necessary to support license

Davis-Besse Nuclear Power Station
L-09-300
Page 2

renewal would be limited to previously disturbed areas on site. License renewal at Davis-Besse would require neither the expansion of existing facilities nor additional land disturbance. As a result, FENOC is confident that continued operation of Davis-Besse during the license renewal period would be consistent with the policies of the Ohio CZM program.

To ensure that impacts are adequately addressed, FENOC requests information from your office regarding concerns you may have, if any, related to renewal of the Davis-Besse facility operating license. FENOC would appreciate receiving a letter in reply detailing any concerns you may have or confirmation that no concerns exist and that a renewed operating license is consistent with the policies of the CZM program. Receipt of your reply by December 31, 2009, will provide us the time needed to evaluate and incorporate the information into our application.

Thank you for your attention to our request.

Please feel free to contact Mr. Clifford Custer, Davis-Besse License Renewal Project Manager, at 724-682-7139. Please address any questions or need for additional information about the environmental review to:

Mr. Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

Telephone: 724-682-7139
Email: custerc@firstenergycorp.com

Sincerely,

Barry S. Allen

Barry S. Allen

Attachments:
1. Davis-Besse Nuclear Power Station Area Map, 6-Mile Radius
2. Davis-Besse Nuclear Power Station Site Map

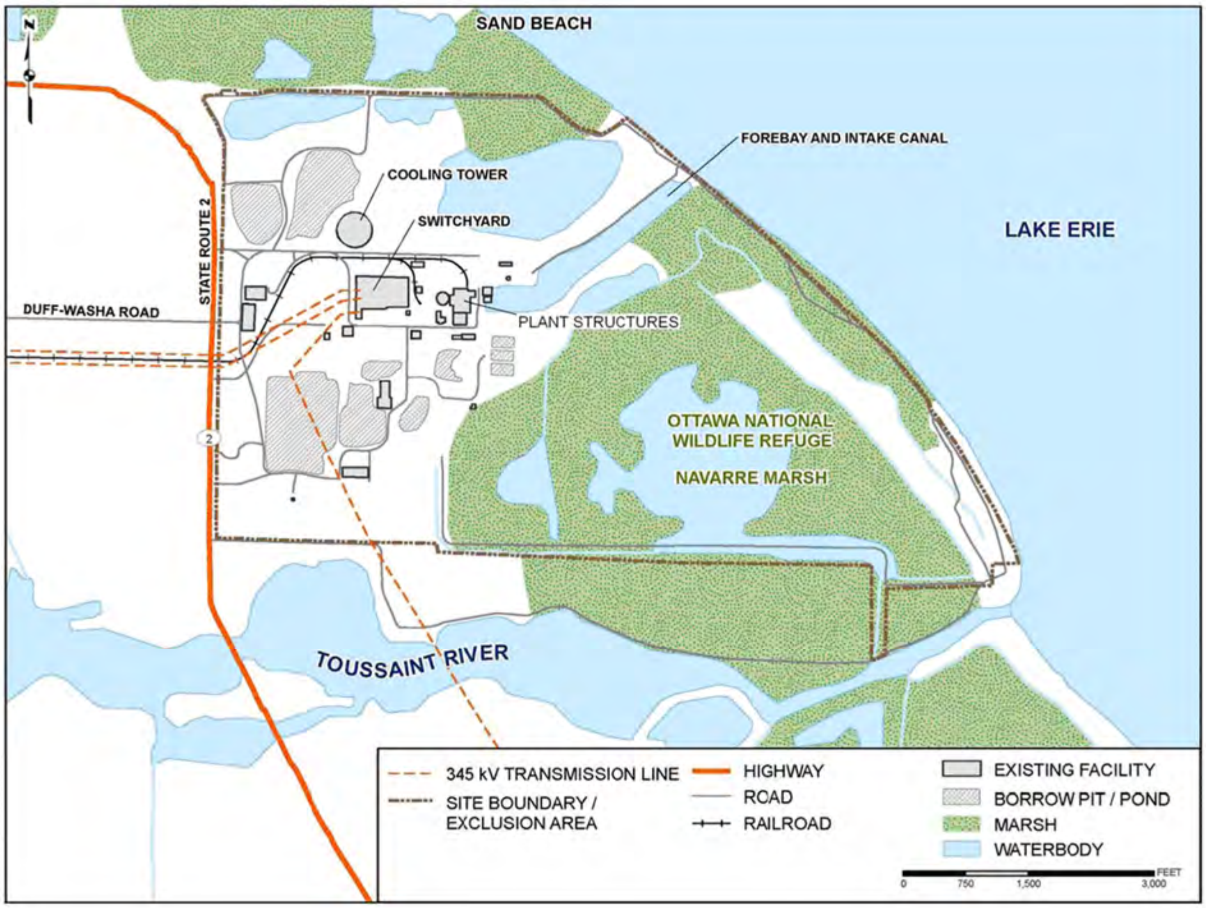
cc: DB-1 NRC Senior Resident Inspector

Attachment 1
L-09-300

Davis-Besse Nuclear Power Station
Area Map, 6-Mile Radius
Page 1 of 1

Attachment 2
L-09-300

Davis-Besse Nuclear Power Station Site Map
Page 1 of 1



FENOC
FirstEnergy Nuclear Operating Company

5501 North State Route 2
Oak Harbor, Ohio 43449

Barry S. Allen
Vice President - Nuclear

419-321-7676
Fax: 419-321-7582

November 12, 2009
L-09-299

Mr. Mark J. Epstein
Department Head
Resource Protection and Review
Ohio Historic Preservation Office
1982 Velma Avenue
Columbus, OH 43211-2497

SUBJECT:
Request for Information on Archaeological and Historic Resources

FirstEnergy Nuclear Operating Company (FENOC) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for the Davis-Besse Nuclear Power Station (Davis-Besse). If approved, the renewal term would be for an additional 20 years beyond the original Davis-Besse license expiration date in 2017.

As part of the license renewal process, the NRC requires (10 CFR 51.53(c)(3)(ii)(K)) license renewal applicants to assess whether any historic or archaeological properties will be affected by the proposed project. The NRC also may request, under Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800), an informal consultation with your office at a later date. By contacting you early in the application process, FENOC wishes to identify any potential issues that need to be addressed or information that your office may require to expedite the NRC consultation.

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio (Attachment 1). Coordinates for the station are 41º 35' 49" north Latitude and 83º 05' 16" west Longitude. The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge (Attachment 2). Approximately 100 miles of transmission lines were constructed to connect the station to the regional electric grid.

Based on consultation with the Ohio Historical Society prior to construction, there are no known deposits of archaeological interest on the site. A recent query of the Ohio Historic Preservation Office's Online Mapping System conducted for a 6-mile radius around the site identified 378 previously recorded cultural resources. This number includes buildings, archaeological sites, cemeteries, churches, and other structures.

Davis-Besse Nuclear Power Station
L-09-299
Page 2

Resource types range from a historic military base with many contributing structures to archaeological sites and individual architectural resources. One resource, a historic-period site (OT0025), appears to be located at the extreme southeastern corner of the station property. Only one resource was listed in the National Register of Historic Places, the Carroll Township Hall, located about 3.2 miles to the southwest of the Davis-Besse site.

FENOC has no plans to alter current Davis-Besse operations over the 20-year license renewal period. In addition, maintenance activities necessary to support license renewal would be limited to previously disturbed areas on site. License renewal at Davis-Besse would require neither the expansion of existing facilities nor additional land disturbance. As a result, FENOC is confident that continued operation of Davis-Besse during the license renewal period would have minimal impact on any archaeological or historic resources.

To ensure that impacts are adequately addressed, FENOC requests information from your office regarding concerns you may have, if any, related to potential impacts to listed archaeological and cultural resources from continued operation of Davis-Besse. FENOC would appreciate receiving a letter in reply detailing any concerns you may have or confirmation that no concerns exist. Receipt of your reply by December 31, 2009, will provide us the time needed to evaluate and incorporate the information into our license renewal application.

Thank you for your attention to our request.

Please feel free to contact Mr. Clifford Custer, Davis-Besse License Renewal Project Manager, at 724-682-7139. Please address any questions or need for additional information about the environmental review to:

Mr. Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

Telephone: 724-682-7139
Email: custerc@firstenergycorp.com

Sincerely,

Barry S. Allen

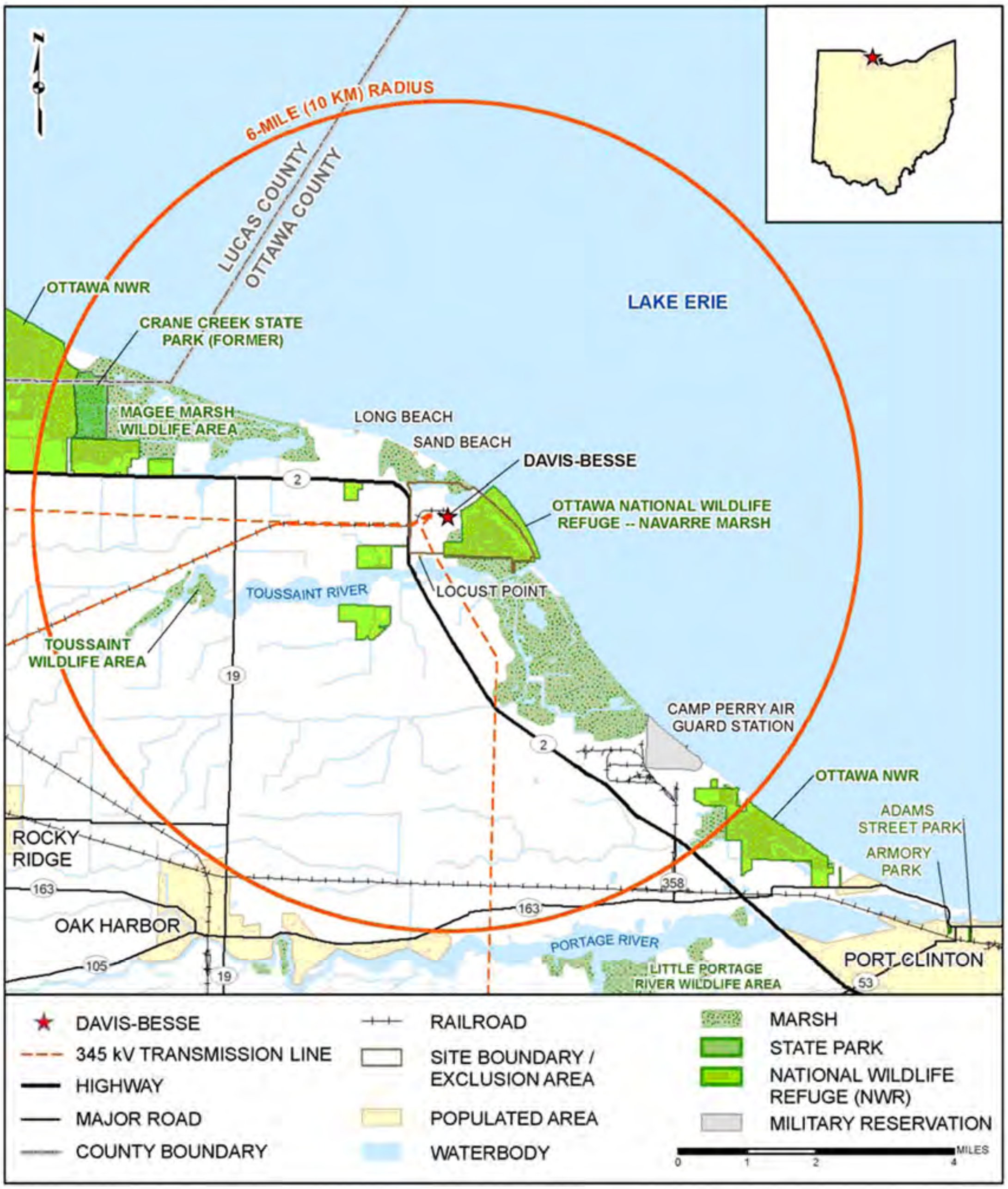
Davis-Besse Nuclear Power Station
L-09-299
Page 3

Attachments:
1. Davis-Besse Nuclear Power Station Area Map, 6-Mile Radius
2. Davis-Besse Nuclear Power Station Site Map

cc: DB-1 NRC Senior Resident Inspector

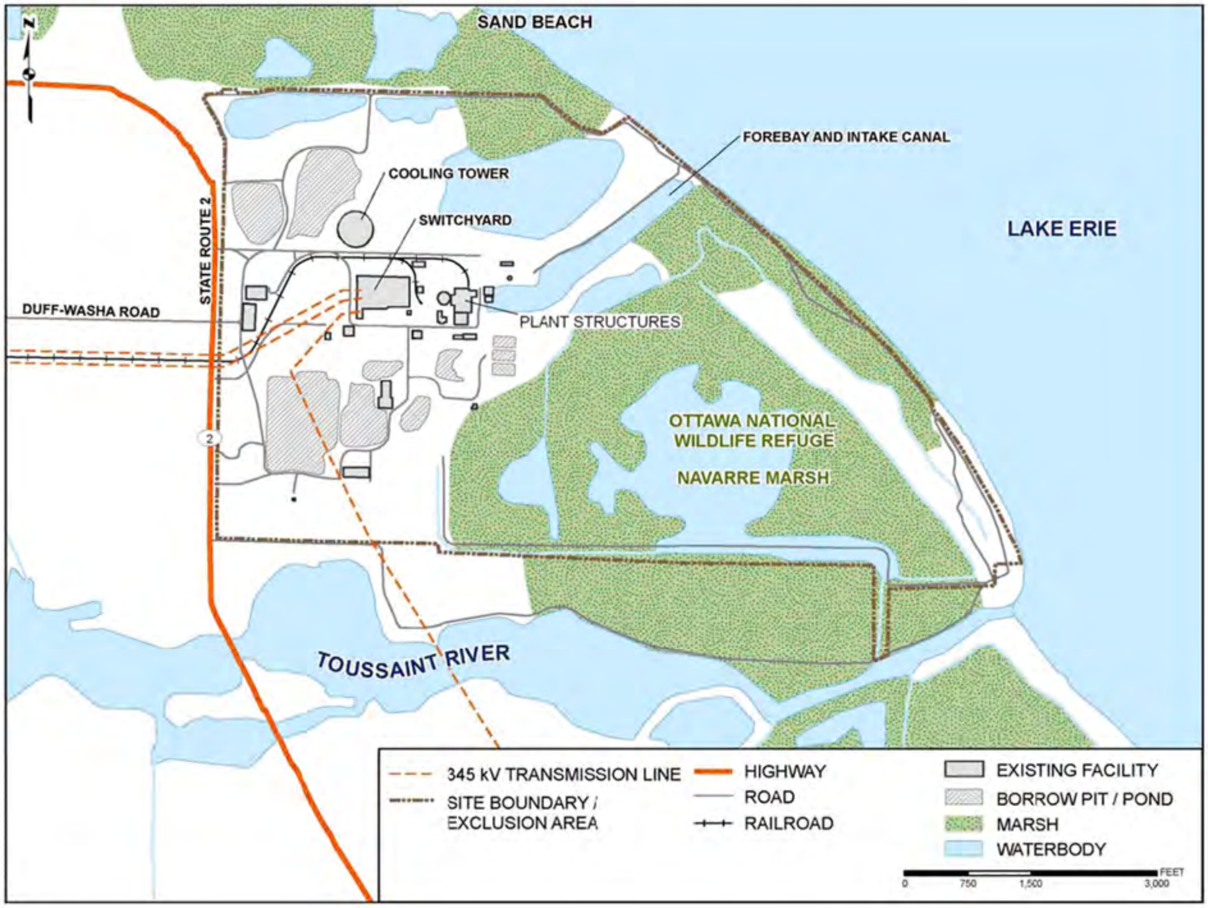
Attachment 1
L-09-299

Davis-Besse Nuclear Power Station
Area Map, 6-Mile Radius
Page 1 of 1



Attachment 2
L-09-299

Davis-Besse Nuclear Power Station Site Map
Page 1 of 1



OHIO
HISTORY

March 23, 2010

Clifford I. Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, Ohio 43449

Dear Mr. Custer:

Re: Davis-Besse Nuclear Power Station Renewal, Ottawa County, Ohio

This is in response to correspondence, received on November 16, 2009 regarding the renewal of the operating license for the Davis-Besse Nuclear Power Station in Ottawa County, Ohio. My comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, and the associated regulations at 36 CFR Part 800.

Based on the limited information included in your submission, the proposed license renewal, as the only action being reviewed, does not appear to have a high probability effecting historic properties. It is my opinion that the proposed license renewal will not affect historic properties.

No further coordination with this office is necessary unless there is a change in the project. Additionally, any future improvements or earthmoving activities at the Davis-Besse facility requiring review under the regulations at 36 CFR 800 will need to be coordinated with this office. If new or additional historic properties are discovered during implementation of this project, this office should be notified as required by 36 CFR 800.13.

If you have any questions regarding this matter, please call me, at (614) 298-2000. Thank you for your cooperation.

Sincerely,

Nathan J. Young, Project Reviews Manager
Resource Protection and Review

OHIO HISTORICAL SOCIETY
Ohio Historic Preservation Office
1982 Velma Avenue, Columbus, Ohio 43211-2497 ph: 614.298.2000 fx: 614.298.2037
www.ohiohistory.org

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Attachment D:

Coastal Zone Management Consistency

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COASTAL ZONE MANAGEMENT CONSISTENCY

This certification documents the FirstEnergy Nuclear Operating Company (FENOC) determination that U.S. Nuclear Regulatory Commission (NRC) renewal of the Davis-Besse Nuclear Power Station (Davis-Besse) operating license would be consistent with enforceable policies of the approved Ohio Coastal Management Program.

FENOC has patterned this certification after the example included as Appendix E to NRC, Nuclear Reactor Regulation Office, Instruction No. LIC-203, Revision 1 (**NRC 2004**). The certification describes background requirements, the proposed action, (i.e., license renewal), anticipated environmental impacts, Ohio enforceable coastal resource protection policies and Davis-Besse compliance status, and summary findings.

Ohio Coastal Management Program
Consistency Certification Statement

I, Barry S. Allen, do certify that the proposed activity complies with the enforceable policies of Ohio's approved coastal management program and will be conducted in a manner consistent with such program (16 U.S.C. § 1456 and O.R.C. §1506.03).

Address: Davis-Besse Nuclear Power Station, 5501 N. State Route 2

City: Oak Harbor State: OH Zip Code: 43449

Telephone Number: (419) 321 - 7676

Applicant's Signature: [Signature on file] Date: ____________

Project Name/Description: Davis-Besse Nuclear Power Station License Renewal / Submittal of a License Renewal Application to the U.S. Nuclear Regulatory Commission to renew the Davis-Besse Facility Operating License for an additional 20 years beyond the original license expiration date in 2017

Please list all local, State, and Federal permits, licenses, leases, and/or other authorizations required for this project:

1) Please refer to the Davis-Besse License Renewal Application, Appendix E, "Applicant's Environmental Report — Operating License Renewal Stage," Attachment D, "Coastal Zone Management Consistency," Table D-2, "Environmental Authorizations for Davis-Besse Operation."
2)
3)
4)

Please submit an original copy of this document signed by the applicant (not an agent or representative) with your Federal permit application or submit to:

Federal Consistency Coordinator
Ohio Department of Natural Resources
Office of Coastal Management
105 West Shoreline Drive
Sandusky, Ohio 44870

D.1 NECESSARY DATA AND INFORMATION

D.1.1 STATUTORY BACKGROUND

The Federal Coastal Zone Management Act (16 USC 1451 et seq.) imposes requirements on an applicant for a Federal license to conduct an activity that could affect a state's coastal zone. The Act requires an applicant to certify to the licensing agency that the proposed action would be consistent with the state's federally approved coastal zone management program. The Act also requires the applicant to provide to the state a copy of the certification statement and requires the state, at the earliest practicable time, to notify the federal agency and the applicant whether the state concurs with, or objects to, the consistency certification. See 16 USC 1456(c)(3)(A).

The National Oceanic and Atmospheric Administration (NOAA) has promulgated implementing regulations that indicate the certification requirement is applicable to renewal of federal licenses for activities not previously reviewed by the state [15 CFR 930.51(b)(1)]. NOAA approved the Ohio coastal zone management program in May 1997. In Ohio, the approved program is the Ohio Coastal Management Program (OCMP), which was authorized by the Ohio General Assembly passage of the Ohio Coastal Management Law in 1988. (**ODNR 2009b**)

Ohio has a networked coastal management program, which means the program is based on several different state authorities. The Ohio Department of Natural Resources (ODNR) serves as the lead agency (**ODNR 2009b**). The Coastal Management Program Document describes the major components of the program and has been updated several times to reflect changes in Ohio Revised and Administrative codes, and organizational changes. The document was most recently updated and federal re-approved in April 2007. (**NOAA 2007**)

The OCMP does not affect all activities and projects in the coastal area. Only those activities considered to have a direct and significant impact on the coastal lands, waters and resources are identified as managed activities. Consequently, of the 41 policies in the OCMP, all or portions of 30 policies are enforceable. The remaining 11 polices are enhancement policies. The polices are enforced pursuant to Ohio Revised Code, Title 15, Conservation of Natural Resources, Chapter 1506, Coastal Zone (O.R.C. 1506).

Table D-1 lists the enforceable policies of the OCMP and discusses for each the applicability to Davis-Besse and, where applicable, the FENOC basis for certifying consistency. Table D-2 provides a list of all certifications, permits, and authorizations for current operation of Davis-Besse.

D.1.2 PROPOSED ACTION

FENOC is applying to the NRC for renewal of the Davis-Besse license to operate for an additional 20 years beyond the current expiration date of April 22, 2017. FENOC expects Davis-Besse operations during the license renewal term to be a continuation of current operations as described in the following paragraphs, with no changes that would affect the Ohio coastal zone. FENOC certifies that license renewal complies with the enforceable program policies of the Ohio approved coastal management program and that continued plant operation will be conducted in a manner consistent with such policies.

D.1.3 BACKGROUND INFORMATION

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio. Nearby communities include Oak Harbor approximately 8 miles southeast, Fremont 16 miles south, and Toledo 24 miles west northwest.

The site consists of 954 acres, of which approximately 733 acres are marshland that is leased to the U.S. Government as a national wildlife refuge. To the west is the main unit of the Ottawa National Wildlife Refuge and the State of Ohio Magee Marsh Wildlife Area. On the southern boundary is the Toussaint River, which empties into Lake Erie 700 feet from the lake shoreline site boundary. The land area surrounding the site is generally agricultural with no major industry in the vicinity.

Davis-Besse is a single-unit plant with a pressurized water reactor and turbine generator licensed for an output of 2,817 megawatts-thermal (MWt), and an electric rating of 908 megawatts-electric (MWe) gross. The plant employs a closed-cycle circulating water system that withdraws water from and discharges water to Lake Erie in accordance with a state-issued National Pollutant Discharge Elimination System (NPDES) discharge permit. Heat is rejected from the main condenser via a natural draft hyperbolic cooling tower, whose blowdown and service water discharge to the lake via a submerged jet. The discharge permit also encompasses storm water runoff and effluent from an onsite wastewater treatment plant.

Three high-voltage transmission lines were built to connect Davis-Besse to Toledo Edison (a FirstEnergy transmission company) transmission 345 kV substations. The transmission lines occupy rights of way of approximately 1,800 acres, primarily flat agricultural land, with routine vegetation maintenance of the transmission line corridors approximately every five years. Maintenance includes removal or pruning of woody vegetation as necessary to ensure adequate line clearance (no less than 30 feet from the conductor for transmission lines operated above 138 kV) and to allow vehicular access for maintenance.

FENOC employs approximately 885 employees and contractor employees at Davis-Besse. Approximately 88% reside in the four contiguous counties of Ottawa, Lucas, Wood, and Sandusky. During refueling outages, which occur about every two years and average about 48 days in length, site employment is supplemented with the addition of an average 1,300 temporary workers.

D.2 ENVIRONMENTAL IMPACTS

D.2.1 BACKGROUND INFORMATION

The NRC has prepared a Generic Environmental Impact Statement (**NRC 1996**) on impacts that nuclear power plant license renewal could have on the environment and has codified its findings (10 CFR Part 51, Subpart A, Appendix B, Table B-1). The codification identified 92 potential environmental issues, 69 of which the NRC identified as having small impacts and termed "Category 1 issues." The NRC defines "SMALL" as:

> *SMALL – For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purpose of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small as the term is used in this table (10 CFR Part 51, Subpart A, Appendix B, Table B-1).*

The NRC based its assessment of license renewal impacts on its evaluations of impacts from current plant operations. The NRC codification and the Generic Environmental Impact Statement discuss the following types of Category 1 environmental issues:

- Surface water quality, hydrology, and use
- Aquatic ecology
- Groundwater use and quality
- Terrestrial resources
- Air quality
- Land use
- Human health
- Postulated accidents
- Socioeconomics
- Uranium fuel cycle and waste management
- Decommissioning

In its decision making for plant-specific license renewal applications, absent new and significant information to the contrary, the NRC relies on its codified findings, as amplified by supporting information in the Generic Environmental Impact Statement, for assessment of environmental impacts from Category 1 issues [10 CFR 51.95(c)(4)].

For plants such as Davis-Besse that are located in a coastal zone, many of these issues involve potential impacts to the coastal zone. FENOC has adopted by reference the NRC findings and Generic Environmental Impact Statement analyses for the 61[1] applicable Category 1 issues.

The NRC regulation identified 21 issues as "Category 2," for which license renewal applicants must submit additional site-specific information.[2] Of these, 12 apply to Davis-Besse[3], and like the Category 1 issues, could potentially involve impacts to the coastal zone. The applicable issues and FENOC's impact conclusions are listed below.

- Aquatic ecology:
  - Entrainment of fish and shellfish in early life stages – This issue addresses mortality of organisms small enough to pass through the plant's circulating cooling water system. The Ohio Environmental Protection Agency (OEPA), in issuing the plant's NPDES discharge permit, has determined that the plant maintains the best available technology to minimize impact. FENOC concludes that these impacts are SMALL during current operations and has no plans that would change this conclusion for the license renewal term.
  - Impingement of fish and shellfish – This issue addresses mortality of organisms large enough to be caught by intake screens before passing through the plant's circulating cooling water system. The NPDES permit also addresses impingement. FENOC concludes that these impacts are SMALL during current operations and has no plans that would change this conclusion for the license renewal term.
  - Heat shock – This issue addresses mortality of aquatic organisms by exposure to heated plant effluent. The OEPA, in issuing the plant's NPDES discharge permit, has determined that more stringent limits on the heated effluent are not necessary to protect the aquatic environment. FENOC

[1] The remaining Category 1 issues do not apply to Davis-Besse because they are associated with design or operational features that Davis-Besse does not have, e.g., once-through cooling.

[2] 10 CFR Part 51, Subpart A, Appendix B, Table B-1 also identifies two issues as "NA" for which the NRC could not come to a conclusion regarding categorization. FENOC believes that these issues, chronic effects of electromagnetic fields and environmental justice, do not affect the "coastal zone" as that phrase is defined by the Coastal Zone Management Act [16 USC 1453(1)].

[3] The remaining Category 2 issues do not apply to Davis-Besse because they are associated with design or operational features that Davis-Besse does not have, e.g., once-through cooling.

concludes that these impacts are SMALL during current operations and has no plans that would change this conclusion for the license renewal term.

- Threatened or endangered species: This issue addresses effects that Davis-Besse operations potentially could have on species that are listed under federal law as threatened or endangered. In analyzing this issue, FENOC has also considered species that are listed under Ohio law. Table D-3 lists the threatened and endangered animal and plant species whose range is known to occur in the vicinity of Davis-Besse. FENOC has identified no adverse impacts to these species and consultation with cognizant state and Federal agencies has identified no impacts of concern (**ODNR 2009a, b**; **NMFS 2010**; **USFWS 2009**). FENOC concludes that Davis-Besse impacts to these species are SMALL during current operations and has no plans that would change this conclusion for the license renewal term.

- Human health: Electromagnetic fields, acute effects (electric shock) – This issue addresses the potential for shock from induced currents, similar to static electricity effects, in the vicinity of transmission lines. Because this strictly human-health issue does not directly or indirectly affect natural resources of concern within the Coastal Zone Management Act definition of "coastal zone" [16 USC 1453(1)], FENOC concludes that the issue is not subject to the certification requirement.

- Socioeconomics:

  - Housing – This issue addresses impacts that Davis-Besse employees required to support license renewal could have on local housing availability. The NRC concluded, and FENOC concurs, that impacts would be SMALL for plants located in high population areas with no growth control measures. Using the NRC definitions and categorization methodology, Davis-Besse is located in a high population area and locations where additional employees would probably live do not have growth control measures. In addition, as FENOC does not intend to add additional permanent employees to the Davis-Besse workforce, FENOC concludes that impacts during the Davis-Besse license renewal term would be SMALL.

  - Public services; public utilities – This issue address impacts that adding license renewal workers could have on public water supply systems. FENOC has analyzed the availability of public water supplies in candidate locales and has found no limitations that would suggest that additional Davis-Besse workers would cause impacts. As FENOC does not intend to add additional permanent employees to the Davis-Besse workforce, FENOC concludes that impacts during the Davis-Besse license renewal term would be SMALL.

- o Offsite land use – This issue addresses impacts that local government spending of plant property tax dollars can have on land use patterns. Davis-Besse property tax payments are less than 10% of the regional tax revenue and nearly 20% of the local tax revenue. FENOC expects this tax revenue distribution to remain generally unchanged during the license renewal term. The NRC concluded, and FENOC concurs, that impacts to offsite land use would be small if tax payments are less than 10% percent of total revenue and moderate if payments are 10-20%. FENOC concludes that regional impacts during the Davis-Besse license renewal term would be SMALL and that local impacts would be MODERATE, but positive.

- o Public services; transportation – This issue addresses impacts that adding license renewal workers could have on local traffic patterns. As FENOC does not intend to add additional employees to the permanent workforce for the license renewal term, this would result in SMALL impacts

- o Historic and archaeological resources – This issue addresses impacts that license renewal activities could have on resources of historic or archaeological significance. Although a number of archaeological or historic sites have been identified near the Davis-Besse site or associated transmission lines, FENOC is not aware of any adverse or detrimental impacts to these sites from current operations and FENOC has no plans for license renewal activities that would disturb these resources. FENOC correspondence with the Ohio Historic Society, State Historic Preservation Officer, identified no issues of concern. .

- o Severe accidents – The NRC determined that the license renewal impacts from severe accidents would be small, but that applicants should perform site-specific analyses of ways to further mitigate impacts. Results from the FENOC severe accident mitigation alternatives (SAMA) analysis have not identified any cost-beneficial enhancements to further mitigate risk to public health and the economy in the area of the plant, including the coastal zone, due to potential severe accidents at Davis-Besse.

D.2.2 FINDINGS

1. The NRC has found that the environmental impacts of Category 1 issues are SMALL. FENOC has adopted by reference NRC findings for Category 1 issues applicable to Davis-Besse.

2. For Category 2 issues applicable to Davis-Besse, FENOC has determined that the environmental impacts are SMALL or if larger have a positive benefit.

3. To the best of FENOC's knowledge, Davis-Besse is in compliance with Ohio licensing and permitting requirements and is in compliance with its state-issued licenses and permits (Table D-2).

4. FENOC's license renewal and continued operation of Davis-Besse would be consistent with the enforceable provisions of the Ohio Coastal Zone Management Program.

D.3 STATE NOTIFICATION

By this certification that Davis-Besse license renewal is consistent with the Ohio Coastal Management Program, the State of Ohio is notified that, pursuant to 15 CFR 930.63(a), it has six months from the receipt of this letter and accompanying information in which to concur with or object to the FENOC certification. However, pursuant to 15 CFR 930.63(b), if Ohio has not issued a decision within three months following commencement of State agency review, it shall notify the contacts listed below of the status of the matter and the basis for further delay. The State's concurrence, objections, or notification of review status shall be sent to the following contacts:

Ms. Paula E. Cooper
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 020852-2738

Mr. Clifford Custer
Davis-Besse License Renewal Project Manager
Mail Stop 3370
Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, OH 43449

D.4 REFERENCES

NMFS 2010. Northeast Region, National Marine Fisheries Service, National Oceanic Atmospheric Administration, U.S. Department of Commence, NMFS letter, M.A. Colligan to B. Allen (FENOC) January 15, 2010, Gloucester, Massachusetts.

NOAA 2007. Combined Coastal Management Program and Final Environmental Impact Statement for the State of Ohio, Vol. 1, Office of Ocean and Coastal Resource Management, National Oceanic Atmospheric Administration, U.S. Department of Commence, Revised April 2007.

NRC 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), NUREG-1437, Volumes 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1996.

NRC 2004. Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues, NRR Office Instruction No. LIC-203, Revision 1, U.S. Nuclear Regulatory Commission, May 24, 2004.

ODNR 2009a. Ohio Department of Natural Resources, Division of Wildlife, ODNR letter, J. Navarro to B. Allen (FENOC), December 22, 2009, Columbus, Ohio.

ODNR 2009b. Ohio Department of Natural Resources, Division of Wildlife, ODNR e-mail, B. Mitch to C.I. Custer (FENOC), December 22, 2009, Columbus, Ohio.

USFWS 2009. U.S. Fish and Wildlife Service, U.S. Department of Interior, USFWS letter, M.K. Knapp to B. Allen (FENOC), TAILS #3142002010-TA-0132, December 16, 2009, Columbus, Ohio.

Table D-1. Ohio Coastal Management Program Enforceable Polices

POLICY	CONSISTENCY JUSTIFICATION
Coastal Erosion and Flooding (1-4)	
POLICY 1 − LAKE ERIE COASTAL EROSION AREA MANAGEMENT Minimize threats to human safety and property due to Lake Erie-related erosion while protecting the functions of natural shore features. {Pursuant to O.R.C. 1506.06 and 1506.07, ODNR administers a permit system for construction, erection and redevelopment of permanent structures within Lake Erie coastal erosion areas.}	FENOC is unaware of any impacts to coastal erosion from Davis-Besse operations. In addition, license renewal will not include any construction-related projects.
POLICY 2 − SHORE EROSION CONTROL Promote sound decisions regarding control of shore erosion. {Pursuant to O.R.C. 1521.22, any person planning to construct a beach, groin or other structure that will arrest or control erosion, wave action or inundation along or near the Ohio shore of Lake Erie must first submit plans and specifications to ODNR for review.}	Not applicable – This policy applies to land-disturbing activities that FENOC has no plans to undertake at Davis-Besse for the purpose of license renewal.
POLICY 3 − FLOODPLAIN MANAGEMENT: Minimize future flood damages and prevent potential loss to existing development in coastal floodplains. {O.R.C. 1506.04 mandates that all communities with coastal flood hazard areas designated under the Flood Disaster Protection Act of 1973 (P.L. 93-234) must either participate in the NFIP or enact regulations that meet or exceed the standards required for such participation.}	Not Applicable - Davis-Besse is a privately owned facility. In addition, license renewal will not include any construction-related projects.
POLICY 4 − FLOOD PROTECTION AND MITIGATION Promote effective flood protection. {Pursuant to O.R.C. 1521.06 et seq., the ODNR Division of Water requires construction	Not Applicable – This policy applies to land-disturbing activities, such as construction of dams, dikes, and levees, that FENOC has no plans to undertake at Davis-Besse for the purpose of license renewal.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
permits for new dams, dikes and levees and makes periodic inspections of existing dams, dikes and levees}	
Water Quality (6,7,9,11,)	
POLICY 6 − WATER QUALITY Maintain and improve the quality of the state's coastal waters for the purpose of protecting the public health and welfare and to enable the use of such waters for public water supply, industrial and agricultural needs, and propagation of fish, aquatic life and wildlife. {Water quality standards set forth in O.A.C. Chapter 3745-1, which establish minimum requirements for all surface waters of the state, have been approved by the U.S. Environmental Protection Agency (USEPA), as well as the enforcement procedures and authorities of OEPA.}	Davis-Besse operations are consistent with its NPDES permit requirements, which are based on federally approved water quality standards, and FENOC has no plans that would change this practice for the license renewal term.
POLICY 7 − ENVIRONMENTAL CONTAMINANTS: PREVENTION AND EMERGENCY RESPONSE Prevent and/or minimize to the greatest extent possible, damages to the public health, safety and welfare, and to the environment from contaminants. {Pursuant to O.R.C. 3745.01, OEPA administers the laws pertaining to chemical emergency planning, community right-to-know, and toxic chemical release reporting.}	Davis-Besse has a spill prevention control and countermeasure (SPCC) plan and related emergency response procedures. In addition, Davis-Besse's storm water runoff is covered by its NPDES permit, which is evidence of state water quality (401) certification.
POLICY 9 − POTABLE WATER SUPPLY Ensure that a safe supply of water is available for private, community, industrial, agricultural and commercial uses along Lake Erie. {OEPA's Division of Drinking and Ground Waters ensures that a safe supply of water is available per P.L. 93-523, the Safe Drinking	Davis-Besse receives its potable water from an off-site public water supply system, the Carroll Township Water System.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
Water Act and its Amendments 42 U.S.C. 300(f) et seq.}	
POLICY 11 − GROUND WATER Promote the protection and management of Ohio's ground water resources. {Ohio's Department of Health, OEPA, and State Fire Marshal administer the state's ground water programs relating to water quality concerns, including implementation of permits, monitoring and planning activities. and technical assistance to local governments per O.R.C 1509, 3701, 3718, 6109, 6111 and O.A.C. 3701 and 3745.}	Davis-Besse operations do not use ground water and FENOC has no plans that would change this process for the license renewal term. In addition, Davis-Besse has a ground water monitoring network to detect potential contaminantes.
Ecologically Sensitive Resources (12,14,15)	
POLICY 12 − WETLANDS Protect, preserve and manage wetlands with the overall goal to retain the state's remaining wetlands, and, where feasible, restore and create wetlands to increase the state's wetlands. {All coastal area wetlands fall within the jurisdiction of the U.S. Army Corps of Engineers (COE) in regulating activities under the Rivers and Harbors Act of 1899 (Section 10) and/or the Clean Water Act (CWA), Section 404. The scope of Ohio's authority under Section 401 of the CWA and Ohio water pollution control laws (O.R.C. 6111 and O.A.C. 3745) is coterminous with that of the COE and covers all surface waters within the coastal area, including wetlands.}	Davis-Besse's associated Navarre Marsh site wetlands are protected habitat that is managed cooperatively by FENOC and the Ottawa National Wildlife Refuge. FENOC has no plans that would change this practice for the license renewal term. In addition, Davis-Besse's storm water runoff is covered by its NPDES permit, which is evidence of state water quality (401) certification.
POLICY 14 − RARE AND ENDANGERED SPECIES Preserve and protect rare, threatened and endangered plant and animal species to prevent their possible extinction. {ODNR's Division of Wildlife protects fish and	FENOC has identified no adverse impacts to these species from Davis-Besse operation and consultation with cognizant state and Federal agencies has identified no impacts of concern related to Davis-Besse license renewal.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
wildlife species threatened with statewide extinction per O.R.C. 1531.25.}	
POLICY 15 − EXOTIC SPECIES Prevent introduction of and control exotic species to preserve the balance and diversity of natural ecosystems of Ohio's Lake Erie region. {ODNR’s Division of Wildlife and Division of Natural Areas and Preserves prevent introduction of and control exotic species to preserve the balance and diversity of natural ecosystems per to O.R.C. 927 and O.A.C. 1501.}	Not Applicable – Davis-Besse is an electric generating facility that neither sells nor imports exotic species and FENOC has no plans during license renewal that would change this practice.
Ports and Shore Area Development (16,17)	
POLICY 16 − PUBLIC TRUST LANDS Protect the public trust held waters and lands underlying the waters of Lake Erie, protect public uses of Lake Erie and minimize the occupation of public trust lands for private benefit. {ODNR protects the public trust held waters and lands underlying the waters of Lake Erie per O.R.C. 1506.11 and O.A.C. 1501-6-01 through 1501-6-06}.	Davis-Besse license renewal will not include any construction-related projects that would affect public trust lands.
POLICY 17 − DREDGING AND DREDGED MATERIAL DISPOSAL Provide for the dredging of harbors, river channels and other waterways and to protect the water quality, public right to navigation, recreation and natural resources associated with these waters in the disposal of the dredged material. {OEPA regulates discharges of dredged materials into Ohio waters through a state water quality certification that the discharge will comply with the Clean Water Act per O.R.C. 6111.03(P).}	Davis-Besse license renewal will not include any construction-related projects. Dredging to maintain the intake canal, if needed, is coordinated through the OEPA, which would include a 401 certification.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
Recreational and Cultural Resources (21,23,24,26)	
POLICY 21 − LAKESHORE RECREATION AND ACCESS Provide lakeshore recreational opportunities and public access and encourage tourism along Lake Erie. {ODNR's Division of Parks and Recreation is charged with the development, operation and maintenance of a system of state parks in Ohio for the recreational use of the citizens of Ohio (O.R.C. Chapter 1541)}	Due to the heightened national security situation and at the direction of the U.S. Nuclear Regulatory Commission, Davis-Besse has closed its lakeshore area to public access for recreation. However, adequate lakeshore access is available nearby and will remain available during license renewal.
POLICY 23 − RECREATIONAL BOATING Satisfy and serve the public interest for recreational boating opportunities and watercraft safety in the coastal area {ODNR’s Division of Watercraft is responsible for the enforcement of the state watercraft laws and pursuant regulations (O.R.C. Chapter 1547).}	Due to the heightened national security situation and at the direction of the U.S. Nuclear Regulatory Commission, Davis-Besse has closed its lakeshore area to public access for recreational boating. However, adequate lakeshore access for recreational boating is available nearby and will remain available during license renewal.
POLICY 24 − FISHING AND HUNTING Provide expanded sport fishing and safe hunting opportunities in the coastal area. {ODNR’s Division of Wildlife issues hunting, trapping, and fishing licenses per O.R.C. 1533 and conducts related safety programs.}	Due to the heightened national security situation and at the direction of the U.S. Nuclear Regulatory Commission, Davis-Besse has closed its lakeshore area to public access to fishing and hunting. However, adequate lakeshore access for fishing and hunting is available nearby and will remain available during license renewal.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
POLICY 26 − PRESERVATION OF CULTURAL RESOURCES Provide for the preservation of cultural resources to ensure that the knowledge of Ohio's history and pre-history is made available to the public and is not willfully or unnecessarily destroyed or lost. {The Ohio Historic Preservation Office (OHPO) within the Ohio Historical Society (OHS) coordinates cultural resource protection per O.R.C. 149 and 1506.}	FENOC is unaware of any Davis-Besse impacts on designated or registered historic districts or sites and license renewal will not alter this belief. FENOC has been in contact with the Ohio Historic Preservation Office, which is in agreement that license renewal for Davis-Besse is unlikely to affect historic sites or districts.
Fish and Wildlife Management (27,29)	
POLICY 27 − FISHERIES MANAGEMENT Assure the continual enjoyment of the benefits received from the fisheries of Lake Erie and to maintain and improve these fisheries. {ODNR's Division of Wildlife regulates fish habitats, including protection, preservation, propagation, and management per O.R.C. 1531.}	FENOC is unaware of any Davis-Besse impacts on the fisheries of Lake Erie and consultation with cognizant state and Federal agencies has identified no impacts of concern related to Davis-Besse license renewal.
POLICY 29 − WILDLIFE MANAGEMENT Provide for the management of wildlife in the coastal area to assure the continued enjoyment of benefits received from wildlife. {ODNR's Division of Wildlife regulates wildlife habitats, including protection, preservation, propagation, and management per O.R.C. 1531.}	FENOC promotes wildlife management through the lease of 733 acres of Davis-Besse property to wildlife preservation, including the Navarre Marsh and Ottawa National Wildlife Refuge.
Environmental Quality (30,31,32,33,)	
POLICY 30 − AIR QUALITY Attain and maintain air quality levels that protect public health and prevent injury to plant and animal life and property by surveying and monitoring air quality; enforcing national ambient air quality standards through permits and variances; and restricting open burning. (O.R.C. Chapters 3745, 3706 and 5709).	Davis-Besse operations are in compliance with its air pollution control permit application (Table D-2) and FENOC has no plans that would change this practice for the license renewal term. In addition, Davis-Besse promotes cleaner air in Ohio by avoiding emissions of greenhouse gases.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
{OEPA implements and enforces Ohio's State Implementation Plan (SIP), which is approved by USEPA, to control state-wide air pollution.}	
POLICY 31 − HAZARDOUS, SOLID AND INFECTIOUS WASTE MANAGEMENT Ensure that the generation of solid, infectious and hazardous waste is reduced as much as possible. {OEPA's Division of Hazardous Waste Management implements and enforces the management, transportation, treatment, storage and disposal of hazardous waste (O.R.C. Chapter 3745)}	Davis-Besse operations are in compliance with OEPA's solid and hazardous waste management requirements (Table D-2) and FENOC has no plans that would change this practice for the license renewal term.
POLICY 32 − MARINA FACILITIES Assure that marinas will provide adequate sanitary facilities for the watercraft using the marina, and that such marinas will be constructed, located, maintained, and operated in a sanitary manner so as not to create a nuisance or cause a health hazard (O.R.C. 3733.21 through 3733.30 and O.A.C. 3701-35). {Ohio Department of Health and local health departments regulate marina construction to assure proper sanitary facilities.}	Not Applicable - Davis-Besse is an electric generating facility that does not include a marina.
POLICY 33 − VISUAL AND AESTHETIC QUALITY Protect the visual and aesthetic amenities of Lake Erie and its shoreline to enhance the recreational, economic, cultural and environmental values inherently associated with the coastal area. {O.R.C. 3767.32, prohibits litter deposit on any public property, on private property not owned by that individual, or in or on waters of the state; O.R.C. 1531.29 prohibits the disposal of any litter into watercourses of the state or onto banks thereof.}	Davis-Besse operations are consistent with its environmental protection authorizations (Table D-2) and FENOC has no plans that would change this condition for the license renewal term.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY CON	SISTENCY JUSTIFICATION
Energy and Mineral Resources (34,35,36,37,38)	
POLICY 34 − ENERGY FACILITY SITING Provide for environmentally sound siting of major electric energy generating and transmission facilities in the coastal area, and to regulate the siting of these facilities to protect the health, safety, and welfare of Ohio's citizens and the natural resources of the state. {Per O.R.C. Chapter 4906, the Ohio Power Siting Board (PSB) within the Public Utilities Commission (PUCO) is the lead agency to implement a "one-stop" process for all permits involving the construction, operation, and maintenance of a major utility facility.}	Not applicable - Davis-Besse is an existing facility and FENOC has no plans for construction of additional electric generation facilities on the Davis-Besse site as part of license renewal.
POLICY 35 − ENERGY RESOURCE STORAGE AND TRANSSHIPMENT Regulate the storage of energy related resources (coal, oil and gas) in the coastal area through planning assistance and permit review to assure the safe and efficient use of these resources; and to ensure that air, water and other environmental standards are met (O.R.C. 4906.06 and O.A.C. 4906-13-02). { The Ohio Power Siting Board (PSB), as a part of the certification process described in Policy 34, reviews the location and layout of all storage areas for proposed major utility facilities per O.R.C. 4906.01(B)}.	Davis-Besse operations are in compliance with its diesel storage underground tank registration, air pollution control permit, and NPDES permit (Table D-2).
POLICY 36 − OIL AND NATURAL GAS DRILLING Protect public safety and welfare and the environment and assure wise management. {ODNR, Division of Mineral Resources Management (DMRM), requires a permit for any oil or natural gas drilling, including plugging and abandonment per O.R.C. 1509.05 and 1509.13}.	Not Applicable - Davis-Besse is an electric generating facility that does not conduct onshore or offshore oil or natural gas drilling.

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
POLICY 37 − OFFSHORE MINERAL EXTRACTION Provide for and regulate the extraction of minerals and other substances from and from under the bed of Lake Erie, through the issuance of Ohio Department of Natural Resources mineral leases and permits, to protect the public safety and welfare, and to minimize adverse environmental impacts, including adverse impacts on littoral owners' rights (O.R.C. 1505.07). {ODNR requires a lease or permit before removing sand, gravel, stone or other minerals or other substances from or from under the bed of Lake Erie per O.R.C. 1505.07.}	Not Applicable - Davis-Besse is an electric generating facility that does not conduct the extraction of mineral or other substances.
POLICY 38 − SURFACE MINING Regulate surface mining activities to minimize adverse environmental impacts, prevent damage to adjoining property, ensure reclamation of all affected areas through the issuance of Ohio Department of Natural Resources permits and see to the health and safety of all persons within the mining facility (O.R.C. 1514.02, 1514.021, 1561, 1563, 1565 and 1567). {ODNR, Division of Mineral Resources Management (DMRM), requires a permit prior to any surface mining activity per O.R.C. 1514.02(A)}.	Not Applicable – Davis-Besse is an electric generating facility that does not conduct surface mining.
Water Quantity (39, 41)	
POLICY 39 − WATER DIVERSION Manage diversion of Lake Erie and tributary waters. {ODNR regulates diversions in excess of 100,000 gallons per day out of and into the Lake Erie Basin per O.R.C. 1501.32 and O.A.C. 1501-2-01 through 1501-2-12}.	Davis-Besse operations are in compliance with its water withdrawal registration and NPDES permit (Table D-2).

Table D-1. Ohio Coastal Management Program Enforceable Polices
(continued)

POLICY	CONSISTENCY JUSTIFICATION
POLICY 41 − WATER MANAGEMENT Collect and analyze water resources information to promote water resources planning and management. {ODNR administers a water withdrawal facility registration program for water withdrawal facilities with a capacity of more than 100,000 gallons per day, a well closure program, and collects and analyzes data and develops governmental water supply plans per O.R.C. 1521 et seq.}	Partially Applicable - Davis-Besse operations are in compliance with its water withdrawal registration and well monitoring program (Table D-2). Otherwise, FENOC is a privately owned, non-governmental company that does not conduct water resources planning and management.

Table D-2: Environmental Authorizations for Davis-Besse Operation

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Authorized
Federal Authorizations					
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10CFR50.10	License to operate	NPF-3	Issued: 4/22/1977 Expires: 4/22/2017	Operation of Davis-Besse
U.S. Nuclear Regulatory Commission	10 CFR Part 72	Requirements to store spent nuclear fuel and high-level radioactive waste	Certificate Number 1004	Issued: 1/23/ 1995 Expires: 1/31/2015	Use of radioactive waste cask Model Number NUHOMS-24P
U.S. Department of Transportation	49 CFR Part 107, Subpart G	Hazardous material registration	042009 450 002RT	Issued: 5/19/2009 Expires: 6/30/2012 (Renewed Triennially)	Transportation of hazardous materials
U.S. Environmental Protection Agency	RCRA [42 U.S.C. s/s 321 et seq. (1976)]	Notification of regulated waste activity	EPA ID# OHD000720508	Issued: -- Expires: Indefinite	Generation and accumulation of hazardous waste
State and Local Authorizations					
Ohio Environmental Protection Agency, Division of Surface Water	Federal Water Pollution Control Act, as amended (33 U.S.C Section 1251 et seq.); Ohio Water Pollution Control Act (Ohio Revised Code Section 6111)	National Pollutant Discharge Elimination System (NPDES) Permit	Ohio Permit No. 2IB00011*ID	Issued: 9/1/2006 Expires: 4/30/2011 (every 5 years)	Treatment of wastewater and effluent discharge to surface receiving waters (Toussaint River and Lake Erie)

Table D-2: Environmental Authorizations for Davis-Besse Operation
(continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Authorized
Ohio Environmental Protection Agency, Division of Surface Water	Federal Water Pollution Control Act, as amended (33 U.S.C Section 1251 et seq.); Ohio Water Pollution Control Act (Ohio Revised Code Section 6111)	NPDES construction stormwater permit	Ohio Permit No. 2GC02563*AG	Issued: 12/21/ 2009 Expires: Upon project completion	Construction of Switchyard project and control-discharge of stormwater in Ottawa County, Carroll Township
Ohio Environmental Protection Agency, Division of Air Pollution Control	Clean Air Act, 40 U.S.C. 1857 et seq.; Ohio Air Pollution Control Act (Ohio Administrative Code Chapter 3745-31)	Permit to operate an air contaminant source	Permit Application No. 0362000091B001	Issued: Annual reporting Expires: Indefinite	Operation of station auxiliary boiler
Ohio Environmental Protection Agency, Division of Hazardous Waste Management	Ohio Administrative Code Chapter 3745-52-41	Report of regulated waste activity	EPA ID# OHD000720508	Issued: Annual reporting Expires: Indefinite	Generation, accumulation, and off-site disposal of hazardous waste
Ohio Department of Natural Resources, Division of Wildlife	Ohio Revised Code Section 1531.08	Scientific collection permit	Permit #10-21	Issued: Annually Expires: 3/15/2011	Collection of wildlife specimens for Radiological Environmental Monitoring Program (REMP)

Table D-2: Environmental Authorizations for Davis-Besse Operation
(continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Authorized
Ohio Department of Natural Resources, Division of Water Resources	Ohio Revised Code Section 1521.16	Water withdrawal and use registration and file annual report	Registration #00598	Issued: 1/1/1990 Expires: Indefinite	Withdraw and use of more than 100,00 gallons of water daily from all sources
Ohio Department of Health	Ohio Administrative Code 3701: 1-38-03(C); Ohio Revised Code 3748.06 and 3748.07	X-Ray generating equipment registration	Registration # 17-M-07181-005	Issued: Biennially Expires: 5/31/2010	Operation of X-ray generation equipment
Ohio Department of Commerce, Division of State Fire Marshal	Ohio Administrative Code 1301: 7-9-04	Underground storage tank registration	Certificate # 62000072	Issued: Annually Expires: 6/30/2011	Registration of underground diesel storage tanks T00001, T00002, and T00003
Tennessee Department of Environment and Conservation	Tennessee Code Annotated 68-202-206	License to deliver radioactive waste	Tennessee Delivery License # T-OH003-LO9	Issued: Annually Expires: 12/31/2010	Shipment of radioactive material to a licensed disposal-processing facility within the State of Tennessee

Table D-3: State and Federal Listed Endangered and Threatened Species Potentially Occurring in the Davis-Besse Site Vicinity

Common Name	Scientific Name	State Status	Federal Status
Plants			
alpine rush	*Juncus alpinus*	P	
American beach grass	*Ammophila breviligulata*	T	
American sweet flag	*Acorus americanus*	P	
American water milfoil	*Myriophyllum sibiricum*	T	
balsam poplar	*Populus balsamifera*	E	
baltic rush	*Juncus balticus*	P	
bearded wheat grass	*Elymus trachycaulus*	T	
Bebb's sedge	*Carex bebbii*	P	
bullhead-lily	*Nuphar variegata*	E	
bushy cinquefoil	*Potentilla paradoxa*	T	
Canada milk-vetch	*Astragalus canadensis*	T	
Caribbean spike-rush	*Eleocharis geniculata*	E	
deer's-tongue arrowhead	*Sagittaria rigida*	P	
Drummond's rock cress	*Arabis drummondii*	E	
prairie fringed orchid	*Platanthera leucophaea*	T	T
flat-stemmed pondweed	*Potamogeton zosteriformis*	P	
floating pondweed	*Potamogeton natans*	P	
Garber's sedge	*Carex garberi*	E	
golden fruited sedge	*Carex aurea*	T	
lakeside daisy	*Tetraneuris herbacea*	E	T
little green sedge	*Carex viridula*	P	
low umbrella sedge	*Cyperus diandrus*	P	
narrow-leaved blue-eyed grass	*Sisyrinchium mucronatum*	E	
ovate spike-rush	*Eleocharis ovata*	E	
Philadelphia panic grass	*Panicum philadelphicum*	E	
Pursh's bulrush	*Schoenoplectus purshianus*	P	
Richardson's pondweed	*Potamogeton richardsonii*	P	
rock elm	*Ulmus thomasii*	P	
Smith's bulrush	*Schoenoplectus smithii*	E	

Table D-3: State and Federal Listed Endangered and Threatened Species Potentially Occurring in the Davis-Besse Site Vicinity
(continued)

Common Name	Scientific Name	State Status	Federal Status
Smith's bulrush	*Scirpus smithii*	E	
southern wapato	*Lophotocarpus (=Sagittaria) calycinus*	P	
Sprengel's sedge	*Carex sprengelii*	T	
variegated scouring-rush	*Equisetum variegatum*	E	
wapato	*Sagittaria cuneata*	T	
wheat sedge	*Carex atherodes*	P	
wild rice	*Zizania aquatica*	T	
Invertebrates			
Insects			
Canada darner	*Aeshna canadensis*	E	
elfin skimmer	*Nannothemis bella*	E	
frosted elfin	*Incisalia irus*	E	
Karner blue	*Lycaeides melissa samuelis*	E	E
marsh bluet	*Enallagma ebrium*	T	
persius dusky wing	*Erynnis persius*	E	
plains clubtail	*Gomphus externus*	E	
purplish copper	*Lycaena helloides*	E	
silver-bordered fritillary	*Boloria selene*	T	
tiger beetle	*Cicindela hirticollis*	T	
unexpected cycnia	*Cycnia inopinatus*	E	
Mussels			
black sandshell	*Ligumia recta*	T	
deertoe	*Truncilla truncata*	SC	
eastern pondmussel	*Ligumia nasuta*	E	
fawnsfoot	*Truncilla donaciformis*	T	
purple wartyback	*Cyclonaias tuberculata*	SC	
rayed bean	*Villosa fabalis*	E	C
snuffbox	*Epioblasma triquetra*	E	
threehorn wartyback	*Obliquaria reflexa*	T	
wavy-rayed lampmussel	*Lampsilis fasciola*	SC	

Table D-3: State and Federal Listed Endangered and Threatened Species Potentially Occurring in the Davis-Besse Site Vicinity
(continued)

Common Name	Scientific Name	State Status	Federal Status
Fish			
burbot	*Lota lota*	SC	
channel darter	*Percina copelandi*	T	
cisco	*Coregonus artedii*	E	
eastern sand darter	*Ammocrypta pellucida*	SC	
lake sturgeon	*Acipensar fulvescens*	E	
lake whitefish	*Coregonus clupeaformis*	SC	
spotted gar	*Lepisosteus oculatus*	E	
Reptiles			
Blanding's turtle	*Emydoidea blandingi*	SC	
box turtle	*Terrapene Carolina*	SC	
eastern massasauga swamp rattler	*Sistrurus catenatus catenatus*	E	C
Kirtland's water snake	*Natrix kirtlandii*	T	
Lake Erie water snake	*Natrix sipedon insularium*	E	T
spotted turtle	*Clemmys guttata*	T	
Birds			
American bittern	*Botaurus lentiginosus*	E	
bald eagle	*Haliaeetus leucocephalus*	T	
black tern	*Chlidonias niger*	E	
Canada warbler	*Wilsonia canadensis*	SI	
golden-winged warbler	*Vermivora chrysoptera*	E	
hermit thrush	*Catharus guttatus*	T	
king rail	*Rallus elegans*	E	
Kirtland's warbler	*Dendroica kirtlandii*	E	E
least bittern	*Ixobrychus exilis*	T	
least flycatcher	*Empidonax minimus*	T	
loggerhead shrike	*Lanius ludovicianus*	E	
magnolia warbler	*Dendroica magnolia*	SI	
mourning warbler	*Oporornis philadelphia*	SI	
northern harrier	*Circus cyaneus*	E	
osprey	*Pandion haliaetus*	T	

Table D-3: State and Federal Listed Endangered and Threatened Species Potentially Occurring in the Davis-Besse Site Vicinity
(continued)

Common Name	Scientific Name	State Status	Federal Status
peregrine falcon	*Falco peregrinus*	T	
sandhill crane	*Grus canadensis*	E	
sharp-shinned hawk	*Accipiter striatus*	SC	
sora rail	*Porzana carolina*	SC	
Virginia rail	*Rallus limicola*	SC	
yellow-bellied sapsucker	*Sphyrapicus varius*	E	
Mammals			
star-nosed mole	*Condylura cristata*	SC	

Table Captions:

State Status

E: ENDANGERED **-** A native species or subspecies threatened with extirpation from the state.

T: THREATENED **-** A species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists.

SC: SPECIES OF CONCERN **-** A species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern but for which information is insufficient to permit an adequate status evaluation.

SI: SPECIAL INTEREST - A species that occurs periodically and is capable of breeding in Ohio. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance Ohio's wildlife diversity.

P: POTENTIALLY THREATENED - A native Ohio plant species may be designated potentially threatened if one or more of the following criteria apply:

1. The species is extant in Ohio and does not qualify as a state endangered or threatened species, but it is a proposed federal endangered or threatened species or a species listed in the Federal Register as under review for such proposal.

2. The natural populations of the species are imperiled to the extent that the species could conceivably become a threatened species in Ohio within the foreseeable future.

Table D-3: State and Federal Listed Endangered and Threatened Species Potentially Occurring in the Davis-Besse Site Vicinity
(continued)

3. The natural populations of the species, even though they are not threatened in Ohio at the time of designation, are believed to be declining in abundance or vitality at a significant rate throughout all or large portions of the state.

Federal Status

E: ENDANGERED – An animal or plant species in danger of extinction throughout all or a significant part of its range.

T: THREATENED - Likely to become endangered within the foreseeable future throughout all or a significant part of its range.

C: CANDIDATE - Sufficient information exists to support listing as endangered or threatened

Attachment E:

Severe Accident Mitigation Alternatives Analysis

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Executive Summary

The purpose of the analysis is to identify severe accident mitigation alternative (SAMA) candidates at Davis-Besse Nuclear Power Station (Davis-Besse) that have the potential to reduce severe accident risk and to determine if implementation of each SAMA candidate is cost beneficial. The cost-benefit evaluation is required by the Nuclear Regulatory Commission regulations governing the license renewal process.

A summary of the Davis-Besse Level 1 PRA and Level 2 PRA is provided. A Level 3 PRA model was developed to support the SAMA analysis. The development of the Level 3 PRA input files, execution of the base case, and execution of sensitivity cases are described. Dose and economic consequence metrics from the Level 3 PRA, combined with the release category frequency vector (from the Level 1 PRA and Level 2 PRA), have been used as input to the SAMA cost-benefit analysis.

A set of SAMA candidates was developed using industry and Davis-Besse-specific information. Qualitative screening criteria (not applicable to Davis-Besse, already implemented at Davis-Besse, low benefit, high costs) were applied. For the SAMA candidates screened as considered for further evaluation, PRA cases were run to estimate the delta core damage frequency and an expert panel was convened to estimate the implementation costs. Several input parameters were subject to sensitivity analysis.

The cost-benefit evaluation of SAMA candidates performed for Davis-Besse provides significant insight into the continued operation of Davis-Besse. The results of the evaluation of 167 SAMA candidates indicate no enhancements to be cost-beneficial for implementation at Davis-Besse.

However, the sensitivity cases performed for this analysis found one SAMA candidate (AC/DC-03) to be cost-beneficial for implementation at Davis-Besse under the assumptions of three of the sensitivity cases (lower discount rate, replacement power, and multiplier). SAMA candidate AC/DC-03 considered the addition of a portable diesel-driven battery charger for the DC system. While the identified SAMA candidate is not related to plant aging and therefore not required to be resolved as part of the relicensing effort, FENOC will, nonetheless, consider implementation of this candidate through normal processes for evaluating possible changes to the plant.

The cost-benefit evaluation performed used several modeling conservatisms. These conservative assumptions, combined with the results of several sensitivity cases, demonstrate the robustness of the SAMA analysis results.

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Acronyms and Abbreviations

AC	Alternating Current
AFW	Auxiliary Feedwater
AMSAC	ATWS Mitigation System Actuation Circuitry
AOC	Averted Off-site Property Damage Cost
AOE	Averted Occupational Exposure
AOSC	Averted On-site Cost
AOV	Air-Operated Valve
APE	Averted Public Exposure
ATWS	Anticipated Transient Without Scram
BWR	Boiling Water Reactor
B&W	Babcock & Wilcox
BWST	Borated Water Storage Tank
CAFTA	Computer-Aided Fault Tree Analysis
CCF	Common Cause Failure
CCW	Component Cooling Water
CDF	Core Damage Frequency
CET	Containment Event Tree
CIV	Containment Isolation Valve
CST	Condensate Storage Tank
CWRT	Clean Waste Receiver Tank
DC	Direct Current
DHR	Decay Heat Removal
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
EPZ	Emergency Planning Zone
FCIA	Fire Compartment Interaction Analysis
FIVE	Fire Induced Vulnerability Evaluation
FSAR	Final Safety Analysis Report

Acronyms and Abbreviations
(continued)

FTREX	Fault Tree Reliability Evaluation eXpert
F-V	Fussell-Vesely
GL	Generic Letter
HEP	Human Error Probability
HPI	High Pressure Injection
HRA	Human Reliability Analysis
HVAC	Heating, Ventilation, and Air Conditioning
ICS	Integrated Control System
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination – External Events
ISLOCA	Interfacing Systems Loss of Coolant Accident
LERF	Large Early Release Frequency
LOCA	Loss of Coolant Accident
LOOP	Loss of Off-site Power
LPI	Low Pressure Injection
LPR	Low Pressure Recirculation
MAAP	Modular Accident Analysis Program
MACCS2	MELCOR Accident Consequence Code System
MCC	Motor Control Center
MDFP	Motor-Driven Feedwater Pump
MFW	Main Feedwater
MGL	Multiple Greek Letter
MSIV	Main Steam Isolation Valve
MSSV	Main Steam Safety Valve
NFPA	National Fire Protection Association
NNI	Non-Nuclear Instrumentation
NRC	Nuclear Regulatory Commission
PAMS	Post Accident Monitoring System
PCAQR	Potential Condition Adverse to Quality Report
PDS	Plant Damage State

Acronyms and Abbreviations
(continued)

PORV	Power Operated Relief Valve
PRA	Probabilistic Risk Assessment
PWR	Pressurized Water Reactor
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RPV	Reactor Pressure Vessel
RRW	Risk Reduction Worth
SAMG	Severe Accident Management Guideline
SAMA	Severe Accident Mitigation Alternative
SBO	Station Blackout
SER	Safety Evaluation Report
SGTR	Steam Generator Tube Rupture
SMA	Seismic Margin Assessment
SPDS	Safety Parameter and Display System
SQUG	Seismic Qualifications Utility Group
SRV	Safety Relief Valve
SSIE	Support System Initiating Event
TDAFW	Turbine-Driven Auxiliary Feedwater
USAR	Updated Safety Analysis Report

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E.1 INTRODUCTION

E.1.1 PURPOSE

The purpose of the analysis is to identify severe accident mitigation alternative (SAMA) candidates at Davis-Besse Nuclear Power Station (Davis-Besse) that have the potential to reduce severe accident risk and to determine if implementation of each SAMA candidate is cost-beneficial. The cost-benefit evaluation is required by the Nuclear Regulatory Commission (NRC) regulations governing the license renewal process.

E.1.2 REQUIREMENTS

As part of the Environment Report prepared to support the Davis-Besse License Renewal Application, 10 CFR Part 51 contains the requirements to perform a SAMA analysis, as noted below.

<u>10 CFR 51.53(c)(3)(ii)(L)</u>

The environmental report must contain a consideration of alternatives to mitigate severe accidents

> *… if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environment assessment ...*

<u>10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76 (Severe Accidents)</u>

> *… The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives….*

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E.2 METHODOLOGY

The SAMA analysis approach used for the Davis-Besse assessment consisted of the following steps:

- **Determine Severe Accident Risk**

  Level 1 and 2 Probabilistic RIsk Assessment (PRA) Model

  The results of the Davis-Besse Level 1 PRA and Level 2 PRA models were used as input to a Level 3 PRA. The Level 2 PRA defined release categories that have been characterized using the Modular Accident Analysis Program (MAAP) computer code. Output from MAAP was used to generate input for the Level 3 PRA. In addition, the release category frequency vector from the Level 2 PRA was used as input to the SAMA analysis. Davis-Besse PRA models are only available for internal events and high winds.

  Level 3 PRA Model

  The results of the Level 1 PRA and the Level 2 PRA, and Davis-Besse-specific meteorological, demographic, land use, and emergency response data were used as input for a Level 3 PRA. One set of consequence results (i.e., off-site dose and economic impacts of a severe accident) were used to estimate the maximum benefit achievable.

- **Determine Cost of Severe Accident Risk / Maximum Benefit**

  The NRC regulatory analysis techniques in NUREG/BR-0184 (Reference 1) were used to estimate the cost of severe accident risk. The maximum benefit that a SAMA candidate could achieve if it eliminated all risk, i.e., the maximum benefit, was also estimated.

- **SAMA Candidate Identification**

  Potential SAMA candidates (that prevent core damage and that prevent significant releases from containment) were identified from the PRA models, Individual Plant Examination (IPE) and IPE – External Events (IPEEE) recommendations, and industry documentation. The list of potential SAMA candidates in the Pressurized Water Reactor (PWR) Table 14 of NEI 05-01 (Revision A) (Reference 2) was the initial list and was supplemented with insights from the Davis-Besse PRA model. As has been demonstrated by past SAMA analyses, SAMA candidates are not likely to prove cost-beneficial if they only mitigate the consequences of events that present a low risk to the plant.

Therefore, risk importance analyses play a key role in the SAMA candidate identification process.

- **Preliminary Screening (Phase I SAMA Analysis)**

  Potential SAMA candidates were screened out that were not applicable to the Davis-Besse plant design, were already implemented at Davis-Besse, were identified as having extreme cost, or were identified as having very little (risk) benefit. Some SAMA candidates were subsumed into other identified SAMA candidates. Those SAMA candidates that were not screened out were considered for further evaluation.

- **Final Screening (Phase II SAMA Analysis)**

  The benefit of severe accident risk reduction to each remaining SAMA candidate was estimated and compared to an implementation cost estimate to determine net cost-benefit. The PRA was modified to determine the core damage frequency (CDF) and release category frequency vector for each remaining SAMA candidate. To determine the benefit, the delta CDF and change in the release category frequency vector between the base case and enhanced case were compared. To estimate the cost of implementation, costs associated with adopting the SAMA candidate were considered; these included costs related to design, engineering, safety analysis, installation, long-term maintenance, calibrations, and training.

- **Sensitivity Analysis**

  A number of assumptions and input parameters used in the Level 3 PRA and SAMA analysis were subjected to a sensitivity analysis to determine the cost-benefit sensitivity.

- **Identify Conclusions**

  The results of the cost-benefit analysis were summarized. There were no potential SAMA candidates for which the cost-benefit analysis showed that the SAMA candidates were cost beneficial. However, the sensitivity analysis identified one SAMA candidate that was potentially beneficial when considered in the context of the sensitivity analysis.

E.3 DAVIS-BESSE PRA MODEL SUMMARY

Davis-Besse models use PRA techniques to:

- develop an understanding of severe accident behavior;
- understand the most likely severe accident consequences, fission product releases; and
- evaluate hardware and procedure changes to assess the overall probabilities of core damage and fission product releases.

The PRA was initiated in response to Generic Letter (GL) No. 88-20 (Reference 3), which resulted in IPE and IPEEE analyses. The current models are separate Level 1 PRA and Level 2 PRA models including internal and some external initiating events for power operation. Severe accident sequences have been developed from internal and external initiated events, including internal floods and high winds.

E.3.1 LEVEL 1 PRA SUMMARY

E.3.1.1 Internal Events

E.3.1.1.1 Description of Level 1 Internal Events PRA Model

The updated PRA model, used to determine CDF, is the SAMA Analysis Model. The SAMA Analysis Model was created by modifying the Davis-Besse Revision 4 PRA model to address some existing gaps identified in an internal peer review and gap assessment. The SAMA Analysis Model contains the Level 1 PRA for internal events. The software used to update the model is CAFTA (Computer-Aided Fault Tree Analysis) (Reference 4). The Level 1 PRA presents the risk for core damage. For the SAMA Analysis Model, core damage is defined as MAAP-calculated maximum core node temperature exceeding 1800° F for a period of 60 seconds. The 60-second time delay is used to prevent short-lived temperature transients from defining core damage.

The Davis-Besse Level 1 PRA internal events CDF is estimated to be 9.2E-06/yr and when including high winds, and internal flooding, CDF was estimated at 9.8E-06/yr. Table E.3-1 provides a breakdown of CDF by initiating event, and Table E.3-2 provides Level 1 importance measures. The quantification was calculated using a truncation cutoff frequency of 5.0E-13/yr.

Note: The results presented in this report are based on an updated PRA model (SAMA Analysis Model), which had a “freeze date” of July 9, 2009, for the plant configuration, and a “freeze date” of August 1, 2006, for component failure data and initiating event data. Equipment unavailabilities based on Maintenance Rule availability have freeze dates of April 30, 2007, and January 1, 2006, for non-Maintenance Rule unavailability.

E.3.1.1.2 Level 1 PRA Model Changes since IPE Submittal

The major Level 1 PRA changes incorporated into each revision of the Davis-Besse PRA model are discussed below.

Revision Change Summary

The Davis-Besse IPE was issued in February, 1993 (Reference 5). The IPE examined risk from internal events, including internal flooding. The IPE Level 1 CDF was 6.6E-05/yr. The sum of the release categories for the Level 2 PRA was 6.5E-05/yr. No large early release frequency (LERF) was issued for the IPE.

The Davis-Besse PRA was dormant from 1993 to 1999. Following the issuance of PRA model Revision 0, successive PRA model Revisions 1 and 2 occurred throughout 1999 to recover the Davis-Besse PRA. These successive revisions would be considered a single revision by today’s standards.

Davis-Besse PRA, Revision 0 – CDF = 1.4E-05/yr to Revision 2 CDF = 1.7E-05/yr and LERF = 7.3E-08/yr

- Performed plant-specific data update for failure rates, unavailability, common cause, initiating event frequency, and human reliability analysis.
- Modified the PRA model to encompass all plant modifications to date to reflect the as-built, as-operated plant including changes to plant operating procedures. This included adding the station blackout (SBO) diesel generator, removal of a start-up feed pump that was abandoned, improvements to modeling of component cooling water (CCW) and service water systems, update of the steam generator tube rupture (SGTR) event tree to reflect changes in emergency procedures, and internal flooding model improvements.
- Improved model documentation to comport with draft PRA standard requirements.

- The Level 2 IPE model information was also updated in October of 1999, but due to software limitations, the Level 2 model was evaluated in a back end analysis using various software and spreadsheets. This back end analysis quantified frequencies of various types of containment failure, fraction of core damage frequency that results in each of the containment failure modes, frequency of release categories and frequency of large early release.

The site conducted an industry peer review of PRA internal events Level 1 and LERF model on November 8, 1999 as a pilot for the B&W fleet using draft standards and processes. Areas for improvement were associated with PRA guidance, success criteria documentation, thermal-hydraulic analysis documentation, basis for HRA timing, more detailed dependency tables, no uncertainty analysis performed, and lack of plant walk down and system engineer reviews. This peer review resulted in 18 supporting requirements at B level of significance, and no A level issues.

Following the industry peer review, Davis-Besse then conducted a revision 3 PRA model update, to close gaps to the draft standard and explicitly model LERF with the PRA model.

<u>Davis-Besse PRA, Revision 3, effective date 5/16/2001 – CDF = 1.3E-05/yr and LERF = 3.8E-08/yr at a cutoff frequency of 1E-11/yr.</u>

- Added an explicit LERF model to the PRA.
- Addressed all B level significant findings resulting from peer review.
- Performed a complete update due to incorporation of RELMCS quantification software.
- Reorganized the PRAQUANT file to combine all sequences into a single run.
- Reduced truncations to a minimum of 2.0E-10.
- Deleted sequence for interfacing systems LOCA (ISLOCA) due to premature opening of the reactor coolant system (RCS) drop line isolation valves (DH11 and DH12). This sequence was judged to not be credible.
- Deleted reactor vessel rupture event AV. A frequency for this event was not published in NUREG/CR-5750 (Reference 6), so this event lacks a justifiable frequency. Based on the large LOCA frequencies in NUREG/CR-5750, this event should be a negligible contributor to the total CDF. (Note this was put back in the SAMA analysis model.)
- Added events to model conditional probability that a reactor trip will occur due to loss of either 4160 bus C or D.

- Revised logic for loss of start-up feedwater pump due to circulating water flooding.
- Revised large and medium LOCAs to require one of two core flood tanks.
- Improved model documentation to comply with draft PRA standard requirements.

Davis-Besse PRA, Revision 4, effective 9/28/2007 – Internal CDF = 4.7E-06/yr and Total CDF = 5.3E-06/yr. No LERF quantified or updated.

- Performed a complete update due to new quantification software.
- Increased the amount of time that operators have to trip the reactor coolant pumps (RCPs) following a loss of CCW from ten minutes to one hour since the high pressure injection (HPI) pumps can run for one hour without CCW cooling.
- Added tornado initiating events to the model (only high wind effects are considered). The tornado events are divided into six categories corresponding to the tornado intensity classes F0 through F5 (TF0, TF1, TF2, TF3, TF4, and TF5).
- Changed modules that contained house event(s) or dependent events to basic events.
- Reduced truncations to a minimum of 5.0E-13.
- Made all initiators CAFTA initiating events.
- Reduced the number of modules, but all common-cause modules were retained.
- Updated database and converted database from Btrieve to Access.

Following PRA model Revison 4, on April 7, 2008 a “gap” self-assessment was conducted using a team of industry peers and internal staff. This assessment was specifically targeted at meeting Capability Category 2 for all high level requirements and supporting requirements in Reference 7. Therefore, some A and B level findings would meet Capability Category 1, but not Capability Category 2, and the gap is associated with what would be required to meet Capability Category 2. In this assessment, internal flooding was not reviewed as it was clear it would not meet the requirements of the standard for Capability Category 2. There were four A level findings and 23 B level findings. These areas for improvement related to the following:

- Need to put back into the PRA model reactor pressure vessel rupture event.
- Correct common cause modeling inconsistencies, missing common cause within support system initiators, and perform generic data update.
- Document control and verification of PRA thermohydraulic calculations used to support the PRA model for medium LOCA success criteria.

- Correct missing information in system modeling documentation.
- Correct logic error in SFAS system fault tree for HRA actuation versus automatic actuation and permissives and lockouts incorrectly modeled.
- Correct support system dependency inconsistencies in modeling and documentation.
- Plant-specific data documentation should add consideration of service condition when grouping components when assessing failure rates. There is also inconsistent use of time in denominator for some failure rates when Bayesian update performed. There is also a recommendation to use only plant-specific data for certain failure rates where sufficient data exists.
- Need more rigorous SGTR analysis to meet Category 2.
- Need to improve on model convergence to verify truncation value.
- Need to improve PRA model update process and control of documentation including analysis used to support PRA.
- Need to perform HRA update and improve HRA documentation. For example, LERF review did not include determining if engineering analysis can support continued operation or operator action that could reduce CDF, current analysis meets Capability Category 1.

Following the self-assessment, Davis-Besse proceeded to close the A and B level findings in the next model update. Due to implementing new processes for controlling PRA model update and supporting analysis, the next model revision would be referred to as PRA-DB1-AL-R05. The Davis-Besse SAMA analysis model is a clone of the PRA-DB1-AL-R05 "Working Model," which is effectively the Revision 4 model with all A and B level findings addressed, but full model update not yet complete, hence the term "Analysis Model." Due to the number of changes being made, the "Working Model" was considered to be the best representation of the as-built, as operated plant and would be frozen mid-update as an "Analysis Model." The Davis-Besse SAMA analysis model was documented in accordance with plant processes and retained in plant records. The Davis-Besse Level 1 PRA internal event CDF is estimated to be 9.2E-06/year and when including high winds and internal flooding, the CDF is estimated at 9.8E-06/year. The quantification was performed using a truncation cutoff frequency of 5.0E-13/year. The results presented in this report are based on a "freeze date" of July 9, 2009, for the plant configuration, and a "freeze date" of August 1, 2006, for component failure data and initiating event data. Equipment unavailabilities based on Maintenance Rule availability have freeze dates of April 30, 2007, and January 1, 2006, for non-Maintenance Rule unavailability. The release category frequencies are the same as the Containment Systems State frequencies calculated by the Level 2 PRA model, and the sum is slightly different than the CDF calculated by the Level 1 PRA due to the delete term approximation and the additional systems included in the Level 2 PRA models.

<u>Davis-Besse SAMA Analysis Model, Effective 7/9/2009 – CDF = 9.8E-06/yr and LERF = 6.6E-07/yr</u>

- Reviewed all system fault trees for component dependencies (air, heating, ventilation, and air conditioning (HVAC), power, cooling water, water source, actuation logic, permissives/interlocks), and updated the fault trees with missing dependencies, where necessary.
- Added the reactor vessel rupture initiating event, which directly leads to core damage in the model.
- Changed the core flood tank success criteria for large LOCAs from one required to two required to match the criteria specified in the Updated Safety Analysis Report (USAR).
- Restructured the CCW and service water system fault trees to correct errors in the CCW and service water trees with regard to system lineups, to correctly model dependencies, and to move the model from a single assumed alignment to a model that uses split fractions to model all alignments simultaneously.
- Adjusted all system trees that had assumed a particular alignment to use split fractions to model all alignments simultaneously. Affected systems: CCW, service water, Turbine Plant Cooling Water, Instrument Air, Containment Air Coolers, and the Makeup System.
- Revised the common cause failure (CCF) modeling to use the CAFTA common cause tool and the Multiple Greek Letter (MGL) methodology. Updated the MGL data to currently acceptable values where applicable. Reviewed components for inclusion in common cause groups and groups created where appropriate.
- Updated the Human Reliability Analysis (HRA) events using the Electric Power Research Institute (EPRI) HRA Calculator software. Replaced all Revision 4 combination events with combination events generated by the HRA Calculator.
- Restructured support system initiating events (SSIEs) to comply with EPRI 1013490, “Support System Initiating Events: Identification and Quantification Guideline.” (Reference 8)
- Removed most modules from the fault trees. The individual events under the former module gate now appear in cutsets.
- Developed the National Fire Protection Association (NFPA) 805 PRA fire model in conjunction with the analysis model. As such, added gates to the model to

accommodate the fire modeling functionality. Since the fire modeling is not complete, the fire logic is tied to a single fire initiating event (IEFIREDUMMY) that has a frequency of zero; therefore, the fire logic currently has no effect on the solution to the fault trees.

- Developed new processes for PRA model update and associated analysis.

Davis-Besse SAMA Analysis Model (Level 1 Quantification)

- Addressed sequence success gates by PRAQUANT in Revision 4. The success gates are now incorporated into the sequence fault tree so that the quantifier (FTREX) will perform the DELTERM function.
- Included many mutually exclusive events under the gate MUX016. This change does not alter CDF, but does increase the efficiency of the quantification process.
- Performed quantification in two steps. The first quantification is performed at a truncation of 5.0E-09 with the post-initiator HRA events set to one. The second quantification is performed at 5.0E-13 with the post-initiator HRA events set to their nominal values. The cutsets are then merged and recovery rules applied. The 5.0E-09 cutsets preserve cutsets that contain combination events, and the 5.0E-13 cutsets capture those cutsets that are above the desired 5.0E-13 truncation limit and do not contain post-initiator HRA combinations.

E.3.1.2 External Events

E.3.1.2.1 Internal Fires

To evaluate fire risk for the IPEEE, Davis-Besse used the EPRI FIVE methodology (Reference 9) supplemented by PRA analyses. Since the FIVE methodology was intended for plants built more recently than Davis-Besse, the FIVE methodology allowed few of the Davis-Besse fire compartments to be screened. Therefore, modification of the FIVE process was employed to include more detailed analysis of affected circuits, improved fire initiation frequency quantification, inclusion of fire effects evaluations, and accrediting of fire prevention and suppression activities at the site. These modifications were primarily taken from the EPRI Fire PRA Implementation Guide (Reference 10).

The FIVE process consisted of several phases. Fire compartments of potential risk significance were identified using the initial qualitative and quantitative screening steps of FIVE. The first phase of the FIVE process included identification of safe shutdown equipment and the route of supporting electrical cables in the plant. This information was qualitatively evaluated to determine if there were any plant locations which could be screened out due to the absence of any safe shutdown equipment or cables. The fire barriers of the plant were also evaluated to ensure that any screened out compartments could not cause a fire in any adjacent compartment that could not be screened out. The results of the Fire Compartment Interaction Analysis (FCIA) were used by the FIVE program in the detailed fire analyses of each compartment.

The second phase of the FIVE process used PRA for plant areas that did not pass the initial screening criteria. In this phase, equipment failures beyond those caused by the fire were considered. Plant areas that had a fire-induced core damage frequency below <1E-06/yr were screened from further evaluation.

The third phase of the FIVE process involved a detailed fire analysis of the unscreened compartments. This work entailed incorporation of the Fire PRA Implementation Guide information, detailed evaluation of the potential for fire damage due to specific fires within an area, and detailed evaluation of the function of individual cables within the safe shutdown equipment circuitry. The results of these evaluations permitted modification of the fire induced equipment failure lists and allowed more compartments to be screened.

Following completion of the detailed fire anlaysis, there were four fire areas identified with an estimated bounding CDF value above the screening criteria of 1.0E-06/yr. The compartments and the resulting CDF included:

1) Q.01, High Voltage Switchgear Room B, CDF of 8.2E-06/yr
2) S.01, High Voltage Switchgear Room A, CDF of 6.5E-06/yr
3) X.01, Low Voltage Switdcgear Room, CDF of 5.9E-06/yr
4) FF.01, Control Room Cabinets, CDF of 4.3E-06/yr

The total CDF for the four areas was approximately 2.5E-05/yr.

Based on the identification of fire compartments with CDF values above the screening criteria, Davis-Besse committed to having Severe Accident Management Guidelines in place by December 31, 1997 with emphasis on the prevention/mitigation of core damage or vessel failure, and containment failure of these compartments. The FIVE model has not been updated since the IPEEE.

E.3.1.2.2 Seismic Events

To evaluate seismic risk for the IPEEE, Davis-Besse performed a Seismic Margin Assessment (SMA) (Reference 11). As a consequence of using an SMA, Davis-Besse did not quantitatively estimate the seismic CDF contribution.

Davis-Besse was classified as a 0.3g focused-scope plant for the IPEEE. However, Davis-Besse decided a 0.15g reduced scope SMA was more appropriate. Nevertheless, the seismic margin analysis indicated that the overall high confidence of low probability of failure (HCLPF) of plant capacity was great than 0.26g.

Davis-Besse expanded its USI A-46 program to include all equipment and components on the IPEEE safe shutdown list. This list was developed using the EPRI SMA methodology for both the primary and secondary shutdown paths. The SMA indicated an overall high confidence of a low probability of failure of plant capacity.

As stated in Section 2.4 of the Davis-Besse IPEEE (Reference 12), no actions beyond those previously identified for the Seismic Qualification Utility Group (SQUG) program were identified from the seismic analysis. The SMA model has not been updated since the IPEEE.

E.3.1.2.3 Other External Events

For the assessment of applicable external phenomena, a progressive screening approach was used as recommended in Section 5 of NUREG-1407 (Reference 13). Based on the results in the Davis-Besse IPEEE, it was concluded that the plant structures and facilities at the site are well designed to withstand high winds, external floods, extreme rainfall, and transportation and nearby facility accidents. No events were found to exceed the screening criteria.

As discussed previously, since the IPEEE, Davis-Besse has added a tornado high winds model to the plant PRA. The model can be used to quantify the effects of tornadic winds on the structures of the Davis-Besse site; the model does not include tornado-generated missiles.

As stated in Section 2.4 of the Davis-Besse IPEEE (Reference 12), the analysis of high winds, floods and other external events were found to screen below the applicable screening criteria. Several actions were taken, however, to further reduce the plant risk to postulated significant external events as follows: (1) Potential Condition Adverse to Quality Report (PCAQR) 96-0186 was initiated to address the issue of onsite hazards from hazardous material; (2) USAR Change Notice 96-58 was initiated to revise the description of the hazards from chemicals stored or transported onsite; (3) the controlled materials program was revised so that new materials approved for use onsite will be evaluated for control room habitability; and (4) PCAQR 96-0956 was initiated to document plugged roof drains and standing water on the 643 foot elevation of the Auxiliary Building roof.

In the SER on the Davis-Besse IPEEE, the NRC concluded that the IPEEE process was capable of identifying the most likely severe accidents and severe accident vulnerabilities, and that the results were reasonable. (Reference 14)

E.3.1.2.4 External Event Severe Accident Risk

This section describes the method used to address external events risk.

As discussed in Section E.3.1.2.2, Davis-Besse used the SMA to evaluate the risk from seismic events. While this methodology does not provide a quantitative result, the resolution of outliers ensures that the seismic risk is low and further cost-beneficial seismic improvements are not expected. Also, as discussed in Section E.3.1.2.3, no other external events were found to exceed the screening criteria. Therefore, the FIVE results were used as a measure of total external events risk.

As discussed in Section E.3.1.2.1, using the EPRI FIVE methodology, Davis-Besse conservatively estimated the Fire CDF to be 2.5E-05/yr. Since the FIVE methodology contains numerous conservatisms, a more realistic assessment could result in a substantially lower fire CDF. As noted in NEI 05-01 (Reference 2), the NRC staff has accepted that a more realistic fire CDF may be a factor of three less than the screening value obtained from a FIVE analysis.

Based on the Davis-Besse FIVE CDF of 2.5E-05/yr, a factor of three reduction would result in a fire CDF of approximately 8.3E-06/yr. This value is the same order of magnitude as the internal events CDF of 9.2E-06/yr. Therefore, this justifies use of an external events multiplier of three to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events.

E.3.2 LEVEL 2 PRA SUMMARY

The Level 2 PRA model determines release frequency, severity, and timing of a release based on the Level 1 PRA, accident progression analysis, and containment performance.

E.3.2.1 Description of the Level 2 PRA Model

The Level 2 PRA model addresses the effects on containment of the core damage accidents evaluated in the front-end analysis, and determines the potential for and severity of radionuclide releases that might result.

Level 1 PRA accident sequences that lead to core damage are grouped into core damage bins according to similarities in their impact on subsequent containment response. These bins help ensure that the sequences are developed in sufficient detail to permit them to be properly tracked in the containment event tree (CET).

The core damage bins are quantified through a containment systems bridge tree to evaluate the status of various containment systems (e.g., containment air coolers, containment spray, containment isolation). The status of these systems helps define the capability of containment to prevent a release. The core damage bins, together with the states of containment systems, comprise the plant damage states (PDSs).

The CET provides the framework for evaluating containment failure modes and conditions that would affect the magnitude of the release. The probabilities of the CET end states were quantified for each PDS. Finally, the PDS frequencies are combined with the conditional probabilities of containment failure to provide the frequencies of the release category end states.

Each combination of PDS and CET outcome is assigned to one of nine general release categories: 1) Containment Bypass – SGTR; 2) Containment Bypass – ISLOCA; 3) Large Isolation Failure; 4) Small Isolation Failure; 5) Early Containment Failure; 6) Sidewall Containment Failure; 7) Late Containment Failure; 8) Basemat Metlthrough; and 9) No failure. Table E.3-3 provides a matrix showing the mapping of the Level 1 accident sequences into the Level 2 release categories.

As shown in Table E.3-4, the the release categories are subdivided to account for additional release characteristics (e.g., fission product scrubbing). The release categories characterize the release of fission products to the environment in terms of release fractions for major fission product groups, release start time, release duration, and location. The release fraction represents the fraction of the initial core inventory from a particular radionuclide, or group of radionuclide’s, that is released to the environment. Table E.3-5 provides a general description of the representative release sequences. Table E.3-6 and Table E.3-7 provide descriptions of the release severity source term release fraction, and release timing classification scheme.

The Level 2 PRA model used for the SAMA analysis was the most current model (updated in conjunction with revision 3 of the PRA). The Level 2 SAMA model also included the following enhancements:

- Added 14 additional plant-damage states to better define the status of certain containment systems. This was done to support quantification of the CET.
- Further automated the framework in which the containment systems (e.g., containment air coolers, containment spray) bridge tree was quantified. Success logic was added to perform the DELTERM function, and top logic was added so that all contributors to each plant-damage state could be solved at once.

- Quantification of the Level 2 PRA model was performed twice (as described in the Level 1 PRA), and the full Level 2 PRA model was quantified.
- All Level 1 PRA model changes (PRA revision 4).

The SAMA analysis model calculated a LERF of 6.6E-07/year. Table E.3-8 ranks the top 30 components for Level 2 PRA based on Fussell-Vesely importance measure. Table E.3-9 provides the top ten operator actions for Level 2 PRA ranked by Fussell-Vesely importance measure.

E.3.2.2 Level 2 PRA Model Changes since IPE Submittal

Following the IPE, a major update of the Davis-Besse PRA was performed in 1999 (PRA Revisions 0-2). This included an update to the Level 2 analysis. In addition to the Level 1 changes, the Level 2 added PDSs, and enhanced the manner in which the frequencies were calculated. This update included nearly 500 PDSs to accommodate the core-damage bins and the various combinations of systems that could affect containment response. A framework was also established to allow all of the PDS frequencies to be calculated in a manner that could be readily repeated. In this update, the LERF was calculated to be 7.3E-08/yr. LERF sequences included early containment failures, bypass failures and containment sidewall failures. This update concluded that containment would retain its integrity for approximately 93% of the core damage sequences. The IPE concluded that containment would retain its integrity for approximately 84% of the core damage sequences.

Another update to the Level 2 PRA was performed after the industry peer review in conjunction with Revision 3 to the PRA. In addition to the Level 1 changes, the Level 2 included simplifying LERF quantification. In this update, the LERF was calculated to be 3.8E-08/yr. Of the 500 PDSs, five contributed 85% of the LERF: 1) ISLOCA; 2) SGTR; 3) SBO; 4) loss of feedwater with induced SGTR; and 5) RCP seal LOCA.

E.3.3 DAVIS-BESSE PRA MODEL REVIEW SUMMARY

Regulatory Guide 1.174, Revision 1 (Reference 15), Section 2.2.3 states that the quality of a PRA used to support an application is measured in terms of its appropriateness with respect to scope, level of detail and technical acceptability, and that these are to be commensurate with the application for which it is intended.

The PRA technical acceptability of the model used in the development of this SAMA application has been demonstrated by a peer review process. The peer review was completed in March 2000, by the [former] B&W Owner's Group. The overall conclusions of the peer review were:

> *During the peer review, all parts of the PRA elements identified as part of the peer review process were included in the PRA. Each technical element was assessed as sufficient to support applications requiring risk ranking determination supported by deterministic insight, but in one case this assessment was contingent upon enhancing some specific aspect of the PRA. Furthermore, of the 11 technical elements, nine were assessed as sufficient to support risk significant applications supported by deterministic insights, but in one case this assessment was contingent upon enhancing some specific aspects of the PRA.*

There were no Category A observations identified by the peer reviewers.

The Category B observations were as follows:

OBSERVATION AS-3

The sequence analysis success criteria appear to be a mixture of Final Safety Analysis Report (FSAR), Babcock & Wilcox (B&W) memos, hand calculations, and poorly documented RELAP analysis. The level of documentation is not adequate to determine the validity of the success criteria. Additionally, the references that are included do not always support the criteria being used. Also, many of the references are over ten years old, raising concerns that they may not be consistent with the current plant operation.

CLOSED

The success criteria in the PRA that differ from the Design Basis success criteria are primarily for transients such as “feed and bleed cooling” and for small break LOCA. Transients and small break LOCA make use of the make-up pumps in combination with the HPI pumps for inventory control and heat removal. Make-up pumps are not credited for accident mitigation in the Design Basis. The completed calculations provide the basis for the success criteria for feed and bleed cooling and small break LOCA. These calculations generally verify the PRA existing success criteria of the PRA and provide additional flexibility.

OBSERVATION AS-5

In the sequence analysis notebook, the success criteria for large and medium LOCAs reference a RELAP5 calculation as the basis for the core flood tank requirements. The reference was available for review, but there was no evidence of any technical review associated with this calculation.

CLOSED

This observation is a specific example of the issue addressed for AS-3. The success criteria for the large and medium LOCA only credit one core flood tank. The PRA SAMA update resolved this issue by crediting both core flood tanks for the large LOCA. This change turns out to have a small effect on large LOCA, but no impact on overall CDF.

OBSERVATION MU-6

The Davis-Besse Probabilistic Assessment Program Guidelines, which includes guidance for maintenance and update of the PRA, is weak in the discussion of evaluation and interpretation of results in Section 2.5.

CLOSED

The Davis-Besse Probabilistic Assessment Program Guidelines have been replaced by the following Nuclear Operating Business Practices: "Probabilistic Risk Assessment Model Management," Revision 0, and "Probabilistic Risk Assessment Applications Management," Revision 0. Both of these Business Practices became effective January 19, 2009, and provide a rigorous basis for the maintenance and upgrade of the existing PRA models and the application of the PRA model for risk-informed applications and assessments.

OBSERVATION QU-4

There was no evidence of sensitivity studies other than those done for the valve ranking calculations. Sensitivity studies should be performed on the base model to investigate the sensitivity of the results to modeling assumptions. For example, the CDF could be significantly affected by the RCP seal LOCA model assumptions.

OPEN:

FENOC plans to include a Sensitivity Analysis Notebook in Revision 5 of the PRA.

OBSERVATION SY-9

Basic event EB3EF15F is in two different modules EMM0EF15 and EMM2EF15.

OPEN:

This case corresponds to failure of the same motor control center (MCC) but in two mutually exclusive service water system alignments. Therefore, there is no impact on the PRA results. In Revision 5 of the PRA, FENOC plans to change EMM0EF15 and EMM2EF15 to be OR gates instead of modules. FENOC also plans to include basic event EB3EF15F under each OR gate.

E.3.4 DAVIS-BESSE PRA MODEL – LEVEL 3 PRA INPUTS

E.3.4.1 Introduction

This section describes the development of the inputs needed to perform a Level 3 PRA for Davis-Besse. For the SAMA analysis, the cost-benefit analysis required comparison of comparable quantities; dose results from the Davis-Besse Level 3 PRA were converted into dollars for the purpose of comparison.

The Level 3 PRA relied on the results of the severe accident consequence code MELCOR Accident Consequence Code System (MACCS2) (References 16, 17). Version 1.12 of MACCS2 was used for this analysis. MACCS2 simulates the impact of severe accidents at nuclear power plants on the surrounding environment. The principal phenomena considered are atmospheric transport, mitigative actions (based on dose thresholds), dose accumulation via a number of pathways (e.g., food and water ingestion), early and latent health effects, and economic costs.

The scope of a Level 3 PRA is generally driven by the nature of the release categories, which are the end states of a Level 2 PRA. The release categories are viewed as the initiating events of a Level 3 PRA. Accordingly, to use the output results of MACCS2 on a comparative basis, the release category consequence parameters were weighted by the likelihood of that release category to create a consequence. The risk metric was created by using the results of the Level 1 PRA and the Level 2 PRA, in the form of a release category frequency vector, containing the release frequency of each release category and the Level 3 PRA consequence parameters for each release category. Release category frequency vectors were only available for initiating events. As with the initiating events and CDF for a Level 1 PRA, the risk results of a Level 3 PRA were summed over all of the release categories.

The Level 3 PRA analysis considered a base case and eleven sensitivity cases to account for variation in data and assumptions. The following list describes the sensitivity cases, which are discussed in Section E.8:

- Case S1 – Use estimated 2060 site population data (with an escalation rate of 4.7%/decade); the same escalation rate for the base case population to 2040
- Case S2 – Use a less conservative escalation rate of 1.5% to estimate the 50-mile population around Davis-Besse in 2040

- Case S3 – Set all watershed indices to “1”
- Case M1 – Use 2007 meteorological data
- Case M2 – Use meteorological data from circa late-1990s
- Case A1 – Use an alternative method to estimate PLHEAT
- Case A2 – Use conservative meteorological boundary conditions
- Case A3 – Use a longer OALARM value to better reflect operator’s ability to react
- Case E1 – Use a more realistic (higher) speed of evaluation (ESPEED)
- Case E2 – Set sheltering shielding factors based on brick house (versus wood housing used in the base case)

E.3.4.2 Population Data

The population data were extracted using SECPOP2000 (Reference 18) with 2000 census data for Davis-Besse sited at latitude of 41 degrees, 35 minutes, 50 seconds, and longitude of 83 degrees, 5 minutes, 11 seconds. The population data were adjusted to account for the transient population within 10 miles of Davis-Besse. The transient population segment, includes seasonal residents, transient population, and boating population. The population escalation factor was developed considering different sets of population data, e.g., state-wide versus within a 50-mile radius of the plant.

The year 2040 was selected as the year to estimate the population since a 20-year license renewal for Davis-Besse will extend its operating license from 2017 to 2037. For the Level 3 PRA model, the estimated population for 2040 overestimated the population at the end of the extended operating license, and therefore generated conservative results because the population dose and economic impact costs are a function of increasing population. The escalated population estimate is conservative for a second reason, since an accident could only occur between now and 2037, the actual population would be less than what is used in the Level 3 PRA model, and the benefit of each SAMA candidate evaluated is over-estimated.

Ohio State census data are provided in Table E.3-10. Population of the counties surrounding Davis-Besse has been reasonably constant until 2004, after which the population declines (Reference 19).

To be conservative, the state-wide data were used to estimate an escalation factor for the population. Despite the decreasing population rate trend indicated for the population within the 50-mile radius of the plant, a constant escalation rate (per decade) was assumed based on the state-wide data presented in Table E.3-10. A constant escalation rate of 4.7%/decade was used to estimate the population for 2040 (base case) and for 2060 (sensitivity case).

The population used in the base case was conservative, since the transient population was included and escalated in a manner similar to the resident population. Table E.3-11 shows the 2040 population used in the base case.

E.3.4.3 Meteorological Data

Meteorological data were obtained for the years 2006 through 2008 recorded at the Davis-Besse permanent on-site meteorological tower located “within a fenced compound in the southwest corner of the plant” (Reference 20, Section 2.3.3). The meteorological tower is located approximately a half-mile southwest of the containment building. Meteorological data included wind speed, wind direction, delta-temperature, and precipitation for each hour of the year.

An initial review identified long sequences of unusable meteorological data for 2008. As it was not reasonable to replace such a long sequence using the data substitution strategy, the 2008 meteorological data were deemed to be not viable as MACCS2 input. Accordingly, only the data for years 2006 and 2007 were reviewed. It was determined which of these years contained the least number of unusable meteorological data entries. This was the criterion used to determine which year would be the base case meteorological data. The second best year was used for a sensitivity case.

The meteorology data from 2006 were found to have the least amount of unusable data, therefore the 2006 meteorological data were used as the base case and the meteorological data from 2007 were used as a sensitivity case. Results of the sensitivity cases confirmed that the 2006 meteorological data were representative and typical.

The mixing height values were estimated from Figures 2-5 (morning), and Figures 7-10 (afternoon) from Reference (21), as shown in Table E.3-12. The values were provided as real numbers in 100s of meters in the MET file.

E.3.4.4 Other Site Characteristics

Other site characteristics include land fraction, region index, watershed index, crop and season share, and building dimensions, which are discussed below.

The **land fraction** is the fraction of land in each section. Using maps (see Figures 2.1-1 and 2.1-2 in the body of the Environmental Report), the land fraction in each grid sector was estimated by visual inspection.

The **region index** equates the counties for which economic data have been specified for each section of the grid. The region index block was developed from Figures 2.1-1 and 2.1-2 in the body of the Environmental Report. These figures show the ten concentric rings and 16 wind directions overlaid on the Ohio and Michigan State counties, Lake Erie, and Canada. Each section was evaluated to determine which county occupied the most land in the sector; this was then used as the region index.

The **watershed index** is assigned either a “1” or a “2.” Using Figures 2.1-1 and 2.1-2 in the body of the Environmental Report, any region (sector) that contained some land was assigned a watershed index of “1” (run-off possible). An index of "2" was assigned for the segment if there was no runoff to a public water supply. Any region that was exclusively water (i.e., Lake Erie) was assigned a watershed index of “2.” The sensitivity of these assignments were tested with a sensitivity case assigning a “1” to all the sectors.

The **growing season** used was the default growing season specified by MACCS2. The default growing season for pasture is March 1 to August 30; for all other crops, the growing season is April 30 to July 30.

The **fraction of farmland** devoted to specific crops was estimated from the total acres of farmland in the region and acres devoted to each crop. This input was generated using the 2007 Census of Agriculture Data for Ohio (Reference 22) and Michigan (Reference 23). The total farm land in the region was summed from the acres of farmland in each county.

Seven categories of crops were accounted for: pasture, forage, grains, vegetables, other food crops, legumes and seeds, and roots and tubers. To calculate the other food crops harvested, the crops mentioned above less the pasture was subtracted from the total farmland harvested. This difference was assumed to be other crops that were not accounted for in the six categories.

The ATMOS file also required reactor **building dimensions** to determine the parameters SIGYINIT (σ_y) and SIGZINIT (σ_z). Building dimensions were taken from Figure 1.2-1 (height) and Figure 3.8-3 (width) (Reference 20) for the MACCS2 base case. The reactor building width is approximately 44 meters; the building height is approximately 73 meters.

E.3.4.5 Release Categories Characteristics (from MAAP)

Each release category was processed in the MACCS2 code. Over 30 accident sequences involving a spectrum of LOCAs, transients, and SGTRs were analysed using MAAP. In addition, several sensitivity study runs were performed to further define the potential impact of uncertainties in release categories associated with phenomenological modeling in MAAP. The input that differentiates each release category is the information that is extracted from the MAAP run (for each release category). One of the outputs of the Level 2 PRA is the definition of the release categories and their frequencies. Each release category with a non-zero frequency is characterized by a MAAP run. The definition of each release category and the correspondence to a MAAP run are presented in Table E.3-4.

There are some differences in how radioisotopes are grouped in MAAP and MACCS2. The MAAP grouping is as follows:

Group	Description
1	Nobles & Inert Gases
2	CsI, RbI
3	TeO_2
4	SrO
5	MoO_2
6	CsOH, RbOH
7	BaO
8	La_2O_3, Nd_2O_3, Y_2O_3, Pr_2O_3, Sm_2O_3
9	CeO_2
10	Sb
11	Te
12	NpO_2, PuO_2

The MACCS2 grouping is as follows:

Group	Description
1	Xe, Kr
2	I
3	Cs
4	Te, Sb
5	Sr

Group	Description
6	Ru, Co, Mo, Tc, Rh
7	La, Y, Zr, Nb, Am, Cm, Pr, Nd
8	Ce, Pu, Np
9	Ba

Based on these groups, the following mapping was used between the MAAP and MACCS2 radioisotopic groups:

MAAP	1	2	6	3, 10, 11	4	5	8	9, 12	7
MACCS2	1	2	3	4	5	6	7	8	9

Table E.3-13 summarizes the data extracted from MAAP. The data were collected and simple calculations were performed to support the base case and some of the sensitivity cases.

Table E.3-13 shows the correspondence between the MAAP runs and the release categories (as identified in Table E.3-4). The warning time (MACCS2 variable OALARM) was extracted from MAAP as the time to core uncovery. The heat of release (MACCS2 variable PLHEAT) was calculated using information extracted from MAAP. The height of release (MACCS2 variable PLHITE) was extracted from MAAP and used directly as input to MACCS2. The release fractions (MACCS2 variable RELFRC(x)) were mapped from twelve radioisotopic groups defined for MAAP to the nine radioisotopic groups defined for MACCS2. For MACCS2 group 4, the maximum of MAAP groups 3, 10, and 11 was used; for MACCS2 group 8, the maximum of MAAP groups 9 and 12 was used. The duration of the release (MACCS2 variable PLUDUR) was used as input to MACCS2.

The time to core uncovery for a number of release categories (2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 7.1, 7.2, 7.5, 7.6, 8.1, 8.2, 9.1, 9.2) is about 300 seconds (five minutes). This may be an unrealistically short time to expect Davis-Besse to declare a General Emergency. A sensitivity case was performed extending the OALARM parameter to 1200 seconds (20 minutes); there was little or no change in the consequence metrics used to support the SAMA analysis. Accordingly, the SAMA analysis results were not sensitive to this parameter and the MAAP value of 300 seconds remained in the base case.

E.3.4.6 Evacuation Model Parameters

E.3.4.6.1 Weighting Fraction

A weighting fraction of 95% of the people was used, i.e., 95 percent of the people are evacuated and five percent of the population remains within the emergency planning zone (EPZ) during the entire problem time.

E.3.4.6.2 Evacuation Speed

The travel speed can be defined during the three phases of the evacuation: initial, middle, and late (MACCS2 variable ESPEED). The evacuees are presumed to move from a spatial element when they cross the boundary dividing the two elements (MACCS2 variable TRAVELPOINT using the BOUNDARY option). When the BOUNDARY option is used all three values of ESPEED are identical. To determine the speed of evacuation, the time to evacuate the EPZ (ten-mile radius) was estimated. Time-to-clear-affected-population data for a variety of scenarios were used. The most conservative (longest time) scenario was selected: summer, midday, weekend, rain. The time to evacuate from the EPZ area around the plant (ten-mile radius) was estimated as 7 hours, 45 minutes. This is equivalent to a constant evacuation speed of 0.58 meters/second. This value is "slow" compared to a more typical evacuation speed of 1.0 or 2.0 meters/second; accordingly, a sensitivity case with an evacuation speed of 1.0 meters/second was performed.

E.3.4.6.3 Evacuation Delay Time

The results of the evacuation time analysis for "Summer, Midday, Midweek," was used since these conditions were close to the conditions used to estimate the evacuation speed. For evacuation areas 1 to 12 (which corresponds to the EPZ), the clear time relative to the siren alert was used to estimate the delay time from the siren alert to when individuals take shelter (MACCS2 variable DLTSHL). The clear time related to the order to evacuate was used to estimate the delay time from sheltering to evacuation (MACCS2 variable DLTEVA). DLTSHL was set at 10800 seconds (three hours), and DLTEVA was set at 17700 seconds (four hours, 55 minutes).

E.3.4.6.4 Shielding Factors

The groundshine and cloudshine shielding factors used in the base case are presented in Table E.3-14. The basis for the values used in the base case is wooden houses. As a sensitivity case, values based on brick houses were used, as presented in Table E.3-15. The cloudshine and groundshine shielding factors, protection factors, and breathing rate for normal activities, evacuation, and sheltering are presented in Table E.3-16.

E.3.4.7 Core Inventory

The Davis-Besse core inventory is defined as full core inventory at 24-month end-of-cycle (177 fuel assemblies). The core inventory was calculated using ORIGEN-2 (Reference 24) . Table E.3-17 shows the core inventories as provided in curies and in becquerels, to be used as input into MACCS2.

E.3.4.8 Economic Data

Using the 2007 Census of Agriculture Data of References (22) and (23), Table PD-30 from Reference (25) (Ohio property values), Exhibit 22 from Reference (26) (Michigan property values), and 2007 census data from Reference (27)[1] , the following site-specific (averaged per county) inputs in Table E.3-18 were generated: fraction of land devoted to farming, fraction of dairy farm sales, total annual farm sales, farmland property value, and non-farmland property value. The last two values were averaged to provide input to the CHRONC file.

Additional site-specific economic parameters are given below. While many of the parameters were obtained from a government website (extracted in July 2009 and October 2009), these values are considered to be a snapshot in time to perform this analysis. The source of this information does not imply that these values need to be updated as the websites are revised.

EVACST – The daily cost of compensation for evacuees and short-term relocatees who are removed from their homes as a result of radiation exposure during the emergency-phase relocation period. This value includes the following components: food, housing, transportation, and lost income.

The daily cost was calculated by using the 2000 census economic data of per capita income for each state (Reference 28) and the per-county per-diem rate for meals, expenses and lodging (Reference 29). The per capita income was found in the quickfacts section of the website: $21,003 (Ohio) and $22,168 (Michigan). The per-diem rate for Ohio of $147/day was based on the maximum per-diem rate in Erie and Huron counties; the per-diem rate for Michigan of $156/day was based on the maximum per-diem rate in Wayne County.

[1] The population data used for this analysis were extracted from the 2007 Population Estimates.

For Ohio State, **EVACST** is $204.54/person-day; for Michigan State, **EVACST** is $216.73/person-day. The average of the Ohio and Michigan EVACST values was used as input in the CHRONC file.

RELCST – The daily cost of compensation for evacuees and short-term relocatees who are removed from their homes as a result of radiation exposure during the intermediate-phase relocation period. This value includes the following components: food, housing, transportation, lost income, and replacement of personal property.

RELCST was estimated using the evacuation costs plus the average property cost per person. The average property cost per person was calculated from the total property value in the state, which can be found on the individual state's Department of Revenue websites:

- $256,088,369,000 for Ohio (Reference 25, Table PD-30)
- $340,545,761,049 for Michigan (Reference 26, Exhibit 22)

The total property cost was divided by the total population (11,353,140 for Ohio and 9,938,444 for Michigan) (Reference 27).

For Ohio State, **RELCST** is $266.34/person-day; for Michigan State, **RELCST** is $310.61/person-day. The average of the Ohio and Michigan RELCST values was used as input in the CHRONC file.

Other economic input parameters used in the CHRONC file are provided in Table E.3-19.

E.3.5 DAVIS-BESSE PRA MODEL – LEVEL 3 PRA RESULTS

The results are presented via a set of two output parameters that are used to support the SAMA analysis. These parameters are described as followed:

Whole Body Dose (person-rem) (population dose) – this is defined as the sum of the whole body dose received by the population within x miles of the site, where x=1, 10, and 50 miles. (MACCS2 parameter L-EDEWBODY from TYPE5OUT)

Economic impact ($) – this risk is defined as the sum of the population- and farm-dependent costs; because of the uncertainties associated with the cost input parameters, the economic impact results were only used in a relative manner (never considered as an absolute dollar amount) for the SAMA analysis to compare the cost of an alternative to the base case. (MACCS2 parameter defined as TYP10OUT)

To estimate risk, each consequence parameter was weighted by the frequency of the release categories in which the consequence was manifested. These risk results are presented on a per-release category basis, on a rolled-up release category basis, or as a total risk (the sum over all the release categories). Typically, the risk is presented for each parameter from zero to 50 miles summed over all of the release categories.

The Level 1 and Level 2 PRA results are summarized in the release category frequency vector, which contains the frequency (from initiating event) of an individual release category occurring. The frequency vector is presented in Table E.3-20. Values for the base case output parameters were manually extracted from the MACCS2 output file, and then a weighting of the consequences per release category was performed by multiplying by the release category frequency and summing the products. The results from the sensitivity cases were also processed similarly to the base case. For the sensitivity cases, the further step of comparison against the base case was performed.

E.3.5.1 Base Case

The results for the base case are presented in Table E.3-21. The results show the estimated population dose (whole body dose in person-rem/year) and the economic impact in dollars/year. While there are a variety of other consequence metrics that are estimated by MACCS2, these two consequence metrics are the ones used in the SAMA cost-benefit analysis.

Table E.3-22 gives the consequences for each release category for whole body dose and economic impact at 50 miles. These data were used as input into the SAMA analysis.

E.3.5.2 Sensitivity Cases

The sensitivity cases presented in this subsection were performed to demonstrate the robustness of the input parameters selected to support the MACCS2 model developed for the Level 3 PRA. There is no guidance in NEI 05-01 (Reference 2) on the nature of location of these sensitivity cases in the SAMA analysis documentation. Discussion of these sensitivity cases immediately follows the discussion of the Level 3 PRA model and is deemed the most appropriate location in the documentation. There are other sensitivity cases recommended by NEI 05-01 (Reference 2) that deal specifically with the cost-benefit evaluation. As recommended in NEI 05-01 (Reference 2), discussion of the cost-benefit sensitivity studies can be found in Section E.8.

E.3.5.2.1 Site

Case S1 – The population used in the base case was for the year 2040. Case S1 used the 2060 population, which is population of the site in a 50-mile radius around the plant more than 20 years after the extended license would expire. Thus, this sensitivity case represents the most conservative estimate of population around the plant.

The results in Table E.3-23 show the expected uniform increase in all parameters as a result of the increased in the population. The model shows the appropriate sensitivity to an increase in the population.

Case S2 – The population used in the base case was 2000 population data from SECPOP2000 escalated to 2040 using an escalation factor of 4.7% per decade derived from census data. Case S2 uses a less conservative escalation factor of 1.5% (using population increase estimate for the 2000 to 2010 decade). This sensitivity case provides more realistic, less conservative consequence estimates.

The results in Table E.3-24 show the expected, uniform decrease in the consequences as reflected in the reduction of the population in this sensitivity case. The model shows the appropriate sensitivity to an increase in the population.

Case S3 – The base case was run with two watershed indexes. This sensitivity case determines the impact of assuming all the watershed indices are set to 1, i.e., maximum runoff consequences.

The results in Table E.3-25 show there is a minimal impact on the consequences when all the watershed indices are set to 1.

E.3.5.2.2 Meteorological

Case M1 – The base case was performed with Davis-Besse weather data from 2006, which had the least number of unusable meteorological data points. A sensitivity case was performed to demonstrate the typical nature of any particular year’s worth of meteorological data. Data from 2007 were chosen as being the second best with respect to the number of unusable meteorological data points.

The results in Table E.3-26 show that there is minor variability in the results, which is due to the Monte Carlo meteorological model. This sensitivity case supports the typical nature of any particular year’s worth of meteorological data.

Case M2 – An additional sensitivity case was performed to further demonstrate the typical nature of any particular year’s worth of meteorological data. These data are circa late-1990s, but no specific year could be identified, and therefore are only to be used as a second sensitivity case.

The results in Table E.3-27 are similar to sensitivity case M1, with some minor variability in the consequence, demonstrating the representativeness of any year's worth of meteorological data.

E.3.5.2.3 ATMOS

Case A1 – A different approach was taken in the Davis-Besse Level 3 PRA for estimating the energy of release from the MAAP output data for each of the release categories. Accordingly, this sensitivity case, A1, provides a comparison to the simpler method of estimating the heat of release. The energy of release was obtained from MAAP by multiplying the flow rate of the break junction by the enthalpy of the release gas.

The results in Table E.3-28 show that the method used to determine the heat of release in the base case generates more conservative results than the method used in sensitivity case A1.

Case A2 – A sensitivity case was run with more extreme values of the meteorological boundary parameters, i.e., mixing height (BNDMXH), stability class (IBDSTB), rain rate (BNDRAN), wind speed (BNDWND). In general, the sensitivity case considered all of these boundary parameters collectively (i.e., all considered in one case). The rain rate boundary condition was set at 0.0 mm/hour for the base case; there is no value more conservative than that. The conservative boundary parameters had no impact on the results as shown in Table E.3-29.

Case A3 – With some warning time (MACCS2 variable OALARM) values at about 300 seconds, there is a question about the operator's ability to react in such a short period of time. Accordingly, this sensitivity case was performed using 20 minutes (for those release categories with an OALARM value of about 300 seconds); this approach is consistent with the time to oxidation for those release categories.

The results in Table E.3-30 show virtually no impact with the change in OALARM values. Accordingly, the OALARM values as derived from the MAAP time to uncovery will be maintained as the base case.

E.3.5.2.4 EARLY

Case E1 – The base case was performed with an evacuation speed of 0.58 meters/second, based on Davis-Besse-specific evaluation information. This evacuation speed is among the slowest used (in other models), although it includes the most adverse evacuation conditions. Accordingly, a sensitivity case was performed with a faster evacuation speed to gauge the sensitivity of this parameter.

This increase in the evacuation speed results in a minor decease in the consequence values, as shown in Table E.3-31. This result is expected, as faster evacuation should remove the population from the radiological damage more quickly.

Case E2 – The base case was performed with the shielding factors assuming wood housing. This sensitivity case sets the sheltering shielding factors based on brick housing. The results in Table E.3-32 show that brick provides greater shielding (as indicated by the shielding factors), which results in less consequence to the population. However, the decrease is minor, suggesting that the use of shielding factors based on wood housing, while conservative, is appropriate.

E.4 COST OF SEVERE ACCIDENT RISK

The SAMA candidates placed in the *Considered for Further Evaluation* category in Section E.5 required a cost-benefit evaluation. The cost-benefit evaluation of each SAMA candidate was based on the comparison of the cost of implementing a specific SAMA candidate (in U.S. dollars) with the benefit of the averted on-site and off-site risk (in U.S. dollars) from the implementation of that particular SAMA candidate. The methodology used for this evaluation was based on regulatory guidance for a cost-benefit evaluation as described in Section 5 of Reference (1). This regulatory guidance determines the net value for each potential SAMA candidate according to Equation E.4-1:

$$\text{Net Value} = (\text{APE} + \text{AOC} + \text{AOE} + \text{AOSC}) - \text{COE} \qquad \text{(E.4-1)}$$

where,

APE = present value of the averted public exposure ($)

AOC = present value of the averted off-site property damage costs ($)

AOE = present value of the averted occupational exposure ($)

AOSC = present value of the averted on-site costs ($)

COE = cost of the enhancement ($)

The purpose of this section is to quantitatively determine the maximum benefit for Davis-Besse. The maximum benefit was defined as the maximum benefit a SAMA candidate could achieve if it eliminated all risk. If the estimated cost of implementation of a specific SAMA candidate was greater than the maximum benefit, then the alternative was not considered economically viable and was eliminated from further consideration. This section shows the maximum benefit evaluation for internal events[2].

E.4.1 OFF-SITE EXPOSURE COST

The term used for off-site exposure cost is designated as averted public exposure (APE) cost. The off-site dose within a 50-mile radius of the site was determined using the MACCS2 model developed for the Davis-Besse Level 3 PRA in Section E.3.4.

[2] The Davis-Besse internal events PRA model also includes the risk impact from high winds; reference to the internal events PRA model or the CDF therefore includes the risk contribution from high winds.

Table E.3-21 provides the off-site dose for each release category obtained for the base case of the Davis-Besse Level 3 PRA weighted by the release category frequency. The total off-site dose for internal events (D_t) was estimated to be 2.0 person-rem/year. The APE cost was determined using Equation E.4-2 (Reference 1, Section 5.7.1).

$$APE = W_{pha} = (C)(Z_{pha}) \quad (E.4\text{-}2)$$

where,

W_{pha} = monetary value of public health risk after discounting (APE) ($)

C = present value factor (yr)

Z_{pha} = monetary value of public health risk per year before discounting ($/year)

The present value factor (C) was determined using Equation E.4-3, which was obtained from Section 5.7.1 of Reference (1).

$$C = \frac{1 - e^{-rt}}{r} \quad (E.4\text{-}3)$$

where,

r is the discount rate (%/yr) = 7%/yr = 0.07/yr

t is the time to expiration of the renewed Davis-Besse license = 28 years (2009-2037)

The present value factor was calculated in Equation E.4-4, and was used throughout the document.

$$C = \frac{1 - e^{-\left(\frac{0.07}{yr}\right)(28yrs)}}{\left(\frac{0.07}{yr}\right)} = 12.27yr \quad (E.4\text{-}4)$$

The monetary value of public health risk per year before discounting (Z_{pha}) was determined using Equation E.4-5 (Reference 2, Section 4.1).

$$Z_{pha} = (R)(D_t) \qquad \text{(E.4-5)}$$

where,

R = monetary equivalent of unit dose ($/person-rem)

D_t = total off-site dose for internal events (person-rem/yr)

The conversion factor used to establish the monetary value of a unit of radiation exposure was $2,000 per person-rem averted. This monetary value was used for the year in which the exposure occurs and then discounted to the present value to evaluate the values and impacts. The monetary value of public health risk per year before discounting (Z_{pha}) for Davis-Besse was calculated using Equation E.4-6.

$$Z_{pha} = \left(2{,}000\,\frac{\$}{\text{person}-\text{rem}}\right)\left(2.0\,\frac{\text{person}-\text{rem}}{\text{yr}}\right) = \$4000/\text{yr} \qquad \text{(E.4-6)}$$

where,

R = $2,000/person-rem

D_t = 2.0 person-rem/year

The values for the base case are:

C = 12.27 yr

Z_{pha} = $4,000/yr

$$\text{APE} = (12.27\text{yr})\left(\frac{\$4000}{\text{yr}}\right) = \$49{,}080 \qquad \text{(E.4-7)}$$

E.4.2 OFF-SITE ECONOMIC COST

The term used for off-site economic cost is designated as averted off-site property damage costs (AOCs). The off-site economic loss for a 50-mile radius of the site was determined using the MACCS2 model developed for the Davis-Besse Level 3 PRA in Section E.3.4. Table E.3-21 provides the economic loss for each release category obtained for the base case of the Level 3 PRA weighted by the release category frequency. The total economic loss from internal events (I_t) was estimated to be $1,600 per year. The averted cost was determined using Equation E.4-8 from Reference (1), Section 5.7.5.

$$AOC = (C)(I_t) \qquad \text{(E.4-8)}$$

where,

AOC = off-site economic costs associated with a severe accident ($)

C = present value factor (yr)

I_t = monetary value of economic loss per year from internal events before discounting ($/yr)

The values for the base case are:

C = 12.27 yr

I_t = $1,600/yr

$$AOC = (12.27\text{yr})\left(1600\frac{\$}{\text{yr}}\right) = \$19{,}632 \qquad \text{(E.4-9)}$$

E.4.3 ON-SITE EXPOSURE COST

The term used for on-site exposure cost is designated as averted occupational exposure (AOE). The NRC methodology used to estimate the AOE consists of two components: (1) the calculation of immediate dose cost (short-term) and (2) long-term dose cost (Reference 1, Section 5.7.3). The development of the two contributors is discussed in Sections E.4.3.1 and E.4.3.2.

E.4.3.1 Immediate Dose Cost

The immediate doses were those doses received at the time of the accident and during the immediate management of the accident. The immediate on-site dose cost was determined using Equation E.4-10.

$$W_{IO} = (R)(F)(D_{IO})(C) \quad \text{(E.4-10)}$$

where,

W_{IO} = monetary value of accident risk avoided from immediate doses, after discounting ($)

R = monetary equivalent of unit dose ($/person-rem)

F = CDF (events/yr)

D_{IO} = immediate occupational dose (person-rem/event)

C = present value factor (yr)

The values for the base case are:

R = $2,000/person-rem

F = 1.0E-05 events/yr [Table E.3-20] (internal events)

D_{IO} = 3,300 person-rem/event

C = 12.27 yr

$$W_{IO} = \left(2{,}000\frac{\$}{\text{person-rem}}\right)\left(1.0\text{E-05}\frac{\text{events}}{\text{yr}}\right)\left(3{,}300\frac{\text{person-rem}}{\text{event}}\right)(12.27\text{yr}) = \$810 \quad \text{(E.4-11)}$$

E.4.3.2 Long-Term Dose Cost

The long-term doses were those doses received during the process of cleanup and refurbishment or decontamination. The long-term on-site dose cost was determined using Equation E.4-12.

$$W_{LTO} = (R)(F)(D_{LTO})(C)\left(\frac{1-e^{-rm}}{rm}\right) \qquad \text{(E.4-12)}$$

where,

W_{LTO} = monetary value of accident risk avoided from long-term doses, after discounting ($)

R = monetary equivalent of unit dose ($/person-rem)

F = CDF (events/yr)

D_{LTO} = long-term occupational dose (person-rem/event)

r = discount rate (%/yr)

m = on-site cleanup period (yrs)

The values for the base case are:

R = $2,000/person-rem

F = 1.0E-05 events/yr [Table E.3-20] (internal events)

D_{LTO} = 20,000 person-rem/event

C = 12.27 yr

r = 7%/yr = 0.07/yr

m = 10 yrs

$$W_{LTO} = \left(2{,}000\frac{\$}{person \cdot rem}\right)\left(1.0E-05\frac{events}{yr}\right)\left(20{,}000\frac{person \cdot rem}{event}\right)(12.27yr)\left(\frac{1-e^{-\left(\frac{0.07}{yr}\right)(10yrs)}}{\left(\frac{0.07}{yr}\right)(10yrs)}\right) \qquad (E.4\text{-}13)$$

$$W_{LTO} \cong \$3530$$

E.4.3.3 Total Accident-Related Occupational Exposure Costs

The AOE costs were estimated by combining the immediate on-site dose cost (W_{IO}) and long-term dose cost (W_{LTO}) equations and using the numerical values calculated in Sections E.4.3.1 and E.4.3.2.

The base case accident-related occupational exposure cost is:

$$AOE = W_{IO} + W_{LTO} = \$810 + \$3{,}530 = \$4{,}340 \qquad (E.4\text{-}14)$$

E.4.4 ON-SITE ECONOMIC COST

The term used for on-site economic cost is designated as averted on-site costs (AOSCs). To determine the AOSC, the estimation consists of three components: (1) the estimation of cleanup and decontamination costs, (2) repair and refurbishment cost, and (3) the replacement power costs over the remaining life of the facility (Reference 1, Section 5.7.6). The repair and refurbishment costs are only considered for a recoverable accident and not for a severe accident. Therefore, this component did not need to be evaluated for this analysis. The development of the remaining two contributors is discussed in Sections E.4.4.1 and E.4.4.2.

E.4.4.1 Cleanup/Decontamination

The present value of the cost of cleanup and decontamination over the remaining life of the facility (U_{CD}) was determined by using Equation E.4-15.

$$U_{CD} = (PV_{CD})(C)(F) \qquad (E.4\text{-}15)$$

where,

PV_{CD} = present value of the cost of cleanup/decontamination ($)

C = present value factor (yr)

F = CDF (events/yr)

Section 5.7.6 of Reference (1) assumes a total cleanup/decontamination cost of $1.5E+09 as a reasonable estimate and this same value was adopted for these analyses. Assuming a ten-year cleanup period, the present value of this cost was determined by using Equation E.4-16.

$$PV_{CD} = \left(\frac{C_{CD}}{m}\right)\left(\frac{1-e^{-rm}}{r}\right) \qquad \text{(E.4-16)}$$

where,

PV_{CD} = present value of the cost cleanup/decontamination ($)

C_{CD} = total cost of the cleanup/decontamination effort ($)

m = cleanup period (years)

r = discount rate (%/yr)

The values for the base case are:

C_{CD} = $1.5E+09

m = 10 years

r = 7%/yr = 0.07/yr

C = 12.27 yr

F = 1.0E-05 events/yr [Table E.3-20] (internal events)

$$U_{CD} = \left(\frac{\$1.5E+09}{10}\right)\left(\frac{1-e^{-(0.07)(10yrs)}}{0.07}\right)(12.27yr)(1.0E-05) = \$132{,}362 \qquad \text{(E.4-17)}$$

E.4.4.2 Replacement Power Cost

Replacement power costs were calculated in accordance with Reference (1, Section 5.7.6). The replacement power is needed for the time period following a severe accident and for the remainder of the expected generating plant life. Therefore, the long-term power replacement equations were used to calculate replacement power costs. The present value of replacement power was calculated using Equation E.4-18. Equation E.4-18 was developed for discount rates between 5% and 10%.

$$PV_{RP} = \frac{B}{r}\left(1 - e^{-rt_f}\right)^2 \qquad \text{(E.4-18)}$$

where,

PV_{RP} = present value of the cost of replacement power for a single event ($)

t_f = years remaining until end of facility life (yr)

r = discount rate (%/yr)

and *B* is a constant representing a string of replacement power costs that occur over the lifetime of a reactor after an event (for a 910 MWe "generic" reactor, Reference (1) uses a value of $1.2E+08/yr). The net power level for Davis-Besse is 908 MWe. Therefore, the value of $1.2E+08/yr for *B* is representative for Davis-Besse and is used in the analysis.

The values for the base case are:

t_f = 28 yrs

r = 7%/yr = 0.07/yr

B = $1.2E+08/yr

$$PV_{RP} = \frac{\$1.2E+08/\text{yr}}{\left(\frac{0.07}{\text{yr}}\right)}\left(1 - e^{-\left(\frac{0.07}{\text{yr}}\right)(28\text{yrs})}\right)^2 = \$1.27\text{x}10^9 \qquad \text{(E.4-20)}$$

To account for the entire lifetime of the facility, U_{RP} was then calculated from PV_{RP} as follows:

$$U_{RP} = \frac{PV_{RP}}{r}\left(1 - e^{-rt_f}\right)^2(F) \qquad \text{(E.4-21)}$$

where,

U_{RP} = present value of the cost of replacement power over the remaining life ($)

t_f = years remaining until end of facility life (yr)

r = discount rate (%/yr)

F = CDF (events/yr)

Based upon the values previously assumed for the base case:

$$U_{RP} = \frac{\$1.27E+09}{\left(\frac{0.07}{yr}\right)}\left(1-e^{-\left(\frac{0.07}{yr}\right)(28yrs)}\right)^2 (1.0E-05) = \$133{,}917 \qquad \text{(E.4-22)}$$

E.4.4.3 Total Averted On-Site Costs

The AOSCs were estimated by combining the cleanup and decontamination (U_{CD}) and replacement power costs (U_{RP}) equations, and using the numerical values calculated in Sections E.4.4.1 and E.4.4.2.

The base case averted on-site cost is:

$$AOSC = U_{CD} + U_{RP} = \$132{,}362 + \$133{,}917 = \$266{,}279 \qquad \text{(E.4-23)}$$

E.4.5 TOTAL COST OF SEVERE ACCIDENT RISK

The total cost of severe accident impact for internal events was calculated by summing the public exposure cost, off-site property damage cost, occupational exposure cost, and on-site economic cost. The cost of the impact of a severe accident for internal events was $339,331 as shown in Table E.4-1. Davis-Besse does not have external events (fire, seismic, other external events) PRA from which risk contributors could be combined with the internal events risk. This analysis assumed that the benefit from each hazard group's (i.e., fire, seismic, and other external events) contribution is equivalent to that of internal events. This approach is conservative, based on the discussion in Section E.3.1.2. Therefore, the cost of SAMA candidate implementation was compared with a benefit value of four times (i.e., 1x for internal events plus 3x for external events) that calculated for internal events to include the contribution from internal events, fire, seismic, and other hazard groups. This approach provided a comparison of the cost to the risk reduction estimated for internal and external events for each SAMA candidate. The maximum benefit for Davis-Besse was $1,357,324 as shown in Table E.4-1.

E.5 CANDIDATE SAMA IDENTIFICATION

The first step in the SAMA process was to create a comprehensive list of potential SAMA candidates for qualitative evaluation. This was performed to capture any potential SAMA candidates that were not generated by our analyses, but were identified by others within the industry. This list of potential SAMA candidates was a compilation of candidates form several sources. These sources included:

- Industry SAMA guidance documents
- Previously completed SAMA analyses
- Davis-Besse IPE and IPEEE conclusions and recommendations

In addition, the latest Davis-Besse PRA results were evaluated to identify any additional SAMA candidates that may be unique to Davis-Besse. This review included the following results from the Davis-Besse Level 1 and Level 2 analyses:

- Top 100 Level 1 cutsets
- Level 1 CDF importance values
- Level 2 LERF importance values

Once the comprehensive list of SAMA candidates was assembled, each candidate was first qualitatively screened. For those that remained following the qualitative screening, a detailed cost-benefit was performed. The following sections provide a detailed description of this process.

E.5.1 REVIEW OF INDUSTRY DATA

Since Davis-Besse is a PWR, particular interest was paid to existing SAMA candidates for PWRs. NEI 05-01 (Reference 2) provides a standard list of PWR SAMA candidates, which was used as the starting point for the potential Davis-Besse SAMA candidates.

In addition to the SAMA candidates provided in Reference (2), Table 14, a review was undertaken of the PWR SAMA analyses completed and documented as supplements to NUREG-1437 (References 30, 31, 32, 33, 34, 35, 36, 37, and 38). These supplements were reviewed to identify any SAMA candidates that might apply to Davis-Besse, but were not included in Reference (2). No additional candidates were identified by the review of the supplements to NUREG-1437.

E.5.2 DAVIS-BESSE IPE AND IPEEE REVIEW

A review was performed of the following documents:

- IPE for the Davis-Besse, February 1993 (Reference 5).
- IPEEE for the Davis-Besse, November 1996 (Reference 12).

The IPE identified the major contributors to CDF for plant internal events, including internal floods. The IPE identified the following major contributors to plant CDF (Reference 5, Section 1.4.1):

- Total Loss of CCW

  Several SAMA candidates were considered that would either address the reliability of the CCW system or provide alternate cooling sources to CCW loads. These include CW-10, CW-21, CW-22, CW-23, CW-24, and CW-25.

- Electric power dependence between AFW and makeup/HPI cooling

  SAMA candidates AC/DC-25 and AC/DC-26 were considered that would improve the reliability of AFW DC power and separate its dependence from HPI DC power.

- Failure to switchover from RCS injection to either high pressure or low pressure recirculation (LPR) for medium and large LOCAs

  SAMA candidates CC-07 (manual switchover to recirculation and CC-08 (automatic switchover to recirculation) were considered to address this finding.

- Failure to replenish the Borated Water Storage Tank (BWST) in the event of an ISLOCA

  SAMA candidate CC-09 was considered to address this recommendation.

In addition, the following insights as to potential areas of improvement were identified from the original IPE study:

- Operator error of commission during ISLOCA (may not be realistic)

  SAMA CB-7 was considered to address operator training for ISLOCA scenarios.

- Shedding of DC loads during loss of AC power scenarios

  SAMA candidate AC/DC 4 considered this issue.

- Sump recirculation using the make-up pumps

  SAMA candidate CC-20 was developed to address this issue.

- Isolation of RCP seal return line following loss of seal cooling

  SAMA candidate CW-19 was developed to address this issue.

- Service water room ventilation

  SAMA HV-06 was developed to address this issue.

- Limited supply of fuel oil to the SBO diesel generator

  SAMA candidate AC/DC-27 was developed to address this issue.

The IPEEE was reviewed for risk insights for external events and internal fires. The following results were presented in the IPEEE (Reference 12):

- The internal fire PRA consisted of a screening methodology using the EPRI developed FIVE methodology. The conclusions are stated as follows:

  > *The results of the topical assessments performed under the FIVE Fire Risk Scoping Study indicate that the following FRSS issues have been adequately addressed by DB, and the applicable aspects of the DB Fire Protection Program therefore are <u>in conformance</u> with the intent of the FRSS guidelines, as tabulated in Attachment 10.5 of the FIVE methodology:*
  >
  > *(1) Potential seismic/fire interactions.*
  >
  > *(2) Manual fire fighting effectiveness.*
  >
  > *(3) Total environment equipment survival.*
  >
  > *(4) Potential control systems interactions.*

  No plant-specific fire vulnerabilities were presented.

- The IPEEE used a seismic margins methodology. No PRA modeling was performed and no seismic vulnerabilities were found.
- No other plant vulnerabilities that would impact PRA CDF were identified in the IPEEE.

E.5.3 LEVEL 1 INTERNAL EVENTS DOMINANT CUTSETS

A review was performed of the top 100 cutsets for the latest Davis-Besse Level 1 PRA (internal events, including internal flooding). Table E.5-1 provides a summary of the top 100 Level 1 PRA cutsets. These cutsets represent over 56% of the total CDF. This list includes all cutsets above 0.11% of the total CDF. This provides a strong confidence that all significant risk contributors to Level 1 risk are captured within this list.

From these cutsets, the following significant contributors were identified:

- Partial or complete loss of CCW.

  Several SAMA candidates were considered that would either address the reliability of the CCW system or provide alternate cooling sources to CCW loads. These include CW-10, CW-21, CW-22, CW-23, CW-24, and CW-25.

- Reactor vessel rupture initiating event.

  No SAMA candidates were found that would reduce the CDF risk further.

- Operators fail to trip RCPs following loss of CCW

  Procedures at Davis-Besse instruct operators to trip RCPs on loss of CCW, with at least an hour available to trip RCPs to prevent RCP seal damage following loss of CCW. Current Davis-Besse procedures were judged to be adequate, and no additional SAMA candidates were identified.

- Small and Medium LOCA with operator failure to establish LPR.

  No weakness in procedures or training was identified for establishing recirculation cooling. SAMA candidate CC-19 addresses providing automatic switchover of emergency core cooling system (ECCS) suction from the BWST to containment sump when BWST low level is reached.

- SGTR events with failure of operator actions such as isolation of the affected steam generator, failure to provide makeup to the BWST and failure to provide cooldown via HPI.

  SAMA candidates addressing SGTR events include CB-09 through CB-19.

  It should be noted that Davis-Besse plans to replace the existing steam generators with an improved design (CB-10). This should significantly reduce the risk of SGTR events.

E.5.4 LEVEL 1 SYSTEM IMPORTANCE

Davis-Besse Level 1 PRA basic events were evaluated with respect to their risk reduction worth (RRW) importance measure. Having a high RRW indicates that improving the reliability of that system would result in a greater CDF reduction than systems with a relatively lower RRW value.

The list of basic event importance values includes all basic events with a RRW value of 1.005 or greater. It is judged that this list captures all risk significant basic events for the Level 1 PRA model.

Table E.5-2 provides a ranking of the basic events by RRW. Basic events with high RRW values include the following:

- Failure to initiate makeup/HPI cooling after loss of all feedwater

  SAMA candidate FW-01 addresses the installation of a digital feedwater control system to improve main feedwater (MFW) reliability. No weakness in training or procedures was identified pertaining to initiation of HPI cooling on loss of all feedwater.

- Failure to start motor-driven feedwater pump (MDFP) after loss of feedwater

  SAMA candidate FW-01 addresses the installation of a digital feedwater control system to improve MFW reliability. No weakness in training or procedures was identified pertaining to starting the MDFP on loss of all feedwater.

- Operator failure to trip RCP following loss of CCW

  SAMA candidates CW-07, CW-08 and CW-09 address operator training and procedures addressing loss of CCW. Procedures at Davis-Besse instruct operators to trip RCPs on loss of CCW, with at least an hour available to trip

RCPs to prevent RCP seal damage following loss of CCW. Current Davis-Besse procedures were judged to be adequate, and no additional SAMA candidates were identified.

- Failure of operator actions in response to loss of off-site power (LOOP), including starting and aligning the SBO diesel generator or emergency diesel generators (EDGs), EDG 1-1 or EDG 1-2, to the MDFP.

  No potential improvements in operator training or procedures for starting the SBO diesel generator or aligning the SBO diesel generator or EDGs were identified. SAMA candidates were identified that had the potential to reduce the likelihood of SBO events. These included SAMA candidates AC/DC-09, AC/DC-14, and AC/DC-24. In addition, numerous SAMA candidates in category AC/DC address enhancing the ability to cope with SBO scenarios. These SAMA candidates included increasing battery life and emergency battery charging systems.

- Operators fail to control AFW on loss of direct current (DC) power

  SAMA candidates AC/DC-25 and AC/DC-26 provided redundant sources of DC power to the AFW control system.

E.5.5 LEVEL 2 IMPORTANCE INSIGHTS

Davis-Besse PRA basic events were also evaluated with respect to their RRW importance measure for LERF. Having a high RRW indicates that improving the reliability of that system would result in a greater LERF reduction than systems with a relatively lower RRW value. Therefore, systems with high RRW values will be considered as potential SAMA candidates.

The list of basic event importance values includes all basic events with RRW value of 1.005 or greater. It is judged that this list captures all risk significant basic events for the Level 1 PRA model.

Table E.5-3 provides a ranking of the basic events by RRW. LERF importance is dominated by SGTR and ISLOCA events. Basic events with high RRW values include the following:

<u>Steam Generator Tube Rupture</u>

In addition to the SGTR initiating event, basic events associated with SGTR include:

- Operators fail to cooldown during SGTR,
- Failure to close main steam isolation valve (MSIV) and isolate affected steam generator,
- Main steam safety valve (MSSV) fails to reseat during SGTR,
- Operators fail to attempt cooldown via makeup/HPI cooling, and
- Failure to makeup to BWST either due to operator error or valve failure.

SAMA candidates addressing SGTR include CB-09 through CB-19. It should be noted that FENOC plans to replace the existing steam generators with an improved design (CB-10). This replacement should significantly reduce the risk of SGTR events.

Interfacing System LOCA in the Decay Heat Removal (DHR) System

SAMA candidates addressing ISLOCA events include CB-01 through CB-08. SAMA candidate CB-21 was developed specifically for Davis-Besse to provide early indication of a potential ISLOCA in the DHR system.

Pressure switches fail high preventing opening of DHR valves

Davis-Besse has an abnormal procedure for loss of DHR that allows the restoration of the decay heat flow path by bypassing the two DHR suction valves (DH 11/12) by opening manual valves in containment. No other SAMA candidates addressing opening of the DHR valves were identified.

E.5.6 INITIAL SAMA CANDIDATE LIST

Based on the review of the aforementioned sources, an initial list of 167 SAMA candidates was assembled. The comprehensive list of initial SAMA candidates considered for implementation at Davis-Besse are provided in Table E.5-4, where each SAMA candidate is categorized and identified according to a global modification identifier.

E.6 PHASE I SAMA ANALYSIS – SCREENING

The cost-benefit evaluation performed as part of this analysis was concerned only with those modifications that reduce the severe accident risk associated with plant operation if implemented at Davis-Besse. Therefore, the purpose of the initial (qualitative) screening was to identify the subset of those SAMA candidates identified in Table E.5-4 that warrant a detailed cost-benefit evaluation.

Since most of the SAMA candidates were derived from industry sources, they include a wide variety of potential enhancements that may not be directly applicable to Davis-Besse. In addition, several SAMA candidates initially considered may have already been implemented at Davis-Besse or met the intent of the SAMA candidate. Some SAMA candidates were screened on the basis of excessive implementation cost (no cost estimate is necessary) or very low benefit (no PRA case is needed to be run). Each of the SAMA candidates was screened consistent with guidance in Reference (2). Table E.6-1 provides the results of the qualitative screening.

E.6.1 NOT APPLICABLE – CRITERION A

The SAMA candidates were reviewed to determine which ones were not applicable to Davis-Besse. Potential enhancements that were not considered applicable to Davis-Besse were those developed for systems specifically associated with boiling water reactors (BWRs) or associated with specific PWR equipment that is not present at Davis-Besse. For example, Davis-Besse does not have a gas turbine generator. Therefore, installing tornado protection is not applicable for Davis-Besse. Also, some SAMA candidates addressed the use of systems from a second unit at a multi-unit site, which also did not apply. SAMA candidates meeting this criterion were eliminated from further analysis.

The SAMA candidates that were not applicable to Davis-Besse were reviewed to ensure that other potential modifications similar in intent, and applicable to Davis-Besse, were identified.

E.6.2 ALREADY IMPLEMENTED – CRITERION B

The remaining SAMA candidates were reviewed to identify those modifications that have already been implemented at Davis-Besse. Some of the SAMA candidates had been implemented as a result of insights gained from the Davis-Besse IPE and IPEEE studies. For example, Davis-Besse has the capability to transfer alternating current (AC) power automatically from normal to standby power; this satisfies the SAMA candidate that calls for the addition of an automatic feature to transfer the AC from normal to standby power. The SAMA candidates meeting this criterion were eliminated from further analysis.

E.6.3 EXCESSIVE IMPLEMENTATION COST – CRITERION C

Some SAMA candidates were determined to be prohibitively expensive by inspection. An example of this type of SAMA candidate was an extensive and extremely expensive modification to the containment. If a SAMA candidate required extensive changes that obviously exceeded the maximum benefit, the candidate was not retained for further evaluation. The maximum benefit (defined in Section E.4 and reported in Table E.4-1) was less than $1,400,000.

E.6.4 VERY LOW BENEFIT – CRITERION D

If a SAMA candidate was related to a non-risk-significant system for which the change in reliability had a negligible impact on the risk profile, the SAMA candidate had a very low benefit and was not retained for further analysis. Determination of non-risk-significance was based on a combination of factors, including importance values and inclusion in dominant cutsets.

E.6.5 SUBSUMING OF SAMA CANDIDATES – CRITERION E

During the screening process, if a particular SAMA candidate was found to be similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or more plant-specific candidate, it was subsumed by the most appropriate SAMA candidate for Davis-Besse. The subsumed SAMA candidate was not evaluated further; however, the intent of such SAMA candidates was captured by the SAMA candidate by which they were subsumed.

E.6.6 CONSIDERED FOR FURTHER EVALUATION – CRITERION F

SAMA candidates that did not meet Criterion A, B, C, D, or E were considered for further evaluation and subject to a cost-benefit evaluation.

E.7 PHASE II SAMA ANALYSIS – COST-BENEFIT

Those SAMA candidates not eliminated by the qualitative screening were selected for cost-benefit analysis. The first step in the cost-benefit analysis was to use the Level 1 PRA and Level 2 PRA models for Davis-Besse to evaluate the impact on the CDF and release category frequencies for each SAMA candidate requiring additional consideration.

The Level 1 PRA core damage sequences were mapped to specific PDSs that reflects the condition of the RCS and to some extent, the conditions in containment prior to vessel breach. Each PDS groups Level 1 PRA sequences based on their impact on subsequent containment response. Characteristics of a PDS include:

- time of core damage,
- leakage rate from the RCS,
- RCS pressure,
- availability of heat removal via steam generators,
- water inventory in the reactor cavity,
- status of containment boundary,
- status of containment heat removal loss of coolant injection,
- status of fission-product spray removal, and
- status of systems important to the containment performance assessment.

In the Level 2 PRA analysis, each PDS is evaluated by the CETs. The CET models accident progression and containment performance from the PDS to the eventual source release characterization. Level 2 PRA results were binned into one of 34 release categories. The frequency and source term characteristic for each release category was provided as input to the subsequent Level 3 PRA. A summary of each Level 2 PRA release category is provided in Table E.3-4.

E.7.1 SAMA BENEFITS

The Davis-Besse baseline PRA model provided the CDF and release category frequencies for input into the cost-benefit evaluation. The CDF was used to determine the maximum benefit of eliminating all risk from the plant. The release category frequencies were used in the Level 3 PRA analysis to determine the maximum monetary loss and population dose. These values were then used in the maximum benefit evaluation.

E.7.1.1 SAMA Candidate Evaluation

The benefit of each SAMA candidate was estimated by modifying either the Level 1 PRA or Level 2 PRA model to reflect the benefit that could be derived (by implementing the SAMA candidate). The estimated benefit was determined by applying a bounding modeling assumption in the PRA model. For example, if the objective of a particular SAMA candidate was to reduce the likelihood of a certain component or system failure, that component or system was modeled to be perfectly reliable, even though the SAMA candidate would likely not completely eliminate failure of that component or system. This bounding treatment is conservative for a SAMA analysis, since underestimating the risk in the modified PRA case makes the modification look more attractive than it may actually be.

Initially applying conservative bounding estimates for an expected SAMA candidate benefit simplified the PRA modeling changes that are required, and therefore improved the efficiency of the entire process. For all the cases, a bounding analysis was sufficient to eliminate a SAMA candidate from further consideration. If the results from a bounding assumption had not provided an unambiguous conclusion for the cost-benefit analysis, then an additional case(s) would have been performed by applying a more detailed analysis and less bounding PRA modifications to better estimate the true benefit.

The PRA model modifications and calculations were performed for the at-power internal events PRA. The release frequencies for the base case are provided in Table E.3-20. It is important to note that the sum of the containment systems state frequencies calculated by the Level 2 PRA model does not exactly equal the CDF calculated by the Level 1 PRA model. The reason for this difference is the delete term approximation used to quantify successes in the sequence trees; this is an approximation to the negation which is valid when the probabilities of events are small. There are also differences in the systems included in the Level 1 and Level 2 models (e.g., the Level 2 model included containment spray and the containment isolation valves (CIVs) that are not included in the Level 1).

The enhanced CDF for each SAMA candidate PRA case was calculated by adding the release category frequencies. A summary of the 14 PRA results for the SAMA candidates analyzed is provided in Table E.7-1.

E.7.1.2 Best-Estimate Benefit Calculation

The reference value parameters included the discount rate, time to expiration of the renewed Davis-Besse license, cost per person-rem, short term exposure, long-term exposure, on-site cleanup duration, total on-site cleanup cost, replacement power net present value, and present value factor. These reference values were used in the baseline calculation performed in Section E.4. A total of 14 PRA cases were modeled to analyze the benefit of plant-specific SAMA candidates identified in the screening process in Section E.6. The final inputs required were the consequence parameters. The consequence parameters, off-site dose and economic impact, were provided from the Level 3 PRA described in Section E.3.4. These consequence parameters were provided for each of the 34 release categories.

The next step in the analysis was to calculate the benefit (in U.S. dollars) for each modeled PRA case associated with the implementation of a SAMA candidate. A delta CDF was used to calculate the benefit for each SAMA candidate. The total benefit included the contribution from all hazard groups. Therefore, a worksheet was developed to calculate the benefit for internal events and total benefit including the contribution from external events. The internal events worksheets used the equations discussed in Section E.4 to calculate the AOE, AOSC, APE, and AOC. For each case, the benefit from internal events and external events (fire, seismic, and other hazard groups) were summed in a worksheet to determine the total benefit of implementing the SAMA candidate. As discussed in Section E.4.5, the fire, seismic, and other hazard group risk contribution was conservatively estimated to be equivalent to three times the internal events risk contribution.

The results of the benefit analysis for all the SAMA candidate cases are presented in Table E.7-2 for internal events. Table E.7-3 represents the total benefit for all the SAMA cases. These are the final benefit results used for comparison against the implementation costs.

E.7.1.3 Cost-Benefit Evaluation

The results of the cost-benefit evaluation are presented in Table E.7-5. This table provides a comparison of cost with the benefits of SAMA candidate implementation and final conclusions drawn for each SAMA candidate.

E.7.2 SAMA CANDIDATE IMPLEMENTATION COSTS

To assess the viability of each SAMA candidate considered for a final cost-benefit evaluation, the cost of implementing that particular SAMA candidate was estimated and compared with the estimated benefit. If the cost of implementation was greater than the attainable benefit for a particular SAMA candidate, then the modification was not considered economically viable and was eliminated from further consideration.

The cost of implementation was established from estimates provided by Davis-Besse Expert Panel review. Expert Panel review is a knowledge-based review process that requires the personnel participating to have combined knowledge of:

- Facility design and plant configuration;
- Facility operation and how SAMA candidates would be accomplished;
- B(5)b mitigation plans;
- Minor/rapid response-type repairs and modifications;
- Corrective maintenance for accomplishment of repairs;
- Major modification costs and cost-estimating;
- Electrical and instrumentation and control design and operational options;
- Radiation hazards – to judge feasibility of a mitigation strategy; and
- Training – to evaluation training impacts of changes and modifications.

The Davis-Besse Expert Panel consisted of senior staff members from the PRA group, Project Management, Design Engineering, Operations, Operations Training, Technical Services Engineering, Procurement Engineering, and License Renewal. This panel, based upon their knowledge and experience, judged for each SAMA candidate whether a modification could be made to the plant, or whether procedure changes or training could be implemented to address the SAMA issues. The panel also estimated the associated costs for each modification, procedure change or training item identified for the SAMA candidates. The purpose of this approach was to minimize the effort expended on detail cost estimation. Table E.7-4 provides the implementation cost estimate in 2009 U.S. dollars for the SAMA candidates.

E.8 SENSITIVITY ANALYSIS

E.8.1 PLANT MODIFICATIONS

There are no plant modifications that are currently pending that would be expected to impact the results of this SAMA analysis. There are two pending plant modifications (steam generator replacement and installation of digital feedwater control) that have been accounted for in the SAMA candidate screening process (CB-10 and FW-01) (see Sections E.5.4 and E.5.5).

E.8.2 UNCERTAINTY

While the results of the sensitivity cases in Section E.3.5.2 show the robustness of the Level 3 PRA model, and the sensitivity cases in this section showed the robustness of the SAMA cost-benefit evaluation, these analyses contained a number of conservative assumptions and inputs. No explicit uncertainty was performed since the number of conservative assumptions and inputs account for any uncertainties in the calculations.

As the SAMA candidates generally appear to be not cost-beneficial when considering the sensitivity cases, the conservatisms add further assurance of the appropriateness of the results and the subsequent conclusions. Thus, the gap between benefit and cost could be increased if some of the conservative assumptions were relaxed. Some of the base case conservatisms included:

- Each of the PRA cases to estimate the change in CDF used bounding assumptions in the manipulation of the PRA model, which offsets the CDF uncertainty. For example, if a SAMA candidate could reduce the likelihood of a large break LOCA, the bounding assumption was that there would be no large break LOCA, overestimating the benefit of the SAMA candidate.

- The multiplier used to account for fire and seismic risk contributions is conservative. The contribution of risk due to fire has been estimated to be on the same order of magnitude as the internal events CDF, while the contribution of risk due to seismic events is considered to be small compared to the internal events CDF. Using a multiplier of three (total CDF considered was four times the internal events CDF), overestimated the benefit of a SAMA candidate. For Davis-Besse, the risk contribution due to high winds is included in the internal events PRA model.

- Davis-Besse cost-benefit analysis used an analysis period of 28 years (the time from now to the end of Davis-Besse's requested license renewal period). This analysis period is conservative in contrast to the 20 years of license renewal extension, which is often used in the base case calculations as part of the SAMA analysis cost-benefit analysis. Accordingly, use of a 28-year analysis period in the base case is conservative.

- Davis-Besse-specific cost estimates were estimated by an expert panel. Detailed cost estimations would likely include factors that were not considered for this analysis; accordingly, the cost estimates are likely conservatively underestimated. The large, more generic costs far exceed the estimated benefit, such that many orders of magnitude of uncertainty could be considered without impacting the results.

- In the Level 3 PRA, several of the input parameters were purposely developed in a conservative manner:

  - The value of release fractions were taken from the end of the time traces, rather than when the release was estimated to be terminated; this approach overestimated the source term.

  - The population was escalated to 2040, three years beyond the end of the requested license renewal period. In addition, the escalation factor used was a constant, despite the census indication that the Ohio state population was increasing at a decreasing rate. Such an overestimation of the population conservatively impacted the consequence metrics used to estimate off-site dose and economic consequences of the SAMA candidates.

E.8.3 EVACUATION SPEED

A sensitivity case was performed to investigate the sensitivity of each analysis case to the evacuation speed used in the Level 3 PRA analysis. The whole body dose was used in this sensitivity case to represent the impact of the evacuation speed on the cost-benefit analysis. The Level 3 PRA sensitivity case involving evacuation speed is discussed in Section E.3.5.2.4 (sensitivity case E1). The whole body dose for Case E1 is provided in Table E.3-31. The equations used and calculations performed are consistent with Section E.4. The result of the evacuation speed sensitivity case is summarized in Table E.8-1.

E.8.4 REAL DISCOUNT RATE

Two sensitivity cases were performed to investigate the sensitivity of each analysis case to the real discount rate. The first sensitivity case assumed a lower discount rate of three percent and the second sensitivity assumed a high discount rate of ten percent. The equations used and calculations performed are consistent with Section E.4. The results of the low and high discount rate sensitivity cases are summarized in Table E.8-1.

E.8.5 ANALYSIS PERIOD

Since an analysis period of 28 years (the time from now to the end of Davis-Besse's requested license renewal period) is used in the base case versus the less conservative 20 years (license renewal period), there is no need to perform a sensitivity case. The base case already incorporates the more conservative value of the analysis period.

E.8.6 OTHER SENSITIVITY CASES

Six additional sensitivity benefit calculations were performed, which are briefly described below. The equations used and calculations performed are consistent with Section E.4.

- The first sensitivity case investigated the impact of assuming damaged plant equipment is repaired and refurbished following an accident scenario, as opposed to automatically decommissioning the facility following the event.

- The second sensitivity case investigated the sensitivity of each analysis case to the on-site dose estimates. This sensitivity case assumed higher short-term dose (14,000 person-rem) and long-term dose (30,000 person-rem) (Reference 1, Section 5.7.3).

- The third sensitivity case investigated the sensitivity of each analysis case to the total on-site cleanup cost. This sensitivity case assumed a higher on-site cleanup cost of $2,000,000,000 (Reference 1, Section 5.7.6).

- The fourth sensitivity case investigated the sensitivity of each analysis case to the cost of replacement power. An inflation rate was determined by assessing the electricity costs in 1993 and in 2009 dollars for the state of Ohio. The inflation rate was used to calculate the 2009 dollar value for the string of replacement power costs.

- The fifth sensitivity case investigated the sensitivity of each analysis to the non-internal events hazard groups' multiplier by assuming a multiplier of five.

- The sixth sensitivity case investigated the sensitivity of each analysis to the off-site economic cost. This sensitivity case assumed the off-site ecomonic cost was increased by twenty-five percent.

The results of the sensitivity cases (Repair, On-site Dose, On-site Cleanup, Replacement Power, Multiplier, and Off-site Economic Cost) are summarized in Table E.8-1.

E.9 CONCLUSIONS

The cost-benefit evaluation of SAMA candidates performed for the Davis-Besse license renewal process provided significant insight into the continued operation of Davis-Besse. The results of the evaluation of 167 SAMA candidates indicated no enhancements to be potentially cost-beneficial for implementation at Davis-Besse.

However, the sensitivity cases performed for this analysis found one SAMA candidate (AC/DC-03) to be potentially cost-beneficial for implementation at Davis-Besse under the assumptions of three of the sensitivity cases (low discount rate, replacement power, and multiplier). SAMA candidate AC/DC-03 considered the addition of a portable diesel-driven battery charger for the DC system. While the identified SAMA candidate is not related to plant aging and therefore not a required modification for the license renewal period, FENOC will, nonetheless, consider implementation of this candidate through the normal processes for evaluating possible plant modifications.

The cost-benefit evaluation performed used several conservatisms. The guidance document, Section 5 of Reference (1), used to perform the cost-benefit evaluation is inherently conservative. The PRA cases used a conservative approach to estimate the benefit from a particular SAMA candidate. The estimation of the total benefit assumed, conservatively, that the contribution due to fire, seismic and “other” external events was three times the risk contributions of internal events, although evidence suggests that it is less than that. The use of an analysis period of 28 years was conservative. These conservative assumptions, combined with the results of several sensitivity cases, demonstrate the robustness of the SAMA analysis results.

E.10 FIGURES AND TABLES

Table E.3-1: Davis-Besse SAMA Analysis Model Dominant Initiating Event Contribution to Core Damage (Initiating Events)

Initiator	Description	Contribution to Internal CDF	Percent of Internal CDF*	Cumulative Percent of Internal CDF*
T3	LOOP (initiating event)	1.91E-06	21%	21%
T1	Reactor/turbine trip (initiating event)	1.32E-06	14%	35%
TMPP43XF-CC_ALL	All CCW pumps fail to run due to CCF (initiating event)	6.64E-07	7%	42%
R	SGTR (initiating event)	6.22E-07	7%	49%
T2	Plant trip due to loss of MFW (initiating event)	5.72E-07	6%	55%
AV	Reactor vessel rupture	5.00E-07	5%	61%
S	Small LOCA (initiating event)	4.25E-07	5%	65%
T13A-1-3-IEF	Loss of CCW Train 1 initiating event Pump 1 running	4.09E-07	4%	70%
T13A-2-3-IEF	Loss of CCW Train 2 initiating event Pump 2 running	3.84E-07	4%	74%
TMPP43XF-CC_1_2	CCW pumps 1 & 2 failure to run due to CCF (initiating event)	2.69E-07	3%	77%
F3AM	Maximum flood in CCW pump room from service water (initiating event)	1.98E-07	2%	79%
M	Medium Break LOCA	1.47E-07	2%	80%
T2B-1	SP6A fails to throttle (initiating event)	1.33E-07	1%	82%
T2A-1	SP6B fails to throttle (initiating event) SP6B	1.32E-07	1%	83%
T12B7-IEF	Service water pump room ventilation failure (T<86)	1.27E-07	1%	85%
T2A-2	FICICS35B fails high (initiating event)	1.22E-07	1%	86%
T2B-2	FICICS35A fails high (initiating event)	1.22E-07	1%	87%
T18-IEF	Loss of DC power from Bus d2p (initiating event)	1.10E-07	1%	88%
F7L	Large circulating water flood in turbine building (initiating event)	8.84E-08	1%	89%
T9-IEF	Loss of DC power supply NNIX (initiating event)	8.24E-08	1%	90%

* Percentages are rounded to whole numbers. Anticipated transient without scram (ATWS) sequences are modeled as a failure to trip after an initiating event; ATWS sequences contribute approximately 1% to CDF. SBO sequences involve a LOOP (as the initiating event or following an initiating event), along with subsequent failure of power to both safety buses, C1 and D1 (i.e, a loss of both EDGs and the SBO diesel generator); SBO sequences contribute approximately 5% to CDF and are dominated by sequences initiated by a LOOP (T3).

Table E.3-2: Davis-Besse SAMA Analysis Model Top 30 Components by Fussell-Vesely (Internal Events)

Rank	Component ID	Description	Fussell-Vesely
1	P43-2	CCW Pump 1-2	1.26E-01
2	P43-1	CCW Pump 1-1	1.26E-01
3	P43-3	CCW Pump 1-3	1.21E-01
4	P14-1	Turbine-Driven Auxiliary Feedwater (TDAFW) Pump 1-1	1.15E-01
5	P14-2	TDAFW Pump 1-2	9.75E-02
6	K5-2	EDG 1-2	9.00E-02
7	HX11B	Auxiliary Transformer 11 to Bus B Breaker	4.92E-02
8	LTSP9A6	SG2 SU LVL XMTR for SFRCS LCH1	4.29E-02
9	LTSP9A7	SG2 SU LVL XMTR for SFRCS LCH3	4.29E-02
10	LTSP9B8	SG1 SU LVL XMTR for SFRCS LCH1	4.29E-02
11	LTSP9B9	SG1 SU LVL XMTR for SFRCS LCH3	4.29E-02
12	LTSP9A8	SG2 SU LVL XMTR for SFRCS LCH2	4.28E-02
13	LTSP9A9	SG2 SU LVL XMTR for SFRCS LCH4	4.28E-02
14	LTSP9B6	SG1 SU LVL XMTR for SFRCS LCH2	4.28E-02
15	LTSP9B7	SG1 SU LVL XMTR for SFRCS LCH4	4.28E-02
16	HX02B	Start-up Transformer 02 to Bus B Breaker	3.70E-02
17	SP17B1	Main Steam Line 1 Code Safety	3.69E-02
18	SP17B2	Main Steam Line 1 Code Safety	3.69E-02
19	SP17B3	Main Steam Line 1 Code Safety	3.69E-02
20	SP17B4	Main Steam Line 1 Code Safety	3.69E-02
21	SP17B5	Main Steam Line 1 Code Safety	3.69E-02
22	SP17B6	Main Steam Line 1 Code Safety	3.69E-02
23	SP17B7	Main Steam Line 1 Code Safety	3.69E-02
24	SP17B8	Main Steam Line 1 Code Safety	3.69E-02
25	SP17B9	Main Steam Line 1 Code Safety	3.69E-02
26	SW1424	CCW Heat Exchanger 1 Outlet Temperature	3.15E-02
27	SW1434	CCW Heat Exchanger 2 Outlet Temperature	3.08E-02
28	K5-1	EDG 1-1	2.55E-02
29	K5-3	SBO Diesel Generator	2.49E-02
30	HX11A	Auxiliary Transformer 11 to Bus A Breaker	2.42E-02

Table E.3-3: Mapping of Level 1 Accident Sequences into Level 2 Release Categories

	Source Term Release Categories																					
	Containment Bypass - SGTR				Containment Bypass - ISLOCA		Large Containment Isolation Failure				Small Containment Isolation Failure				Early Containment Failure				Sidewall Containment Failure			
AS*	1.1	1.2	1.3	1.4	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	6.1	6.2	6.3	6.4
AIX							x	x	x	x	x	x	x	x	x	x	x	x				
ARX							x		x		x	x	x	x	x	x	x	x				
MIX							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MRX							x		x		x	x	x	x	x	x	x	x	x	x	x	x
SIN		x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SIY		x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SRN		x		x			x		x		x	x	x	x	x	x	x	x	x	x	x	x
SRY							x		x		x	x	x	x	x	x	x	x	x	x	x	x
TIN		x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TIY							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TRN		x		x			x		x		x	x	x	x	x	x	x	x	x	x	x	x
RIN		x		x																		
RIY	x		x																			
RRN				x																		
RRY			x																			
V					x	x																

*Level 1 Accident Sequences (AS) defined in terms of Core Damage Bin (i.e., Type of Initiating Event, Timing of Failure, Availability of SG Cooling)

Table E.3-3: Mapping of Level 1 Accident Sequences into Level 2 Release Categories (continued)

	Source Term Release Categories											
	Late Containment Failure								Basemat Containment Failure		No Containment Failure	
AS*	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	8.1	8.2	9.1	9.2
AIX	x	x	x	x	x	x	x	x	x	x	x	x
ARX	x	x	x	x	x	x	x	x	x	x	x	x
MIX	x	x	x	x	x	x	x	x	x	x	x	x
MRX	x	x	x	x	x	x	x	x	x	x	x	x
SIN	x	x	x	x	x	x	x	x	x	x	x	x
SIY	x	x	x	x	x	x	x	x	x	x	x	x
SRN	x	x	x	x	x	x	x	x	x	x	x	x
SRY	x	x	x	x	x	x	x	x	x	x	x	x
TIN	x	x	x	x	x	x	x	x	x	x	x	x
TIY	x	x	x	x	x	x	x	x	x	x	x	x
TRN	x	x	x	x	x	x	x	x	x	x	x	x
RIN												
RIY												
RRN												
RRY												
V												

*Level 1 Accident Sequences (AS) defined in terms of Core Damage Bin (i.e., Type of Initiating Event, Timing of Failure, Availability of SG Cooling)

Table E.3-4: Mapping of Release Categories to MAAP Runs

Release Category Number	Release Category Description				MAAP Case Characterizing Source Term
	Containment Failure Type	Core Debris Cooled?	Fission Product Scrubbing Late?	Late Revapor-ization?	
1.1	Bypass – SGTR	Y	Y	NA	ST11_RIYVXINN_52Y-0021a
1.2	Bypass – SGTR	Y	N	NA	ST12_RIYVXINN_52Y-0021a
1.3	Bypass – SGTR	N	Y	NA	ST13_RIYVXINN_52Y-0021a
1.4	Bypass – SGTR	N	N	NA	ST14_RIYVXINN_52Y-0021a
2.1	Bypass – ISLOCA	N	N	NA	ST21_ISLOCA
2.2	Bypass – ISLOCA	N	Y	NA	ST22_ISLOCA
3.1	Large Isolation	Y	Y	NA	ST31_AXI1a_4
3.2	Large Isolation	Y	N	NA	ST32_AXI1a_4
3.3	Large Isolation	N	Y	NA	ST33_AXI1a_4
3.4	Large Isolation	N	N	NA	ST34_AXI1a_4
4.1	Small Isolation	Y	Y	NA	ST41_AXI1a_4
4.2	Small Isolation	Y	N	NA	ST42_AXI1a_4
4.3	Small Isolation	N	Y	NA	ST43_AXI1a_4
4.4	Small Isolation	N	N	NA	ST44_AXI1a_4
5.1	Early	Y	Y	NA	ST51_SIYYFYYN_36Y-002
5.2	Early	Y	N	NA	ST52_TINYNINN_53Y
5.3	Early	N	Y	NA	ST53_SIYYFYYN_36Y-002
5.4	Early	N	N	NA	ST54_TINYNINN_53Y
6.1	Sidewall	Y	Y	NA	ST61_TINYNINN_53Y
6.2	Sidewall	Y	N	NA	ST62_TINYNINN_53Y
6.3	Sidewall	N	Y	NA	ST63_TINYNINN_53Y
6.4	Sidewall	N	N	NA	ST64_TINYNINN_53Y
7.1	Late	Y	Y	N	ST71_AXI1a_4
7.2	Late	Y	N	N	ST72_AXI1a_4
7.3	Late	Y	Y	Y	ST73_TINYNINN_53Y
7.4	Late	Y	N	Y	ST74_TINYNINN_53Y

Table E.3-4: Mapping of Release Categories to MAAP Runs (continued)

Release Category Number	Release Category Description				MAAP Case Characterizing Source Term
	Containment Failure Type	Core Debris Cooled?	Fission Product Scrubbing Late?	Late Revapor-ization?	
7.5	Late	N	Y	N	ST75_AXI1a_4
7.6	Late	N	N	N	ST76_AXI1a_4
7.7	Late	N	Y	Y	ST77_TINYNINN_53Y
7.8	Late	N	N	Y	ST78_TINYNINN_53Y
8.1	Basemat	N	Y	NA	ST81_AXI1a_4
8.2	Basemat	N	N	NA	ST82_AXI1a_4
9.1	No Failure	Y	Y	NA	ST91_AXI1a_4
9.2	No Failure	Y	N	NA	ST92_AXI1a_4

Table E.3-5: Description of Representative Release Sequences

Release Category	Representative MAAP Accident Sequence
1	Based on the Level 1 sequence RIYVXINN; a double-ended tube rupture above the steam generator lower tube sheet. ECCS injection fails and, an MSSV on the faulted generator sticks open. AFW was secured at time zero. RCs 1.1 and 1.3 include fission product scrubbing; AFW is restored to the faulted steam generator when core exit temperatures exceed 600 F, but limited by CST inventory. RC 1.1 and 1.2 include debris coolability; containment spray injects the contents of the BWST at the time of vessel failure.
2	Based on containment bypass sequence - guillotine rupture of the 12-inch diameter decay heat removal return line with failure of two valves in series. Primary system coolant is discharged to mechanical penetration room #2 which communicates with the shield building annulus (wire mesh doors). Following the pipe rupture, the room blowout panels fail allowing a release to the Auxiliary Building and environment. ECCS injection fails.
3	Based on the Level 1 sequence AXI1a; a 4.0 ft^2 cold leg break with ECCS injection and CAC failures. The large isolation failure was modeled as a failure to isolate a single 8-inch vacuum breaker line to containment. RCs 3.1 and 3.3 include fission product scrubbing; containment spray in injection and recirculation.
4	Based on the Level 1 sequence AXI1a; a 4.0 ft^2 cold leg break with ECCS injection and CACs failures. The small isolation failure was modeled as a failure to isolate the normal containment sump line. RCs 4.1 and 4.3 include fission product scrubbing; containment spray in injection and recirculation.
5	RCs 5.1 and 5.3 are based on Level 1 sequence SIYYFYYN; a loss of CCW and a 100 gpm seal leak per RCP at 30 minutes. AFW was failed at time zero. CACs and containment spray are available, but ECCS injection fails. RCs 5.2 and 5.4 are based on Level 1 sequence TINYNINN; a SBO, and loss of AFW at time zero. The loss of power fails containment spray, so there is no fission product scrubbing. Vessel failure and debris discharge are into an essentially dry containment. Early containment failure due to hydrogen combustion of ex-vessel steam explosion coincident with vessel failure.

Table E.3-5: Description of Representative Release Sequences (continued)

Release Category	Representative MAAP Accident Sequence
6	Based on the Level 1 sequence TINYNINN; a SBO and loss of AFW at time zero. RCs 6.1 and 6.2 assume direct impingement of entrained core debris on the containment free standing steel shell to obtain sidewall failure even with a coolable debris bed geometry. Sidewall failure 2 minutes after vessel failure results in early containment failure. Sidewall failures communicate with the shield building annulus and auxiliary building #4 mechanical penetration room. Release of fission products to the environment occurs following blow out panel failures; no annulus or auxiliary building decontamination factors are credited. RCs 6.3 and 6.4 include uncoolable debris beds; the debris is assumed to pool in the lower compartment against the outer concrete curb. Late containment failure occurs when sufficient concrete is eroded. RCs 6.1 and 6.3 include fission product scrubbing via containment spray and CACs.
7	RCs 7.3, 7.4, 7.7, and 7.8 involve late containment failures with revaporization and are based on Level 1 sequence TINYNINN; a loss of offsite power and loss of battery power for 2 hours. ECCS injection and CACs fail. After 2 hours, pressurizer control is lost (PORV fails closed), and AFW level control is lost (steam generator overfills). The overfill fails the AFW pumps leading to steam generator dryout followed by heatup and loss of primary coolant. RCs 7.1, 7.2, 7.5, and 7.6 involve late containment failures without revaporization and are based on Level 1 sequence AXI1a; a 4.0 ft^2 cold leg break with ECCS injection, containment spray and AFW, but no CACs. RCs 7.1, 7.2, 7.3 and 7.4 include a coolable debris bed; containment spray is modeled to inject the BWST contents to containment to create a deep water pool overlying the debris bed. If fission product scrubbing is successful, containment spray recirculation is also modeled.
8	Based on the Level 1 sequence AXI1a; a 4.0 ft^2 cold leg break with containment spray but ECCS injection failure. The uncoolable debris bed with basemat failure from core-concrete attack results in a large containment failure. Although containment failure occurs at the cavity floor elevation (below grade level), and debris could be leached and transported to ground water, basemat failures were treated as airborne releases at grade elevation. RC 8.1 includes fission product scrubbing; containment spray in injection and recirculation.
9	Based on the Level 1 sequence AXI1a; a 4.0 ft^2 cold leg break with CAC operation but ECCS injection failure. RC 9.1 includes containment spray injection and recirculation; coolable debris and fission product scrubbing.

Table E.3-6: Release Severity Source Term Release Fraction

Release Category	Cesium Iodine % Release
1.4	46.60%
2.1	37.60%
3.2	36.30%
2.2	34.80%
3.4	33.60%
5.4	25.50%
5.2	23.90%
6.2	20.40%
1.2	17.00%
1.3	15.50%
6.1	12.00%
1.1	11.30%
6.4	4.59%
4.2	1.96%
7.8	1.43%
8.2	1.25%
5.1	0.70%
5.3	0.65%
3.1	0.60%
3.3	0.59%
7.2	0.55%
4.4	0.53%
7.6	0.36%
4.1	0.12%
4.3	0.08%
6.3	0.04%
7.4	0.01%
7.3	0.01%
9.2	0.01%
9.2	0.01%
7.1	0.00%
7.7	0.00%
7.5	0.00%
8.1	0.00%
9.1	0.00%

Table E.3-7: Release Timing Classification Scheme

Classification Category	Time of Release [1]
Late	greater than 6 hrs
Early	less than 6 hrs

[1] Relative to declaration of a General Emergency.

Table E.3-8: Davis-Besse SAMA Analysis Model Top 30 Components for Level 2 by Fussell-Vesely (Internal Events)

Rank	Component ID	Description	Fussell-Vesely
1	K5-2	Emergency Diesel Generator 1-2	1.47E-01
2	K5-1	Emergency Diesel Generator 1-1	1.09E-01
3	SP17B1	Main Steam Line 1 Code Safety	8.34E-02
4	SP17B2	Main Steam Line 1 Code Safety	8.34E-02
5	SP17B3	Main Steam Line 1 Code Safety	8.34E-02
6	SP17B4	Main Steam Line 1 Code Safety	8.34E-02
7	SP17B5	Main Steam Line 1 Code Safety	8.34E-02
8	SP17B6	Main Steam Line 1 Code Safety	8.34E-02
9	SP17B7	Main Steam Line 1 Code Safety	8.34E-02
10	SP17B8	Main Steam Line 1 Code Safety	8.34E-02
11	SP17B9	Main Steam Line 1 Code Safety	8.34E-02
12	HX11B	Auxiliary Transformer 11 to Bus B Breaker	6.76E-02
13	K5-3	Station Blackout Diesel Generator	6.37E-02
14	HX11A	Auxiliary Transformer 11 to Bus A Breaker	5.39E-02
15	MS101	Main Steam Line 1 Isolation	5.38E-02
16	DH11	RCS to Decay Heat Removal System	5.09E-02
17	DH12	RCS to Decay Heat Removal System	5.09E-02
18	ICS 11B	Main Steam Line 1 Atmospheric Vent	4.60E-02
19	SP17A1	Main Steam Line 2 Code Safety	4.52E-02
20	SP17A2	Main Steam Line 2 Code Safety	4.52E-02
21	SP17A3	Main Steam Line 2 Code Safety	4.52E-02
22	SP17A4	Main Steam Line 2 Code Safety	4.52E-02
23	SP17A5	Main Steam Line 2 Code Safety	4.52E-02
24	SP17A6	Main Steam Line 2 Code Safety	4.52E-02
25	SP17A7	Main Steam Line 2 Code Safety	4.52E-02
26	SP17A8	Main Steam Line 2 Code Safety	4.52E-02
27	SP17A9	Main Steam Line 2 Code Safety	4.52E-02
28	MS100	Main Steam Line 2 Isolation	4.47E-02
29	P14-1	Turbine Driven Auxiliary Feedwater Pump 1-1	3.80E-02
30	C25-4	EDG Room 1 Ventilation Fan	3.14E-02

Table E.3-9: Davis-Besse SAMA Analysis Model Top Ten Operator Actions for Level 2 by Fussell-Vesely (Internal Events)

Rank	Basic Event Name	Description	Fussell-Vesely
1	XHAMUCDE	Operators fail to attempt cooldown via makeup/HPI cooling	3.76E-01
2	CHASGDPE	Operators fail to cooldown during a SGTR	3.33E-01
3	LHAMSIVE	Failure to close MSIV and isolate steam generator containing ruptured tube	3.07E-01
4	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling	6.49E-02
5	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1	6.17E-02
6	EHASBDGE	Operators fail to align power from SBO diesel generator to supply MDFP	6.06E-02
7	QHAMDFPE	Failure to start MDFP after loss of feedwater coincident with reactor trip	5.71E-02
8	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 to supply MDFP given LOOP	3.88E-02
9	EHAD2DGE	Operators fail to align power from EDG 1-1 or EDG 1-2 to supply MDFP given LOOP	3.71E-02
10	UHAISBOR	Operators fail to manually isolate containment normal sump	3.49E-02

Table E.3-10: Ohio State Census Data

Year	Population	Estimated Escalation (per decade)	Comment
1990	10,847,115	--	
2000	11,353,140	4.7%	
2008	11,485,910 (estimated)	1.5%	Equivalent escalation from 2001 to 2010 assuming uniform escalation per each year in the decade, the per-year escalation rate is $(1.012)^{(1/8)}$% or 1.0015 per year. For a per-decade rate, $(1.0015)^{10}$ = 1.015, or a rate of 1.5% per decade.

Table E.3-11: Total (Permanent and Transient) Escalated Population (50-Mile Radius – Davis-Besse) for the Year 2040

Sector	1 mile	2 miles	3 miles	4 miles	5 miles	10 miles	20 miles	30 miles	40 miles	50 miles
N	0	0	0	0	0	0	0	0	54861	351575
NNE	6	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	828	0	0	0
E	0	0	0	0	0	0	2229	219	0	13561
ESE	0	0	320	0	0	0	11198	50152	20763	104445
SE	662	661	0	0	6786	27558	7443	9301	35612	11828
SSE	661	729	60	71	109	1593	2075	23880	6229	20419
S	4	12	55	328	651	1680	34083	7301	34694	7138
SSW	17	5	82	79	482	5743	4141	6025	26881	12565
SW	37	20	20	469	197	1728	9970	9130	7669	64607
WSW	0	50	0	35	84	1050	8246	12404	47735	14163
W	0	53	72	66	87	847	19318	259606	102087	25871
WNW	683	723	156	0	7274	4821	7009	207932	58896	13460
NW	0	165	595	0	0	1763	0	53092	20356	25771
NNW	20	138	0	0	0	0	0	20080	77289	233548

Table E.3-12: Mixing Height

Time	Mixing Heights (meters)
Morning/Winter	700
Morning/Spring	550
Morning/Summer	350
Morning/Autumn	500
Afternoon/Winter	900
Afternoon/Spring	1500
Afternoon/Summer	1600
Afternoon/Autumn	1200

Table E.3-13: MAAP Output for MACCS2

Davis-Besse MAAP Case ID		ST11_RIYVXINN_52Y-0021a	ST12_RIYVXINN_52Y-0021a	ST13_RIYVXINN_52Y-0021a	ST14_RIYVXINN_52Y-0021a	ST21_ ISLOCA
Release Category		1.1	1.2	1.3	1.4	2.1
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	1.67	1.67	1.67	1.67	8.34E-02
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	6000	6000	6000	6000	300
PLHEAT (watts)		6.94E+07	6.94E+07	6.94E+07	6.94E+07	6.92E+06
PLHITE (meters)	TDPLHITE	18.44	18.44	18.44	18.44	2.13
RELFRC	FREL(1)	9.81E-01	7.00E-01	9.84E-01	7.70E-01	9.41E-01
	FREL(2)	1.13E-01	1.70E-01	1.55E-01	4.66E-01	3.48E-01
	FREL(3)	6.29E-02	1.43E-01	8.62E-02	2.03E-01	3.75E-01
	FREL(4)	9.34E-04	9.67E-05	1.01E-03	2.73E-04	6.51E-03
	FREL(5)	9.91E-03	7.22E-04	9.91E-03	6.74E-04	1.04E-02
	FREL(6)	5.26E-02	6.30E-02	5.85E-02	7.15E-02	3.25E-01
	FREL(7)	8.20E-03	8.18E-04	8.28E-03	1.54E-03	1.17E-02
	FREL(8)	1.64E-04	1.72E-05	2.01E-04	4.09E-05	2.01E-04
	FREL(9)	2.46E-04	3.24E-05	3.70E-04	1.01E-04	8.82E-04
	FREL(10)	3.56E-01	4.03E-02	3.65E-01	1.21E-01	1.58E-01
	FREL(11)	0.00E+00	0.00E+00	4.68E-05	9.54E-05	2.91E-05
	FREL(12)	0.00E+00	0.00E+00	1.25E-06	4.66E-07	1.87E-07
PDELAY (hrs)		73.20	2.17	73.1	2.17	0.42
PDELAY(s)		263520	7812	263160	7812	1512
PLUDUR (hrs)		42.93	13.76	75.20	48.95	11.76
PLUDUR (s)		154548	49536	270720	176220	42336
End of Release (hrs)		116.13	15.93	148.3	51.12	12.18

Table E.3-13: MAAP Output for MACCS2 (continued)

Davis-Besse MAAP Case ID		ST22_ ISLOCA	ST31_AXI1A_4	ST32_AXI1A_4	ST33_AXI1A_4	ST34_AXI1A_4
Release Category		2.2	3.1	3.2	3.3	3.4
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	8.38E-02	8.37E-02	8.37E-02	8.37E-02	8.37E-02
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	302	301	301	301	301
PLHEAT (watts)		9.44E+06	2.22E+06	2.63E+06	2.22E+06	2.63E+06
PLHITE (meters)	TDPLHITE	2.13	45.42	45.42	45.42	45.42
RELFRC	FREL(1)	1.00E+00	9.99E-01	9.68E-01	9.99E-01	9.94E-01
	FREL(2)	3.76E-01	6.02E-03	3.63E-01	5.86E-03	3.36E-01
	FREL(3)	3.75E-01	4.25E-03	3.34E-01	4.23E-03	3.25E-01
	FREL(4)	2.59E-02	5.78E-04	5.54E-03	5.63E-04	1.75E-02
	FREL(5)	1.27E-02	6.59E-03	4.56E-03	6.26E-03	4.62E-03
	FREL(6)	3.43E-01	5.06E-03	2.89E-01	4.97E-03	2.85E-01
	FREL(7)	2.12E-02	1.38E-03	9.69E-03	1.34E-03	1.50E-02
	FREL(8)	1.60E-02	1.64E-05	1.61E-04	1.59E-05	1.48E-02
	FREL(9)	3.62E-02	2.68E-05	6.88E-04	2.65E-05	3.46E-02
	FREL(10)	2.49E-01	7.21E-03	2.10E-01	6.78E-03	2.72E-01
	FREL(11)	3.29E-03	1.80E-08	5.54E-05	1.02E-06	6.71E-03
	FREL(12)	3.29E-04	2.21E-13	1.63E-07	2.32E-09	2.94E-04
PDELAY (hrs)		0.50	0.33	0.33	0.33	0.33
PDELAY(s)		1800	1188	1188	1188	1188
PLUDUR (hrs)		10.96	11.43	49.56	19.52	49.56
PLUDUR (s)		39456	41148	178416	70272	178416
End of Release (hrs)		11.46	11.76	49.89	19.85	49.89

Table E.3-13: MAAP Output for MACCS2 (continued)

Davis-Besse MAAP Case ID		**ST41_AXI1A_4**	**ST42_AXI1A_4**	**ST43_AXI1A_4**	**ST44_AXI1A_4**	**ST51_SIYYFYYN _36Y-002**
Release Category		4.1	4.2	4.3	4.4	5.1
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	8.34E-02	8.37E-02	8.34E-02	8.37E-02	6.68E-01
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	300	301	300	301	2406
PLHEAT (watts)		9.28E+05	2.31E+05	7.41E+05	2.21E+05	3.25E+06
PLHITE (meters)	TDPLHITE	2.13	2.13	2.13	2.13	45.42
RELFRC	FREL(1)	5.33E-01	5.62E-01	4.69E-01	5.52E-01	9.82E-01
	FREL(2)	1.22E-03	1.96E-02	8.26E-04	5.32E-03	7.02E-03
	FREL(3)	1.24E-05	1.16E-02	6.63E-06	4.47E-03	2.84E-03
	FREL(4)	7.00E-11	9.71E-05	1.35E-08	2.30E-03	6.90E-06
	FREL(5)	2.78E-10	1.80E-04	9.37E-08	9.10E-05	1.75E-04
	FREL(6)	1.03E-04	9.31E-03	1.90E-04	3.95E-03	1.61E-03
	FREL(7)	3.67E-10	1.99E-04	1.34E-07	1.07E-03	6.63E-05
	FREL(8)	2.18E-12	4.04E-06	1.40E-08	1.97E-03	2.19E-06
	FREL(9)	4.54E-12	1.79E-05	3.43E-08	4.39E-03	2.42E-06
	FREL(10)	5.17E-05	1.50E-02	1.39E-03	2.22E-02	1.40E-03
	FREL(11)	0.00E+00	0.00E+00	2.92E-04	1.34E-03	3.16E-08
	FREL(12)	0.00E+00	0.00E+00	3.42E-08	3.43E-05	0.00E+00
PDELAY (hrs)		12.75	0.42	14.52	0.42	1.84
PDELAY(s)		45900	1512	52272	1512	6624
PLUDUR (hrs)		36.95	49.25	35.17	49.24	15.26
PLUDUR (s)		133020	177300	126612	177264	54936
End of Release (hrs)		49.7	49.67	49.69	49.66	17.1

Table E.3-13: MAAP Output for MACCS2 (continued)

Davis-Besse MAAP Case ID		ST52_TINYNINN_53Y	ST53_SIYYFYYN_36Y-002	ST54_TINYNINN_53Y	ST61_TINYNINN_53Y	ST62_TINYNINN_53Y
Release Category		5.2	5.3	5.4	6.1	6.2
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	9.17E-01	6.68E-01	9.17E-01	9.18E-01	9.18E-01
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	3300	2406	3300	3305	3305
PLHEAT (watts)		1.07E+07	3.07E+06	9.10E+06	6.44E+07	9.70E+07
PLHITE (meters)	TDPLHITE	45.42	45.42	45.42	2.13	2.13
RELFRC	FREL(1)	9.72E-01	9.70E-01	9.95E-01	9.89E-01	9.87E-01
	FREL(2)	2.39E-01	6.51E-03	2.55E-01	1.20E-01	2.04E-01
	FREL(3)	2.90E-01	2.81E-03	3.07E-01	3.56E-02	5.84E-02
	FREL(4)	1.78E-04	8.36E-06	2.78E-02	1.44E-05	6.02E-05
	FREL(5)	6.36E-04	1.65E-04	5.16E-04	8.56E-05	1.25E-04
	FREL(6)	1.28E-01	1.58E-03	1.30E-01	1.69E-02	2.84E-02
	FREL(7)	1.12E-03	7.81E-05	1.34E-02	9.34E-05	3.04E-04
	FREL(8)	3.81E-05	2.42E-06	2.41E-02	2.18E-06	7.71E-06
	FREL(9)	8.53E-05	2.72E-06	6.87E-02	5.32E-06	1.79E-05
	FREL(10)	3.23E-02	1.32E-03	2.57E-01	7.95E-03	1.97E-02
	FREL(11)	0.00E+00	5.73E-07	1.05E-02	9.14E-09	5.86E-06
	FREL(12)	0.00E+00	2.34E-09	4.36E-04	0.00E+00	0.00E+00
PDELAY (hrs)		2.00	1.84	2.00	2.33	2.33
PDELAY(s)		7200	6624	7200	8388	8388
PLUDUR (hrs)		48.01	12.50	48.02	2.17	48.13
PLUDUR (s)		172836	45000	172872	7812	173268
End of Release (hrs)		50.01	14.34	50.02	4.5	50.46

Table E.3-13: MAAP Output for MACCS2 (continued)

Davis-Besse MAAP Case ID		ST63_TINYNINN_53Y	ST64_TINYNINN_53Y	ST71_AXI1A_4	ST72_AXI1A_4	ST73_TINYNINN_53Y
Release Category		6.3	6.4	7.1	7.2	7.3
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	9.18E-01	9.18E-01	8.37E-02	8.37E-02	3.51
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	3305	3305	301	301	12636
PLHEAT (watts)		6.19E+07	9.17E+07	2.80E+07	2.78E+07	2.89E+07
PLHITE (meters)	TDPLHITE	2.13	2.13	45.42	45.42	45.42
RELFRC	FREL(1)	9.99E-01	9.94E-01	9.99E-01	1.00E+00	1.00E+00
	FREL(2)	3.61E-04	4.59E-02	6.43E-06	5.48E-03	8.98E-05
	FREL(3)	1.13E-05	2.92E-03	6.30E-05	1.67E-04	1.92E-05
	FREL(4)	1.06E-09	2.99E-04	1.73E-08	4.16E-08	6.03E-10
	FREL(5)	3.94E-09	2.38E-05	1.44E-07	6.39E-07	1.27E-08
	FREL(6)	9.30E-06	1.29E-03	1.27E-04	5.36E-04	1.87E-06
	FREL(7)	5.42E-09	1.39E-04	4.42E-08	1.24E-07	4.59E-09
	FREL(8)	4.06E-10	2.94E-04	5.30E-10	1.37E-09	9.34E-11
	FREL(9)	7.24E-10	9.23E-04	1.43E-09	2.33E-09	2.08E-10
	FREL(10)	9.52E-06	2.14E-02	9.80E-05	1.81E-04	2.11E-05
	FREL(11)	2.61E-06	1.48E-03	0.00E+00	0.00E+00	0.00E+00
	FREL(12)	5.47E-11	9.07E-06	0.00E+00	0.00E+00	0.00E+00
PDELAY (hrs)		11.92	11.02	28.94	33.6	35.14
PDELAY(s)		42912	39672	104184	120960	126504
PLUDUR (hrs)		38.44	39.44	20.69	16.02	7.51
PLUDUR (s)		138384	141984	74484	57672	27036
End of Release (hrs)		50.36	50.46	49.63	49.62	42.65

Table E.3-13: MAAP Output for MACCS2 (continued)

Davis-Besse MAAP Case ID		ST74_TINYNINN_53Y	ST75_AXI1A_4	ST76_AXI1A_4	ST77_TINYNINN_53Y	ST78_TINYNINN_53Y
Release Category		7.4	7.5	7.6	7.7	7.8
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	3.51	8.37E-02	8.34E-02	3.51	3.51
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	12636	301	300	12636	12636
PLHEAT (watts)		2.84E+07	2.24E+07	2.56E+07	1.96E+07	2.53E+07
PLHITE (meters)	TDPLHITE	45.42	45.42	45.42	45.42	45.42
RELFRC	FREL(1)	1.00E+00	9.98E-01	9.62E-01	8.39E-01	9.41E-01
	FREL(2)	1.38E-04	9.65E-07	3.60E-03	4.87E-06	1.43E-02
	FREL(3)	2.30E-05	6.62E-07	5.28E-03	5.70E-07	9.70E-03
	FREL(4)	6.03E-10	2.08E-08	5.92E-06	6.96E-10	1.58E-05
	FREL(5)	1.27E-08	1.90E-07	1.38E-06	1.27E-08	1.43E-06
	FREL(6)	3.18E-06	2.02E-06	1.24E-03	4.49E-07	5.33E-04
	FREL(7)	4.59E-09	5.35E-08	4.79E-06	4.68E-09	8.15E-06
	FREL(8)	9.34E-11	6.38E-10	3.77E-06	1.96E-10	1.43E-05
	FREL(9)	2.08E-10	1.55E-09	9.35E-06	4.80E-10	4.93E-05
	FREL(10)	1.09E-05	1.45E-05	4.01E-02	1.36E-05	1.78E-02
	FREL(11)	0.00E+00	1.02E-06	5.34E-03	1.99E-06	2.59E-03
	FREL(12)	0.00E+00	4.79E-12	2.16E-07	6.80E-12	4.48E-07
PDELAY (hrs)		40.41	35.77	35.29	51.01	41.54
PDELAY(s)		145476	128772	127044	183636	149544
PLUDUR (hrs)		9.60	13.93	14.52	2.26	11.75
PLUDUR (s)		34560	50148	52272	8136	42300
End of Release (hrs)		50.01	49.7	49.81	53.27	53.29

Table E.3-13: MAAP Output for MACCS2 (continued)

Davis-Besse MAAP Case ID		**ST81_AXI1a_4**	**ST82_AXI1a_4**	**ST91_AXI1A_4**	**ST92_AXI1A_4**
Release Category		8.1	8.2	9.1	9.2
OALARM (uncovery) (hrs)	Core Uncovery (IEVNT(49))	8.34E-02	8.34E-02	8.34E-02	8.37E-02
OALARM (uncovery) (s)	Core Uncovery (IEVNT(49))	300	300	300	301
PLHEAT (watts)		1.15E+07	9.07E+07	2.65E+02	3.29E+02
PLHITE (meters)	TDPLHITE	0.00	0.00	45.42	45.42
RELFRC	FREL(1)	8.73E-01	9.88E-01	1.47E-03	1.50E-03
	FREL(2)	7.91E-07	1.25E-02	6.34E-07	5.54E-05
	FREL(3)	1.03E-06	3.98E-03	5.71E-07	4.59E-05
	FREL(4)	2.04E-08	6.40E-05	1.86E-08	4.98E-07
	FREL(5)	1.89E-07	9.69E-06	1.82E-07	1.96E-06
	FREL(6)	3.26E-06	3.49E-03	5.66E-07	3.99E-05
	FREL(7)	5.42E-08	4.00E-05	5.11E-08	1.18E-06
	FREL(8)	6.48E-10	4.68E-05	6.09E-10	2.20E-08
	FREL(9)	1.54E-09	1.18E-04	1.49E-09	8.60E-08
	FREL(10)	2.31E-06	7.20E-02	4.55E-07	3.18E-05
	FREL(11)	3.11E-07	3.45E-03	0.00E+00	0.00E+00
	FREL(12)	1.35E-12	2.36E-06	0.00E+00	0.00E+00
PDELAY (hrs)		33.32	16.04	0.33	0.42
PDELAY(s)		119952	57744	1188	1512
PLUDUR (hrs)		16.43	33.71	5.94	24.58
PLUDUR (s)		59148	121356	21384	88488
End of Release (hrs)		49.75	49.75	6.27	25

Table E.3-14: Groundshine and Cloudshine Shielding Factors (Base Case)

	Evacuation	Normal	Sheltering	Comments
Cloudshine Shielding Factor (CSFACT)	1.0	0.9	0.6	Evacuation – Outside Normal – Wood house Sheltering – Wood house basement
Groundshine Shielding Factor (GSHFAC)	0.5	0.4	0.1	Evacuation – Car on fully contaminated road Normal – One- or two-story wood house Sheltering – House basement with one or two exposed walls

Table E.3-15: Groundshine and Cloudshine Shielding Factors (Sensitivity Case)

	Evacuation	Normal	Sheltering	Comments
Cloudshine Shielding Factor (CSFACT)	1.0	0.6	0.4	Evacuation – Outside Normal – Brick house Sheltering – Brick house basement
Groundshine Shielding Factor (GSHFAC)	0.5	0.2	0.1	Evacuation – Car on fully contaminated road Normal – One- or two-story brick house Sheltering – House basement with one or two exposed walls

Table E.3-16: Summary of Shielding Factors

Category	Evacuation	Normal	Sheltering
Cloudshine Shielding Factor	1.0	0.9	0.6
Groundshine Shielding Factor	0.5	0.4	0.1
Protection Factor for Inhalation	1.0	0.41	0.33
Skin Protection Factor	1.0	0.41	0.33
Breathing Rate (meter^3 per second)	2.66E-04	2.66E-04	2.66E-04

Table E.3-17: Davis-Besse Core Inventory (Full Core at EOC; 177FAs)

Isotope	Activity (Curies)	Activity (Bq)	Isotope	Activity (Curies)	Activity (Bq)
Kr-85	9.68E+05	3.58E+16	Te-132	1.09E+08	4.05E+18
Kr-85m	1.87E+07	6.91E+17	I-131	7.71E+07	2.86E+18
Kr-87	3.54E+07	1.31E+18	I-132	1.11E+08	4.12E+18
Kr-88	4.98E+07	1.84E+18	I-133	1.55E+08	5.73E+18
Rb-86	2.10E+05	7.76E+15	I-134	1.69E+08	6.26E+18
Sr-89	6.76E+07	2.50E+18	I-135	1.45E+08	5.36E+18
Sr-90	7.66E+06	2.84E+17	Xe-133	1.51E+08	5.57E+18
Sr-91	8.49E+07	3.14E+18	Xe-135	3.93E+07	1.45E+18
Sr-92	9.31E+07	3.44E+18	Cs-134	2.05E+07	7.58E+17
Y-90	8.00E+06	2.96E+17	Cs-136	5.41E+06	2.00E+17
Y-91	8.83E+07	3.27E+18	Cs-137	1.12E+07	4.13E+17
Y-92	9.35E+07	3.46E+18	Ba-139	1.37E+08	5.06E+18
Y-93	1.10E+08	4.06E+18	Ba-140	1.32E+08	4.90E+18
Zr-95	1.25E+08	4.63E+18	La-140	1.40E+08	5.17E+18
Zr-97	1.26E+08	4.68E+18	La-141	1.25E+08	4.61E+18
Nb-95	1.26E+08	4.67E+18	La-142	1.20E+08	4.44E+18
Mo-99	1.44E+08	5.35E+18	Ce-141	1.26E+08	4.65E+18
Tc-99m	1.26E+08	4.68E+18	Ce-143	1.14E+08	4.24E+18
Ru-103	1.23E+08	4.56E+18	Ce-144	9.73E+07	3.60E+18
Ru-105	8.76E+07	3.24E+18	Pr-143	1.11E+08	4.12E+18
Ru-106	4.81E+07	1.78E+18	Nd-147	5.05E+07	1.87E+18
Rh-105	8.05E+07	2.98E+18	Np-239	1.73E+09	6.39E+19
Sb-127	8.84E+06	3.27E+17	Pu-238	4.56E+05	1.69E+16
Sb-129	2.56E+07	9.48E+17	Pu-239	3.33E+04	1.23E+15
Te-127	8.75E+06	3.24E+17	Pu-240	5.38E+04	1.99E+15
Te-127m	1.16E+06	4.28E+16	Pu-241	1.21E+07	4.47E+17
Te-129	2.52E+07	9.33E+17	Am-241	1.64E+04	6.06E+14
Te-129m	3.75E+06	1.39E+17	Cm-242	4.03E+06	1.49E+17
Te-131m	1.13E+07	4.19E+17	Cm-244	6.62E+05	2.45E+16

Table E.3-18: Economic Data

Region Name, State	Fraction of Land Devoted to Farming in Region	Fraction of Farm Sales Resulting from Dairy in Region	Total Annual Farm Sales for the Region ($/hectare)	Farmland Property Value for the Region ($/hectare)	Nonfarm Property Value for the Region ($/person)
Crawford, OH	0.854	0.044	1301	1295	266
Erie, OH	0.522	0.025	1186	1616	23037
Fulton, OH	0.709	0.086	1802	1451	6598
Hancock, OH	0.729	0.032	1007	1316	10215
Huron, OH	0.697	0.055	1507	1399	4935
Lorain, OH	0.395	0.106	2612	1821	21053
Lucas, OH	0.289	0.000	1881	1761	20782
Ottawa, OH	0.706	0.019	990	1170	33272
Sandusky, OH	0.694	0.024	1081	1250	10013
Seneca, OH	0.764	0.021	985	1264	1411
Wood, OH	0.698	0.044	1125	1359	15504
Lenawee, MI	0.727	0.244	1142	1294	19618
Monroe, MI	0.591	0.011	1547	1548	33156
Wayne, MI	0.045	0.000	4074	3133	25408

Table E.3-19: MACCS2 Economic Parameters Used in CHRONC

Variable	Description	Value (in Davis-Besse model)
DPRATE	Property depreciation rate (/year)	0.20
DSRATE	Investment rate of return (/year)	0.12
POPCST	Population relocation cost ($/person)	$5000/person
CDFRM0	Cost of farm decontamination for various levels of decontamination ($/hectare)	$562.50/hectare, $1250/hectare
CDNFRM	Cost of non-farm decontamination per person for various levels of decontamination ($/person)	$3000/person, $8000/person
DLBCST	Average cost of decontamination labor ($/person-year)	$35,000/person-year

Table E.3-20: Frequency Vector

Release Category	Frequency (/year)	Percent
1.1	2.2E-08	0.22%
1.2	1.3E-08	0.13%
1.3	5.9E-07	5.83%
1.4	1.2E-09	0.01%
2.1	5.4E-08	0.06%
2.2	6.0E-09	0.53%
3.1	2.5E-09	0.02%
3.2	2.8E-11	0.00%
3.3	2.5E-11	0.00%
3.4	1.7E-09	0.02%
4.1	1.0E-09	0.01%
4.2	3.4E-08	0.34%
4.3	1.1E-11	0.00%
4.4	7.7E-09	0.08%
5.1	2.9E-08	0.29%
5.2	3.8E-09	0.04%
5.3	2.8E-09	0.03%
5.4	8.9E-10	0.01%
6.1	4.4E-10	0.00%
6.2	3.3E-11	0.00%
6.3	4.5E-09	0.04%
6.4	3.1E-08	0.31%
7.1	1.4E-11	0.00%
7.2	5.7E-10	0.01%
7.3	2.2E-12	0.00%
7.4	2.4E-09	0.02%
7.5	2.7E-11	0.00%
7.6	1.9E-08	0.19%
7.7	3.6E-11	0.00%
7.8	9.8E-08	0.97%
8.1	6.3E-08	0.62%
8.2	1.3E-07	1.28%
9.1	7.6E-06	75.11%
9.2	1.4E-06	13.84%
Sum (CDF)	**1.0E-05**[3]	**100.00%**

[3] The sum of the Containment Systems State frequencies calculated by the Level 2 PRA model is slightly different than the CDF calculated by the Level 1 PRA due to the delete term approximation and the additional systems included in the Level 2 PRA models.

Table E.3-21: Base Case Results for Internal Events at 50 Miles

Release Category	Whole Body Dose (50, rem)/yr	Economic Impact (50, $)/yr
1.1	4.4E-02	4.2E+01
1.2	2.7E-02	2.6E+01
1.3	1.2E+00	1.2E+03
1.4	3.2E-03	2.5E+00
2.1	2.8E-02	2.1E+01
2.2	5.0E-01	2.3E+02
3.1	1.9E-03	1.1E+00
3.2	1.1E-04	9.8E-02
3.3	1.9E-05	1.1E-02
3.4	1.1E-02	6.8E+00
4.1	3.5E-05	8.7E-03
4.2	3.1E-02	1.8E+01
4.3	6.6E-07	1.2E-04
4.4	1.0E-02	7.3E+00
5.1	9.0E-03	2.9E+00
5.2	1.1E-02	9.9E+00
5.3	8.7E-04	2.7E-01
5.4	6.6E-03	3.4E+00
6.1	4.8E-04	4.0E-01
6.2	5.3E-05	4.6E-02
6.3	3.9E-05	5.9E-03
6.4	1.7E-02	7.4E+00
7.1	5.3E-07	3.1E-05
7.2	6.8E-05	2.6E-02
7.3	5.1E-09	3.5E-07
7.4	7.7E-06	7.2E-04
7.5	3.5E-08	0.0E+00
7.6	6.1E-03	1.7E+00
7.7	2.7E-08	2.3E-07
7.8	1.8E-02	7.4E+00
8.1	1.1E-04	7.6E-04
8.2	9.1E-02	2.9E+01
9.1	2.0E-03	1.1E-04
9.2	2.0E-02	1.3E+00
Total	**2.0E+00**	**1.6E+03**

Table E.3-22: Base Case Consequence Input to SAMA Analysis

Release Category	Whole Body Dose (50, rem)	Economic Impact (50, $)
1.1	2.0E+06	1.9E+09
1.2	2.1E+06	2.0E+09
1.3	2.0E+06	2.0E+09
1.4	2.7E+06	2.1E+09
2.1	4.7E+06	3.5E+09
2.2	9.3E+06	4.3E+09
3.1	7.7E+05	4.3E+08
3.2	4.1E+06	3.5E+09
3.3	7.6E+05	4.2E+08
3.4	6.3E+06	4.0E+09
4.1	3.5E+04	8.7E+06
4.2	9.1E+05	5.3E+08
4.3	6.0E+04	1.1E+07
4.4	1.3E+06	9.5E+08
5.1	3.1E+05	9.9E+07
5.2	3.0E+06	2.6E+09
5.3	3.1E+05	9.5E+07
5.4	7.4E+06	3.8E+09
6.1	1.1E+06	9.2E+08
6.2	1.6E+06	1.4E+09
6.3	8.6E+03	1.3E+06
6.4	5.5E+05	2.4E+08
7.1	3.8E+04	2.2E+06
7.2	1.2E+05	4.6E+07
7.3	2.3E+03	1.6E+05
7.4	3.2E+03	3.0E+05
7.5	1.3E+03	0.0E+00
7.6	3.2E+05	8.7E+07
7.7	7.4E+02	6.5E+03
7.8	1.8E+05	7.6E+07
8.1	1.8E+03	1.2E+04
8.2	7.0E+05	2.2E+08
9.1	2.6E+02	1.5E+01
9.2	1.4E+04	9.3E+05
Total	**5.26E+07**	**3.52E+10**

Table E.3-23: Comparison of Base Case and Case S1

	Internal Events		
	Base	**S1**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	2.23E+00	9.3%
Economic Impact (50) ($/yr)	1.59E+03	1.73E+03	8.8%

Table E.3-24: Comparison of Base Case and Case S2

	Internal Events		
	Base	**S2**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	1.81E+00	-11.3%
Economic Impact (50) ($/yr)	1.59E+03	1.43E+03	-10.1%

Table E.3-25: Comparison of Base Case and Case S3

	Internal Events		
	Base	**S3**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	2.09E+00	2.5%
Economic Impact (50) ($/yr)	1.59E+03	1.59E+03	0.0%

Table E.3-26: Comparison of Base Case and Case M1

	Internal Events		
	Base	**M1**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	2.07E+00	1.5%
Economic Impact (50) ($/yr)	1.59E+03	1.57E+03	-1.3%

Table E.3-27: Comparison of Base Case and Case M2

	Internal Events		
	Base	**M2**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	1.87E+00	-8.3%
Economic Impact (50) ($/yr)	1.59E+03	1.52E+03	-4.4%

Table E.3-28: Comparison of Base Case and Case A1

	Internal Events		
	Base	**A1**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	1.52E+00	-25.5%
Economic Impact (50) ($/yr)	1.59E+03	1.25E+03	-21.4%

Table E.3-29: Comparison of Base Case and Case A2

	Internal Events		
	Base	**A2**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	2.04E+00	0.0%
Economic Impact (50) ($/yr)	1.59E+03	1.59E+03	0.0%

Table E.3-30: Comparison of Base Case and Case A3

	Internal Events		
	Base	**A3**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	2.04E+00	0.0%
Economic Impact (50) ($/yr)	1.59E+03	1.59E+03	0.0%

Table E.3-31: Comparison of Base Case and Case E1

	Internal Events		
	Base	**E1**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	2.02E+00	-1.0%
Economic Impact (50) ($/yr)	1.59E+03	1.59E+03	0.0%

Table E.3-32: Comparison of Base Case and Case E2

	Internal Events		
	Base	**E2**	**% diff.**
Whole Body Dose (50) (person-rem/yr)	2.04E+00	1.66E+00	-18.6%
Economic Impact (50) ($/yr)	1.59E+03	1.23E+03	-22.6%

Table E.4-1: Total Cost of Severe Accident Impact

APE	$49,080
AOC	$19,632
AOE	$4,340
AOSC	$266,279
Severe Accident Impact (Internal Events)	$339,331
Fire, Seismic, Other	$1,017,993
Maximum Benefit (Internal Events, Fire, Seismic, Other)	$1,357,324

Table E.5-1: Davis-Besse Top 100 Cutsets

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
1	6.55E-07	6.71%	1.04E-03	TMPP43XF-CC_ALL	All CCW pumps fail to run due to CCF (initiating event)
			6.30E-04	ZHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
2	5.00E-07	5.12%	5.00E-07	AV	Reactor vessel rupture
3	1.95E-07	2.00%	3.10E-04	F3AM	Maximum flood in CCW pump room from service water (initiating event)
			6.30E-04	ZHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
4	1.44E-07	1.47%	7.00E-03	R	SGTR (initiating event)
			5.00E-01	AASGTR11	SGTR occurs on OTSG 1-1 (split fraction)
			1.00	CHASGDPE	Operators fail to cooldown during a SGTR
			1.00	LHAMSIVE	Failure to close MSIV and isolate steam generator containing ruptured tube
			1.00	XHAMUCDE	Operators fail to attempt cooldown via makeup/HPI cooling
			4.10E-05	COMBINATION661	HRA events
5	1.44E-07	1.47%	7.00E-03	R	SGTR (initiating event)
			5.00E-01	AASGTR12	SGTR occurs on OTSG 1-2 (split fraction)
			1.00	CHASGDPE	Operators fail to cooldown during a SGTR
			1.00	LHAMSIVE	Failure to close MSIV and isolate steam generator containing ruptured tube
			1.00	XHAMUCDE	Operators fail to attempt cooldown via makeup/HPI cooling
			4.10E-05	COMBINATION661	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
6	1.29E-07	1.32%	1.01E-03	TMPP43XF-CC_1_2	CCW pumps 1 & 2 failure to run due to CCF (initiating event)
			4.00E-01	XHOS-CCW1RUN2STBY	CCW pump 1 running, pump 2 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
7	1.29E-07	1.32%	1.01E-03	TMPP43XF-CC_1_2	CCW pumps 1 & 2 fail to run due to CCF (initiating event)
			4.00E-01	XHOS-CCW2RUN1STBY	CCW pump 2 running, pump 1 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
8	9.09E-08	0.93%	4.64E-02	T3	LOOP (initiating event)
			1.40E-02	EMBEDG12	EDG Train 2 in maintenance
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events
9	8.87E-08	0.91%	1.36E-01	T2	Plant trip due to loss of MFW (initiating event)
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
			2.70E-03	COMBINATION1203	HRA events
10	7.60E-08	0.78%	4.64E-02	T3	LOOP (initiating event)
			1.17E-02	EDG0012A	EDG 1-2 fails to start
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events
11	7.59E-08	0.78%	4.64E-02	T3	LOOP (initiating event)
			7.35E-02	EDG0012F	EDG 1-2 fails to run
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			8.90E-02	ZOP006ER	Failure to restore off-site power within 30 minutes after loss of AFW
			2.50E-04	COMBINATION243	HRA events
12	6.80E-08	0.70%	4.00E-05	M	Medium Break LOCA
			1.70E-03	ZHALPRME	Operators fail to initiate LPR for a medium LOCA
13	6.73E-08	0.69%	1.36E-01	T2	Plant trip due to loss of MFW (initiating event)
			1.83E-04	PLT09XXD-CC_ALL	CCF of all components in group 'PLT09XXD-CC'
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
			2.70E-03	COMBINATION1203	HRA events
14	5.60E-08	0.57%	1.00	T13A-2-3-IEF	Loss of CCW Train 2 initiating event Pump 2 running
			1.34E-01	TTC1434T	Temperature control valve SW1434 fails to throttle (initiating event)
			3.27E-03	WCDC113C	Breaker AC113 fails to close
			4.00E-01	XHOS-CCW2RUN1STBY	CCW Pump 2 running, Pump 1 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
15	5.60E-08	0.57%	1.00	T13A-1-3-IEF	Loss of CCW Train 1 initiating event Pump 2 running
			1.34E-01	TTC1424T	TCV SW1424 fails to throttle (one-year mission time) (initiating event)
			3.27E-03	WCDD113C	Breaker AD113 fails to close
			4.00E-01	XHOS-CCW1RUN2STBY	CCW Pump 1 running, Pump 2 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
16	5.54E-08	0.57%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			8.33E-02	FMFWTRIP	MFW/Integrated Control System (ICS) faults following trip
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
17	4.93E-08	0.50%	4.64E-02	T3	LOOP (initiating event)
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			4.40E-03	COMBINATION372	HRA events
18	4.38E-08	0.45%	5.00E-04	S	Small LOCA (initiating event)
			8.77E-05	LSC007XN-CC_1_2	CCF of two components: LSC0076N & LSC0077N
19	4.21E-08	0.43%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			8.33E-02	FMFWTRIP	MFW/ICS faults following trip
			1.83E-04	PLT09XXD-CC_ALL	CCF of all components in group 'PLT09XXD-CC'
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
20	4.18E-08	0.43%	4.40E-04	F3AL	Large flood in CCW pump room from service water (initiating event)
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHAF3ISE	Failure to isolate flood in room 328 before CCW pumps are affected
			9.50E-05	COMBINATION1226	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
21	4.11E-08	0.42%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			2.49E-03	EC1Z100N	Breaker HX11B fails to open
			7.35E-02	EDG0012F	EDG 1-2 fails to run
			1.00	EHAD1ACE	Failure to lineup alternate source to D1
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	FHASUF3E	Operators fail to actuate the startup feedpump
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			2.20E-04	COMBINATION465	HRA events
22	4.11E-08	0.42%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			2.49E-03	EC1Z153C	Breaker HX02B fails to close
			7.35E-02	EDG0012F	EDG 1-2 fails to run
			1.00	EHAD1ACE	Failure to lineup alternate source to D1
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	FHASUF3E	Operators fail to actuate the startup feedpump
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			2.20E-04	COMBINATION465	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
23	3.81E-08	0.39%	1.00	T13A-2-3-IEF	Loss of CCW Train 2 initiating event Pump 2 running
			9.11E-02	TMPP432F	CCW Pump 1-2 fails to run (initiating event)
			3.27E-03	WCDC113C	Breaker AC113 fails to close
			4.00E-01	XHOS-CCW2RUN1STBY	CCW Pump 2 running, Pump 1 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
24	3.81E-08	0.39%	1.00	T13A-1-3-IEF	Loss of CCW Train 1 initiating event Pump 1 running
			9.11E-02	TMPP431F	CCW Pump 1-1 fails to run (initiating event)
			3.27E-03	WCDD113C	Breaker AD113 fails to close
			4.00E-01	XHOS-CCW1RUN2STBY	CCW Pump 1 running, Pump 2 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
25	3.63E-08	0.37%	5.00E-04	S	Small LOCA (initiating event)
			9.68E-05	VMFC31XA-CC_ALL	CCF of all components in group 'VMFC31XA-CC'
			7.50E-01	XHOS-SWTEMP-LOW	Service Water temperature less than 72
26	3.03E-08	0.31%	4.64E-02	T3	LOOP (initiating event)
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
27	2.98E-08	0.31%	2.21E-05	TF2	Tornado F-Scale 2 (initiating event)
			7.35E-02	EDG0011F	EDG 1-1 fails to run
			7.35E-02	EDG0012F	EDG 1-2 fails to run
			1.00	NORCVRT3	No recovery of off-site power following a tornado
			5.00E-01	NTKTOR2J	Condensate storage tank (CST) fails due to high winds from an F-Scale 2 tornado
			5.00E-01	SBOTOR2A	SBO diesel generator damaged due to high winds from an F-Scale 2 tornado
28	2.88E-08	0.29%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			1.44E-02	FMM00003	Any MSSV on SG1 fails to reseat
			7.26E-04	QMV0599K	Motor-operated valve AF 599 fails to remain open
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
29	2.88E-08	0.29%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			1.44E-02	FMM00004	Any MSSV on SG2 fails to reseat
			7.26E-04	QMV0608K	Motor-operated valve AF 608 fails to remain open
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
30	2.82E-08	0.29%	6.69E-06	TF3	Tornado F-Scale 3 (initiating event)
			7.35E-02	EDG0011F	EDG 1-1 fails to run
			7.35E-02	EDG0012F	EDG 1-2 fails to run
			1.00	NORCVRT3	No recovery of off-site power following a tornado
			8.84E-01	NTKTOR3J	CST fails due to high winds from an F-Scale 3 tornado
			8.84E-01	SBOTOR3A	SBO diesel generator damaged due to high winds from an F-Scale 3 tornado
31	2.66E-08	0.27%	1.40E-04	F2CL	Large flood in room 53 from service water return (initiating event)
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	SHAF2ISE	Failure to isolate flood before service water pumps are affected
			1.90E-04	COMBINATION1157	HRA events
32	2.63E-08	0.27%	1.36E-01	T2	Plant trip due to loss of MFW (initiating event)
			1.29E-02	QMBAFP12	AFW Train 2 in maintenance
			5.55E-03	QTP0001A	AFP/T-1 fails to start
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
33	2.51E-08	0.26%	5.00E-04	S	Small LOCA (initiating event)
			5.03E-05	LMPP42XF-CC_1_2	CCF of two components: LMPP421F & LMPP422F
34	2.47E-08	0.25%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			3.72E-02	QBLAUXBF	Auxiliary boiler fails to supply steam
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
			2.70E-03	COMBINATION1203	HRA events
35	2.41E-08	0.25%	1.36E-01	T2	Plant trip due to loss of MFW (initiating event)
			1.18E-02	QMBAFP11	AFW Train 1 in maintenance
			5.55E-03	QTP0002A	AFP/T-2 fails to start
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
36	2.28E-08	0.23%	4.64E-02	T3	LOOP (initiating event)
			3.51E-03	EMFZ163A	Vent Fan 3 fails to start
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events
37	2.28E-08	0.23%	4.64E-02	T3	LOOP (initiating event)
			3.51E-03	EMFZ165A	Vent Fan 4 fails to start
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
38	2.27E-08	0.23%	4.64E-02	T3	LOOP (initiating event)
			3.50E-03	EMD5336C	Motor-operated damper HV5336B fails to close
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events
39	2.27E-08	0.23%	4.64E-02	T3	LOOP (initiating event)
			3.50E-03	EMDZ119N	Motor damper HV5336A fails to open
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
40	2.27E-08	0.23%	4.64E-02	T3	LOOP (initiating event)
			3.50E-03	EMDZ121N	Motor damper HV5336C fails to open
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events
41	2.05E-08	0.21%	5.00E-04	S	Small LOCA (initiating event)
			4.10E-05	ZHASDCSE	Operators fail to establish shutdown cooling or LPR after small LOCA
42	1.97E-08	0.20%	1.00	T13A-1-3-IEF	Loss of CCW Train 1 initiating event Pump 1 running
			1.15E-03	SAV1434N	Air-operated valve SW 1434 fails to open
			1.34E-01	TTC1424T	TCV SW1424 fails to throttle (one-year mission time) (initiating event)
			4.00E-01	XHOS-CCW1RUN2STBY	CCW Pump 1 running, Pump 2 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
43	1.97E-08	0.20%	1.00	T13A-2-3-IEF	Loss of CCW Train 2 initiating event Pump 2 running
			1.15E-03	SAV1424N	Air-operated valve SW-1424 fails to open
			1.34E-01	TTC1434T	Temperature control valve SW1434 fails to throttle (initiating event)
			4.00E-01	XHOS-CCW2RUN1STBY	CCW Pump 2 running, Pump 1 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
44	1.95E-08	0.20%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			2.93E-02	QMBAUXB1	Auxiliary Boiler unavailable due to maintenance
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
45	1.89E-08	0.19%	4.64E-02	T3	LOOP (initiating event)
			1.40E-02	EMBEDG12	EDG Train 2 in maintenance
			1.18E-02	QMBAFP11	AFW Train 1 in maintenance
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			4.40E-03	COMBINATION297	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
46	1.88E-08	0.19%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			1.83E-04	PLT09XXD-CC_ALL	CCF of all components in group 'PLT09XXD-CC'
			3.72E-02	QBLAUXBF	Auxiliary Boiler fails to supply steam
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
47	1.86E-08	0.19%	4.64E-02	T3	LOOP (initiating event)
			2.42E-04	QTP000XA-CC_1_2	CCF of two components: QTP0001A & QTP0002A
			1.00	MHARMVTE	Operators fail to compensate for loss of room cooling for makeup pumps
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			4.60E-01	ZOP006CR	Failure to restore off-site power
			3.60E-03	COMBINATION674	HRA events
48	1.81E-08	0.18%	4.64E-02	T3	LOOP (initiating event)
			1.28E-05	QSV64XXD-CC_ALL	CCF of all components in group 'QSV64XXD-CC'
			6.60E-02	ZHARMVTE	Operators fail to compensate for loss of room cooling for makeup pumps
			4.60E-01	ZOP006CR	Failure to restore off-site power
49	1.68E-08	0.17%	1.36E-01	T2	Plant trip due to loss of MFW (initiating event)
			4.58E-05	PAVZ01XN-CC_1_2	CCF of two components: PAVZ011N & PAVZ012N
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
50	1.67E-08	0.17%	4.64E-02	T3	LOOP (initiating event)
			1.40E-02	EMBEDG12	EDG Train 2 in maintenance
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	QHAMDF3E	Failure to start MDFP prior to depletion of BWST during makeup
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			4.60E-05	COMBINATION817	HRA events
51	1.64E-08	0.17%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			8.33E-02	FMFWTRIP	MFW/ICS faults following trip
			1.29E-02	QMBAFP12	AFW Train 2 in maintenance
			5.55E-03	QTP0001A	AFP/T-1 fails to start
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
52	1.62E-08	0.17%	1.01E-03	TMPP43XF-CC_1_3	CCW Pumps 1 & 3 fail to run due to CCF (initiating event)
			5.00E-02	XHOS-CCW1RUN3STBY	CCW Pump 1 running, Pump 3 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
53	1.62E-08	0.17%	1.01E-03	TMPP43XF-CC_1_3	CCW Pumps 1 & 3 fail to run due to CCF (initiating event)
			5.00E-02	XHOS-CCW3RUN1STBY	CCW Pump 3 running, Pump 1 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
54	1.62E-08	0.17%	1.01E-03	TMPP43XF-CC_2_3	CCW Pumps 2 & 3 fail to run due to CCF (initiating event)
			5.00E-02	XHOS-CCW2RUN3STBY	CCW Pump 2 running, Pump 3 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
55	1.62E-08	0.17%	1.01E-03	TMPP43XF-CC_2_3	CCW Pumps 2 & 3 fail to run due to CCF (initiating event)
			5.00E-02	XHOS-CCW3RUN2STBY	CCW Pump 3 running, Pump 2 in standby
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
56	1.58E-08	0.16%	4.64E-02	T3	LOOP (initiating event)
			1.17E-02	EDG0012A	EDG 1-2 fails to start
			1.18E-02	QMBAFP11	AFW Train 1 in maintenance
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			4.40E-03	COMBINATION297	HRA events
57	1.51E-08	0.15%	1.00	VD-IEF	ISLOCA due to internal rupture of DHR suction valves
			3.51E-04	LMVF011R	Internal rupture of DH 11 (Annual frequency)
			4.29E-04	LMVU012R	Internal rupture of DH 12 since cold shutdown
			1.00E-01	LPPNISOZ	ISLOCA occurs in non-isolable portion of DHR system
58	1.51E-08	0.15%	1.00	VD-IEF	ISLOCA due to internal rupture of DHR suction valves
			3.51E-04	LMVF012R	Internal rupture of DH 12 (Annual frequency)
			4.29E-04	LMVU011R	Internal rupture of DH 11 since cold shutdown
			1.00E-01	LPPNISOZ	ISLOCA occurs in non-isolable portion of DHR system
59	1.50E-08	0.15%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			8.33E-02	FMFWTRIP	MFW/ICS faults following trip
			1.18E-02	QMBAFP11	AFW Train 1 in maintenance
			5.55E-03	QTP0002A	AFP/T-2 fails to start
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
60	1.48E-08	0.15%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			1.83E-04	PLT09XXD-CC_ALL	CCF of all components in group 'PLT09XXD-CC'
			2.93E-02	QMBAUXB1	Auxiliary boiler unavailable due to maintenance
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
61	1.46E-08	0.15%	4.64E-02	T3	LOOP (initiating event)
			1.29E-02	QMBAFP12	AFW Train 2 in maintenance
			5.55E-03	QTP0001A	AFP/T-1 fails to start
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			4.40E-03	COMBINATION372	HRA events
62	1.40E-08	0.14%	5.00E-04	S	Small LOCA (initiating event)
			1.40E-04	LMPP42XA-CC_1_2	CCF of two components: LMPP421A & LMPP422A
			2.00E-01	ZRCLPIPR	Fail to recover LPI pump from start fault (at least 2 hrs available for recovery)
63	1.40E-08	0.14%	4.64E-02	T3	LOOP (initiating event)
			1.17E-02	EDG0012A	EDG 1-2 fails to start
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	QHAMDF3E	Failure to start MDFP prior to depletion of BWST during makeup
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			4.60E-05	COMBINATION817	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
64	1.40E-08	0.14%	4.64E-02	T3	LOOP (initiating event)
			7.35E-02	EDG0012F	EDG 1-2 fails to run
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	QHAMDF3E	Failure to start MDFP prior to depletion of BWST during makeup
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			8.90E-02	ZOP006ER	Failure to restore off-site power within 30 minutes after loss of AFW
			4.60E-05	COMBINATION817	HRA events
65	1.34E-08	0.14%	1.00	T13A-1-3-IEF	Loss of CCW Train 1 initiating event Pump 1 running
			4.00E-01	XHOS-CCW1RUN2STBY	CCW Pump 1 running, Pump 2 in standby
			9.11E-02	TMPP431F	CCW Pump 1-1 fails to run (initiating event)
			1.15E-03	SAV1434N	Air-operated valve SW 1434 fails to open
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
66	1.34E-08	0.14%	1.00	T13A-2-3-IEF	Loss of CCW Train 2 initiating event Pump 2 running
			4.00E-01	XHOS-CCW2RUN1STBY	CCW Pump 2 running, Pump 1 in standby
			9.11E-02	TMPP432F	CCW Pump 1-2 fails to run (initiating event)
			1.15E-03	SAV1424N	Air-operated valve SW-1424 fails to open
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
67	1.34E-08	0.14%	4.64E-02	T3	LOOP (initiating event)
			1.18E-02	QMBAFP11	AFW Train 1 in maintenance
			5.55E-03	QTP0002A	AFP/T-2 fails to start
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			4.40E-03	COMBINATION372	HRA events
68	1.24E-08	0.13%	4.64E-02	T3	LOOP (initiating event)
			1.91E-03	EC2Z000N	Breaker AD110 fails to open
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.00	QHAOVF2E	Operators fail to take local manual control of AFW turbine 1-2 speed
			5.60E-01	ZOP007BR	Failure to restore off-site power within one hour to prevent loss of DC
			2.50E-04	COMBINATION243	HRA events
69	1.23E-08	0.13%	2.21E-05	TF2	Tornado F-Scale 2 (initiating event)
			2.23E-03	EDG001XF-CC_1_2	CCF of two components: EDG0011F & EDG0012F
			1.00	NORCVRT3	No recovery of off-site power following a tornado
			5.00E-01	NTKTOR2J	CST fails due to high winds from an F-Scale 2 tornado
			5.00E-01	SBOTOR2A	SBO diesel generator damaged due to high winds from an F-Scale 2 Tornado

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
70	1.23E-08	0.13%	1.00	T13A-1-3-IEF	Loss of CCW Train 1 initiating event Pump 1 running
			4.00E-01	XHOS-CCW1RUN2STBY	CCW Pump 1 Running, Pump 2 in standby
			2.93E-02	THXE221P	CCW heat exchanger plugs during operation (initiating event)
			3.27E-03	WCDD113C	Breaker AD113 fails to close
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
71	1.23E-08	0.13%	1.00	T13A-2-3-IEF	Loss of CCW Train 2 initiating event Pump 2 running
			4.00E-01	XHOS-CCW2RUN1STBY	CCW Pump 2 running, Pump 1 in standby
			2.93E-02	THXE222P	CCW heat exchanger 1-2 plugs during operation (initiating event)
			3.27E-03	WCDC113C	Breaker AC113 fails to close
			1.00	QHARCPCE	Operators fail to trip RCPs after a total loss of seal cooling
			1.00	WHASPREE	Failure to recover CCW using spare CCW train
			3.20E-04	COMBINATION1240	HRA events
72	1.22E-08	0.13%	1.29E-02	T2A-1	SP6B fails to throttle (initiating event)
			1.88E-02	PLT09B6D	Level Transmitter LTSP9B6 fails to respond
			1.88E-02	PLT09B8D	Level Transmitter LTSP9B8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
73	1.22E-08	0.13%	1.29E-02	T2A-1	SP6B fails to throttle (initiating event)
			1.88E-02	PLT09B6D	Level Transmitter LTSP9B6 fails to respond
			1.88E-02	PLT09B9D	Level Transmitter LTSP9B9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
74	1.22E-08	0.13%	1.29E-02	T2A-1	SP6B fails to throttle (initiating event)
			1.88E-02	PLT09B7D	Level Transmitter LTSP9B7 fails to respond
			1.88E-02	PLT09B8D	Level Transmitter LTSP9B8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
75	1.22E-08	0.13%	1.29E-02	T2A-1	SP6B fails to throttle (initiating event)
			1.88E-02	PLT09B7D	Level Transmitter LTSP9B7 fails to respond
			1.88E-02	PLT09B9D	Level Transmitter LTSP9B9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
76	1.22E-08	0.13%	1.29E-02	T2B-1	SP6A fails to throttle (initiating event)
			1.88E-02	PLT09A6D	Level Transmitter LTSP9A6 fails to respond
			1.88E-02	PLT09A8D	Level Transmitter LTSP9A8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
77	1.22E-08	0.13%	1.29E-02	T2B-1	SP6A fails to throttle (initiating event)
			1.88E-02	PLT09A6D	Level Transmitter LTSP9A6 fails to respond
			1.88E-02	PLT09A9D	Level Transmitter LTSP9A9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
78	1.22E-08	0.13%	1.29E-02	T2B-1	SP6A fails to throttle (initiating event)
			1.88E-02	PLT09A7D	Level Transmitter LTSP9A7 fails to respond
			1.88E-02	PLT09A8D	Level Transmitter LTSP9A8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
79	1.22E-08	0.13%	1.29E-02	T2B-1	SP6A fails to throttle (initiating event)
			1.88E-02	PLT09A7D	Level Transmitter LTSP9A7 fails to respond
			1.88E-02	PLT09A9D	Level Transmitter LTSP9A9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
80	1.22E-08	0.12%	1.00	T9-IEF	Loss of DC power supply NNIX (initiating event)
			1.00E-06	K1	Reactor fails to trip following automatic demand
			1.22E-02	TPXNNIXF	NNIX power supply no output

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
81	1.21E-08	0.12%	5.00E-04	S	Small LOCA (initiating event)
			9.68E-05	VMFC31XA-CC_ALL	CCF of all components in group 'VMFC31XA-CC'
			2.50E-01	XHOS-SWTEMP-HIGH	Service Water temperature greater than 72
82	1.20E-08	0.12%	5.00E-04	S	Small LOCA (initiating event)
			9.62E-05	VMFC31XA-CC_1_3	CCF of two components: VMFC311A & VMFC314A
			2.50E-01	XHOS-SWTEMP-HIGH	Service Water temperature greater than 72
83	1.20E-08	0.12%	5.00E-04	S	Small LOCA (initiating event)
			9.62E-05	VMFC31XA-CC_1_4	CCF of two components: VMFC311A & VMFC315A
			2.50E-01	XHOS-SWTEMP-HIGH	Service Water temperature greater than 72
84	1.20E-08	0.12%	5.00E-04	S	Small LOCA (initiating event)
			9.62E-05	VMFC31XA-CC_2_3	CCF of two components: VMFC312A & VMFC314A
			2.50E-01	XHOS-SWTEMP-HIGH	Service Water temperature greater than 72
85	1.20E-08	0.12%	5.00E-04	S	Small LOCA (initiating event)
			9.62E-05	VMFC31XA-CC_2_4	CCF of two components: VMFC312A & VMFC315A
			2.50E-01	XHOS-SWTEMP-HIGH	Service Water temperature greater than 72

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
86	1.20E-08	0.12%	4.64E-02	T3	LOOP (initiating event)
			1.00	EHAD2DGE	Operators fail to align power from EDG 1 or 2 to supply MDFP given LOOP
			1.00	EHASBD1E	Operators fail to start SBO diesel generator and align to Bus D1
			1.00	EHASBDGE	Operators fail to align power from SBO diesel generator
			1.40E-02	EMBEDG12	EDG Train 2 in maintenance
			1.18E-02	QMBAFP11	AFW Train 1 in maintenance
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			7.10E-01	ZOP006FR	Failure to restore off-site power
			2.20E-03	COMBINATION374	HRA events
87	1.17E-08	0.12%	6.69E-06	TF3	Tornado F-Scale 3 (initiating event)
			2.23E-03	EDG001XF-CC_1_2	CCF of two components: EDG0011F & EDG0012F
			1.00	NORCVRT3	No recovery of off-site power following a tornado
			8.84E-01	NTKTOR3J	CST fails due to high winds from an F-Scale 3 tornado
			8.84E-01	SBOTOR3A	SBO diesel generator damaged due to high winds from an F-Scale 3 tornado
88	1.16E-08	0.12%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			5.81E-03	FVV011AT	AVV ICS11A fails to reseat after steam
			7.26E-04	QMV0608K	Motor-operated valve AF 608 fails to remain open
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
89	1.16E-08	0.12%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			5.81E-03	FVV011BT	AVV ICS11B fails to reseat after steam
			7.26E-04	QMV0599K	Motor-operated valve AF 599 fails to remain open
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
90	1.13E-08	0.12%	1.36E-01	T2	Plant trip due to loss of MFW (initiating event)
			5.55E-03	QTP0001A	AFP/T-1 fails to start
			5.55E-03	QTP0002A	AFP/T-2 fails to start
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
91	1.13E-08	0.12%	1.19E-02	T2A-2	FICICS35B fails high (initiating event)
			1.88E-02	PLT09B6D	Level Transmitter LTSP9B6 fails to respond
			1.88E-02	PLT09B8D	Level Transmitter LTSP9B8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
92	1.13E-08	0.12%	1.19E-02	T2A-2	FICICS35B fails high (initiating event)
			1.88E-02	PLT09B6D	Level Transmitter LTSP9B6 fails to respond
			1.88E-02	PLT09B9D	Level Transmitter LTSP9B9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
93	1.13E-08	0.12%	1.19E-02	T2A-2	FICICS35B fails high (initiating event)
			1.88E-02	PLT09B7D	Level Transmitter LTSP9B7 fails to respond
			1.88E-02	PLT09B8D	Level Transmitter LTSP9B8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
94	1.13E-08	0.12%	1.19E-02	T2A-2	FICICS35B fails high (initiating event)
			1.88E-02	PLT09B7D	Level Transmitter LTSP9B7 fails to respond
			1.88E-02	PLT09B9D	Level Transmitter LTSP9B9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
95	1.13E-08	0.12%	1.19E-02	T2B-2	FICICS35A fails high (initiating event)
			1.88E-02	PLT09A6D	Level Transmitter LTSP9A6 fails to respond
			1.88E-02	PLT09A8D	Level Transmitter LTSP9A8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
96	1.13E-08	0.12%	1.19E-02	T2B-2	FICICS35A fails high (initiating event)
			1.88E-02	PLT09A6D	Level Transmitter LTSP9A6 fails to respond
			1.88E-02	PLT09A9D	Level Transmitter LTSP9A9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-1: Davis-Besse Top 100 Cutsets (continued)

Cutset	Cutset Frequency	% CDF	Event Probability	Event	Description
97	1.13E-08	0.12%	1.19E-02	T2B-2	FICICS35A fails high (initiating event)
			1.88E-02	PLT09A7D	Level Transmitter LTSP9A7 fails to respond
			1.88E-02	PLT09A8D	Level Transmitter LTSP9A8 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
98	1.13E-08	0.12%	1.19E-02	T2B-2	FICICS35A fails high (initiating event)
			1.88E-02	PLT09A7D	Level Transmitter LTSP9A7 fails to respond
			1.88E-02	PLT09A9D	Level Transmitter LTSP9A9 fails to respond
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
99	1.12E-08	0.11%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			1.44E-02	FMM00003	Any MSSV on SG1 fails to reseat
			2.83E-04	QCV0049R	Check valve AF 49 fails to remain closed
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events
100	1.12E-08	0.11%	1.02E+00	T1	Reactor/turbine trip (initiating event)
			1.44E-02	FMM00004	Any MSSV on SG2 fails to reseat
			2.83E-04	QCV0052R	Check valve AF52 fails to remain closed
			1.00	QHAMDFPE	Failure to start MDFP after loss of feedwater
			1.00	UHAMUHPE	Failure to initiate makeup/HPI cooling after loss of all feedwater
			2.70E-03	COMBINATION1203	HRA events

Table E.5-2: Basic Event Level 1 PRA Importance

Event Name	F-V	RRW	Description
UHAMUHPE	2.59E-01	1.349	Failure to initiate makeup/HPI cooling after loss of all feedwater
QHAMDFPE	2.45E-01	1.324	Failure to start MDFP after loss of feedwater
QHARCPCE	2.32E-01	1.302	Operators fail to trip RCPs after a total loss of seal cooling
T3	1.96E-01	1.243	LOOP (initiating event)
EHASBDGE	1.64E-01	1.196	Operators fail to align power from SBO diesel generator to supply MDFP
EHASBD1E	1.58E-01	1.187	Operators fail to start SBO diesel generator and align to bus D1
EHAD2DGE	1.53E-01	1.181	Operators fail to align power from EDG 1-1 or EDG 1-2 to supply MDFP given LOOP
T1	1.35E-01	1.156	Reactor/turbine trip (initiating event)
QHAOVF2E	1.22E-01	1.139	Operators fail to take local manual control of TDAFW pump 1-2 speed.
ZHARCPCE	1.10E-01	1.124	Operators fail to trip RCPs following loss of seal cooling
WHASPREE	1.07E-01	1.12	Failure to recover CCW using spare CCW train (prior to damage)
QMBAFP11	7.61E-02	1.082	AFW Train 1 in maintenance
XHOS-CCW1RUN2STBY	7.54E-02	1.082	CCW Pump 1 running, Pump 2 in standby
EDG0012F	7.12E-02	1.077	EDG 1-2 fails to run
ZOP007BR	7.09E-02	1.076	Failure to restore off-site power
TMPP43XF-CC_ALL	6.79E-02	1.073	All CCW pumps fail to run due to CCF (initiating event)
XHOS-CCW2RUN1STBY	6.57E-02	1.07	CCW Pump 2 running, Pump 1 in standby
R	6.37E-02	1.068	SGTR (initiating event)
EHAD1ACE	5.90E-02	1.063	Failure to lineup alternate source to D1
T2	5.86E-02	1.062	Plant trip due to loss of MFW (initiating event)
NORCVRT3	5.57E-02	1.059	Offsite power recovery not possible after a tornado.
AV	5.12E-02	1.054	Reactor vessel rupture
QTP000XA-CC_1_2	5.13E-02	1.054	CCF of two components: QTP0001A & QTP0002A (TDAFW)
QTP0001A	4.90E-02	1.051	AFP/T-1 fails to start
QMBAFP12	4.67E-02	1.049	AFW Train 2 in maintenance
ZOP006FR	4.58E-02	1.048	Failure to restore off-site power
S	4.35E-02	1.045	Small LOCA (initiating event)

Table E.5-2: Basic Event Level 1 PRA Importance (continued)

Event Name	F-V	RRW	Description
T13A-1-3-IEF	4.18E-02	1.044	Loss of CCW Train 1 initiating event Pump 1 running
MHARMVTE	4.17E-02	1.043	Operators fail to compensate for loss of room cooling for makeup pumps by.
XHAMUCDE	4.10E-02	1.043	Operators fail to attempt cooldown via makeup/HPI cooling.
T13A-2-3-IEF	3.93E-02	1.041	Loss of CCW Train 2 initiating event Pump 2 running
EMBEDG12	3.85E-02	1.04	EDG Train 2 in maintenance
CHASGDPE	3.63E-02	1.038	Operators fail to cooldown during a SGTR
FMFWTRIP	3.71E-02	1.038	MFW/ICS faults following trip
FMM00003	3.52E-02	1.037	Any MSSVs on SG1 fail to reseat
EDG0012A	3.46E-02	1.036	EDG 1-2 fails to start
AASGTR11	3.42E-02	1.035	SGTR occurs on OTSG 1-1 (split fraction)
LHAMSIVE	3.34E-02	1.035	Failure to close MSIV and isolate steam generator containing ruptured tube
QHAMDF3E	3.34E-02	1.035	Failure to start MDFP prior to depletion of BWST during makeup
QTP0002A	3.25E-02	1.034	AFP/T-2 fails to start
EDG0011F	3.13E-02	1.032	EDG 1-1 fails to run
FCIRCTMP	3.00E-02	1.031	Circ water temperature not acceptable
EC1Z100N	2.84E-02	1.029	BKR HX11B fails to open
EC1Z153C	2.84E-02	1.029	BKR HX02B fails to close
FHASUF3E	2.78E-02	1.029	Operators fail to actuate the startup feed pump as backup to the turbine-driven pump
PLT09XXD-CC_ALL	2.85E-02	1.029	CCF of all components in group 'PLT09XXD-CC'
AASGTR12	2.75E-02	1.028	SGTR occurs on OTSG 1-2 (split fraction)
TMPP43XF-CC_1_2	2.75E-02	1.028	CCW Pumps 1 & 2 fail to run due to CCF (initiating event)
QHAOVF1E	2.64E-02	1.027	Operators fail to take local manual control of AFW turbine-driven pump 1-1 speed.
TF2	2.35E-02	1.024	Tornado F-Scale 2 (initiating event)
NTKTOR2J	2.23E-02	1.023	Condensate storage tank (CST) fails due to high winds from an F-Scale 2 tornado
TTC1424T	2.22E-02	1.023	Temperature control valve SW1424 fails to throttle (one-year mission time) (initiating event)
ZOP006CR	2.27E-02	1.023	Failure to restore off-site power
NTKTOR3J	2.14E-02	1.022	CST fails due to high winds from an F-Scale 3 tornado
TF3	2.20E-02	1.022	Tornado F-Scale 3 (initiating event)

Table E.5-2: Basic Event Level 1 PRA Importance (continued)

Event Name	F-V	RRW	Description
F3AM	2.02E-02	1.021	Maximum flood in CCW pump room from service water (initiating event)
TTC1434T	2.09E-02	1.021	Temperature control valve SW1434 fails to throttle (initiating event)
EHASBC1E	1.88E-02	1.019	Operators fail to start SBO diesel generator and align to bus C1
FMM00004	1.86E-02	1.019	Any MSSVs on SG2 fail to reseat
SBOTOR2A	1.84E-02	1.019	SBO diesel generator damaged due to high winds from an F-Scale 2 Tornado
SBOTOR3A	1.86E-02	1.019	SBO diesel generator damaged due to high winds from an F-Scale 3 Tornado
XHOS-SWTEMP-HIGH	1.88E-02	1.019	Service water temperature greater than 72
EDG0SBOA	1.75E-02	1.018	SBO diesel generator fails to start
XHOS-T-BELOW-86	1.77E-02	1.018	Outside ambient temperature < 86 F
EC1ZXXXN-CC_1_2	1.64E-02	1.017	CCF of two components: EC1Z089N & EC1Z100N
WCDD113C	1.66E-02	1.017	BKR AD113 fails to close
ZOP006ER	1.72E-02	1.017	Failure to restore off-site power within 30 minutes after loss of AFW
QBLAUXBF	1.60E-02	1.016	Auxiliary boiler fails to supply steam
QTP0001F	1.56E-02	1.016	AFP/T-1 fails to run
RMBRC11N	1.55E-02	1.016	Operation with power operated relief valve (PORV) block valve (RC11) closed
WCDC113C	1.54E-02	1.016	Breaker AC113 fails to close
XHOS-SW23RUN	1.59E-02	1.016	Service water pumps 2 and 3 running
ZMMDCBUR	1.62E-02	1.016	Failure to recover Bus after a Bus fault (at least two hours available)
M	1.50E-02	1.015	Medium break LOCA
TMPP431F	1.49E-02	1.015	CCW Pump 1-1 fails to run (initiating event)
EMBEDG11	1.40E-02	1.014	EDG Train 1 in maintenance
FVV011BT	1.34E-02	1.014	AVV ICS11B fails to reseat after steam
QTP0002F	1.41E-02	1.014	AFP/T-2 fails to run
RHA011NE	1.43E-02	1.014	Operators fail to open the PORV block valve (RC 11) to permit use of PORV for MU
T2A-1	1.35E-02	1.014	SP6B fails to throttle (initiating event)
T2B-1	1.36E-02	1.014	SP6A fails to throttle (initiating event)
TMPP432F	1.40E-02	1.014	CCW Pump 1-2 fails to run (initiating event)
EMBSBODG	1.25E-02	1.013	SBO diesel generator in maintenance
QMBAUXB1	1.25E-02	1.013	Auxiliary boiler unavailable due to maintenance
QMV0608K	1.28E-02	1.013	Motor-operated valve AF 608 fails to remain open

Table E.5-2: Basic Event Level 1 PRA Importance (continued)

Event Name	F-V	RRW	Description
T12B7-IEF	1.30E-02	1.013	Service water pump room ventilation failure (T<86)
T2A-2	1.24E-02	1.013	FICICS35B fails high (initiating event)
T2B-2	1.24E-02	1.013	FICICS35A fails high (initiating event)
TMFC99XF-CC_ALL	1.25E-02	1.013	CCF of all components in group 'TMFC99XF-CC'
XHOS-AMB->40F	1.24E-02	1.013	Ambient temperature is > 40
XHOS-SW13RUN	1.31E-02	1.013	Service water pumps 1 and 3 running
EDG0011A	1.12E-02	1.011	EDG 1-1 fails to start
QMV0599K	1.10E-02	1.011	Motor-operated valve AF599 fails to remain open
T18-IEF	1.13E-02	1.011	Loss of DC power from bus d2p (initiating event)
ZHARMVTE	1.07E-02	1.011	Operators fail to compensate for loss of room cooling for makeup pumps.
EMD5336C	9.88E-03	1.01	Motor-operated damper HV5336b fails to close
EMDZ119N	9.88E-03	1.01	Motor damper HV5336a fails to open
EMDZ121N	9.88E-03	1.01	Motor damper HV5336c fails to open
EMFZ163A	9.91E-03	1.01	Vent Fan 3 fails to start
EMFZ165A	9.91E-03	1.01	Vent Fan 4 fails to start
EDG0SBOF	9.33E-03	1.009	SBO diesel generator fails to run
ELOOPRT	8.53E-03	1.009	LOOP given reactor trip
F7L	9.04E-03	1.009	Large circulating water flood in turbine building (initiating event)
PAVZ011N	9.14E-03	1.009	Air-operated valve MS 5889A fails to open
PAVZ01XN-CC_1_2	9.38E-03	1.009	CCF of two components: PAVZ011N & PAVZ012N
QMPMDFPA	8.68E-03	1.009	MDFP fails to start
T9-IEF	8.43E-03	1.009	Loss of DC power supply NNIX (initiating event)
XHOS-CCW1RUN3STBY	9.10E-03	1.009	CCW Pump 1 running, Pump 3 in standby
XHOS-CCW3RUN2STBY	9.26E-03	1.009	CCW Pump 3 running, Pump 2 in standby
LSZ0012R	7.58E-03	1.008	POS Switch ZS DH 12 fails to remain closed
PLT09A6D	7.92E-03	1.008	Level transmitter LTSP9A6 fails to respond
PLT09A7D	7.92E-03	1.008	Level transmitter LTSP9A7 fails to respond
PLT09A8D	7.80E-03	1.008	Level transmitter LTSP9A8 fails to respond
PLT09A9D	7.80E-03	1.008	Level transmitter LTSP9A9 fails to respond
PLT09B6D	7.80E-03	1.008	Level transmitter LTSP9B6 fails to respond
PLT09B7D	7.80E-03	1.008	Level transmitter LTSP9B7 fails to respond

Table E.5-2: Basic Event Level 1 PRA Importance (continued)

Event Name	F-V	RRW	Description
PLT09B8D	7.92E-03	1.008	Level transmitter LTSP9B8 fails to respond
PLT09B9D	7.92E-03	1.008	Level transmitter LTSP9B9 fails to respond
QSV6452D	7.55E-03	1.008	Solenoid valve FW 6452 fails to operate
QSV64XXD-CC_ALL	7.99E-03	1.008	CCF of all components in group 'QSV64XXD-CC'
XHOS-CCW2RUN3STBY	8.24E-03	1.008	CCW Pump 2 running, Pump 3 in standby
XHOS-CCW3RUN1STBY	8.07E-03	1.008	CCW Pump 3 running, Pump 1 In standby
XHOS-SW12RUN3AS1	7.85E-03	1.008	Service water pumps 1 and 2 running, 3 Spare and aligned as 1
XHOS-SW12RUN3AS2	7.85E-03	1.008	Service water pumps 1 and 2 running, 3 Spare and aligned as 2
FVV011AT	7.06E-03	1.007	AVV ICS11A fails to reseat after steam
LSZ0011R	7.10E-03	1.007	POS switch ZS DH 11 fails to remain closed
T7	6.86E-03	1.007	Loss of power from bus YAU (initiating event)
XHALPRME	6.96E-03	1.007	Operators fail to initiate LPR for a medium LOCA
XHOS-SAC1-STBY	6.95E-03	1.007	Service Air Compressor is in standby
XHOS-SAC2-RUN	6.95E-03	1.007	Service Air Compressor 1-2 is running
EMFZ1XXA-CC_ALL	6.16E-03	1.006	CCF of all components in group 'EMFZ1XXA-CC'
K1	5.63E-03	1.006	Reactor fails to trip following automatic demand
NTKTOR4J	6.08E-03	1.006	CST fails due to high winds from an F-Scale 4 tornado
PAVZ012N	6.10E-03	1.006	Air-operated valve MS 5889B fails to open
RRZRC2AN	5.89E-03	1.006	PORV (RC2A) fails to open
SAV1434N	5.81E-03	1.006	Air-operated valve SW 1434 fails to open
SHAF2ISE	6.37E-03	1.006	Failure to isolate flood before service water pumps are affected
T10-IEF	5.97E-03	1.006	Loss of Service Water Train 1
T19A-2-IEF	6.02E-03	1.006	SAC 1-2 fails to run (initiating event)
TAMZ009F	5.76E-03	1.006	SAC 1-2 fails to run
TCID202R	5.95E-03	1.006	INT D202 fails to remain closed
TF4	6.21E-03	1.006	Tornado F-Scale 4 (Initiating Event)
TMPP301F	5.95E-03	1.006	Service water pump 1-1 fails to run (one-year mission time)
TPXNNIXF	5.93E-03	1.006	NNIX power supply no output
VMFC31XA-CC_ALL	5.63E-03	1.006	CCF of all components in group 'VMFC31XA-CC'

Table E.5-2: Basic Event Level 1 PRA Importance (continued)

Event Name	F-V	RRW	Description
XHOS-SWTEMP-LOW	5.51E-03	1.006	Service Water temperature less than 72
EBC002PF	4.79E-03	1.005	Charger 2P no output
EC1XXXXC-CC_1_2	5.33E-03	1.005	CCF of two components: EC1X02AC & EC1Z153C
EC1Z088C	4.89E-03	1.005	BKR HX01A fails to close
EC1Z089N	4.89E-03	1.005	BKR HX11A fails to open
EC2Z000N	5.30E-03	1.005	BKR AD110 fails to open
EDG001XF-CC_1_2	4.96E-03	1.005	CCF of two components: EDG0011F & EDG0012F
F7S	4.88E-03	1.005	Small circulating water flood in turbine building (initiating event)
FLCO101F	5.27E-03	1.005	Logic card fails during operation
HMBHPI11	4.66E-03	1.005	HPI Train 1 in maintenance
LMBDHP11	4.88E-03	1.005	LPI Train 1 in maintenance
LMBDHP12	4.75E-03	1.005	LPI Train 2 in maintenance
LPPNISOZ	4.82E-03	1.005	ISLOCA occurs in non-isolable portion of DHR system
LSC007XN-CC_1_2	4.93E-03	1.005	CCF of two components: LSC0076N & LSC0077N
LTKTOR3J	5.42E-03	1.005	BWST fails due to high winds from F-Scale 3 Tornado
PMV0106N	4.68E-03	1.005	Motor-operated valve MS 106 fails to open
QMV3870K	5.44E-03	1.005	Motor-operated valve AF 3870 fails to remain open
QSV6451D	5.08E-03	1.005	Solenoid valve AF6451 fails to operate
SAV1424N	5.40E-03	1.005	Air-operated valve SW-1424 fails to open
SBOTOR4A	5.36E-03	1.005	SBO diesel generator damaged due to high winds from an F-Scale 4 Tornado
SMPP302A	5.06E-03	1.005	Failure of service water pump 1-2 to start
T11-IEF	5.00E-03	1.005	Loss of Service Water Train 2
T17-IEF	4.90E-03	1.005	Loss of DC power from bus D1P (initiating event)
TBD0D2PF	5.35E-03	1.005	PNL D2P local faults
THXE221P	4.57E-03	1.005	CCW heat exchanger plugs during operation (initiating event)
TMPP302F	4.97E-03	1.005	Service water pump 1-2 pump fails to run (one-year mission time)
VD-IEF	5.07E-03	1.005	ISLOCA due to internal rupture of DHR suction valves
WHAF3ISE	4.50E-03	1.005	Failure to isolate flood in Room 328 before CCW pumps are affected

Table E.5-3: Basic Event LERF Importance

Event Name	F-V	RRW	Description
R	9.00E-01	10.048	SGTR (initiating event)
XHAMUCDE	6.10E-01	2.563	Operators fail to attempt cooldown via makeup/HPI cooling
CHASGDPE	5.40E-01	2.175	Operators fail to cooldown during a SGTR
LHAMSIVE	4.97E-01	1.989	Failure to close MSIV and isolate steam generator containing ruptured tube
AASGTR11	4.81E-01	1.926	SGTR occurs on OTSG 1-1 (split fraction)
AASGTR12	3.93E-01	1.646	SGTR occurs on OTSG 1-2 (split fraction)
FMM00003	7.90E-02	1.086	Any MSSVs on SG1 fail to reseat
VD-IEF	7.54E-02	1.082	ISLOCA due to internal rupture of DHR suction valves
FLCO101F	7.31E-02	1.079	Logic card fails during operation – MSIV 101 fails to close
LPPNISOZ	7.18E-02	1.077	ISLOCA occurs in non-isolable portion of DHR system
FMM00004	6.80E-02	1.073	Any MSSVs on SG2 fail to reseat
FLC0100F	6.13E-02	1.065	Logic card fails during operation – MSIV 100 fails to close
QHAMDFPE	5.96E-02	1.063	Failure to start MDFP as backup to turbine-driven feedwater pumps for transient, Small LOCA or SGTR events
EC1ZXXXN-CC_1_2	5.19E-02	1.055	CCF of two components: EC1Z089N & EC1Z100N
LPSRC2BH	4.93E-02	1.052	Press switch PSH RC2B4 fails high – fails DHR
LPSZ416H	4.93E-02	1.052	Press switch PSH 7531A fails high - fails DHR
LMVF012R	4.53E-02	1.047	Internal rupture of DH 12 (annual frequency)
LMBCWRT1	4.12E-02	1.043	CWR Train 1 unavailable due to maintenance
EDG0012F	3.47E-02	1.036	EDG 1-2 fails to run
FCIRCTMP	3.00E-02	1.031	Circ water temperature not acceptable
FVV011BT	3.04E-02	1.031	AVV ICS11B fails to reseat after steam
LMVF011R	3.01E-02	1.031	Internal rupture of DH 11 (annual frequency)
ELOOPRT	2.93E-02	1.03	LOOP given reactor trip
EHASBDGE	2.70E-02	1.028	Operators fail to align power from SBO diesel generator to supply MDFP given LOOP
EHAD2DGE	2.65E-02	1.027	Operators fail to align power from EDG 1-1 or EDG 1-2 to supply MDFP given LOOP
FVV011AT	2.61E-02	1.027	AVV ICS11A fails to reseat after SGTR

Table E.5-3: Basic Event LERF Importance (continued)

Event Name	F-V	RRW	Description
LMVU011R	2.41E-02	1.025	Internal rupture of DH 11 since cold shutdown
LMVU012R	2.41E-02	1.025	Internal rupture of DH 12 since cold shutdown
LMBCWRT2	2.16E-02	1.022	CWR Train 2 unavailable due to maintenance
FLC011BF	1.97E-02	1.02	ICS logic card fails ICS11B (AVV SG1) fails to open
FLC011AF	1.84E-02	1.019	ICS logic card fails ICS11A (AVV SG2) fails to open
EC1Z100N	1.79E-02	1.018	Breaker HX11B fails to open – fails power from SU1 an d SU2 to Bus B
EC1Z153C	1.79E-02	1.018	Breaker HX02B fails to close - fails power from SU1 to Bus B
EHASBD1E	1.56E-02	1.016	Operators fail to start SBO diesel generator and align to bus D1
ET4DF12F	1.54E-02	1.016	Transformer DF 1-2 local faults
LAV1761N	1.57E-02	1.016	Air-operated valve WC 1761 fails to open
LMV0011H	1.52E-02	1.015	Motor-operated valve DH 11 fails to hold on high exposure
XHOS-CCW1RUN2STBY	1.53E-02	1.015	CCW Pump 1 running, Pump 2 in standby
XHOS-CCW2RUN1STBY	1.51E-02	1.015	CCW Pump 2 running, Pump 1 in standby
EHAD1ACE	1.43E-02	1.014	Failure to lineup alternate source to D1
EB200D1F	1.31E-02	1.013	Bus D1 local faults not including fire
EDG0SBOF	1.33E-02	1.013	SBO diesel generator fails to run
LXV0125C	1.12E-02	1.011	Manual valve WC 125 fails to close – makeup to BWST for SGTR
LXV0169N	1.12E-02	1.011	Manual valve WC 169 fails to open – makeup to BWST for SGTR
LXV0171C	1.12E-02	1.011	Manual valve WC 171 fails to close – makeup to BWST for SGTR
LXV0172C	1.12E-02	1.011	Manual valve WC 172 fails to close – makeup to BWST for SGTR
LXVBW15C	1.12E-02	1.011	Manual valve BW 15 fails to close – makeup to BWST for SGTR
LXVBW16N	1.12E-02	1.011	Manual valve BW 16 fails to open – makeup to BWST for SGTR
LXVSF79N	1.12E-02	1.011	Manual valve SF 79 fails to open – makeup to BWST for SGTR
LXVSF80C	1.12E-02	1.011	Manual valve SF 80 fails to close – makeup to BWST for SGTR

Table E.5-3: Basic Event LERF Importance (continued)

Event Name	F-V	RRW	Description
LXVSF87N	1.12E-02	1.011	Manual valve SF 87 fails to open – makeup to BWST for SGTR
LXVSF92C	1.12E-02	1.011	Manual valve SF 92 fails to close – makeup to BWST for SGTR
LXVWC44N	1.12E-02	1.011	Manual valve WC 44 fails to open – makeup to BWST for SGTR
EDG0SBOA	1.03E-02	1.01	SBO diesel generator fails to start
FIV0101C	1.03E-02	1.01	MS 101 (MSIV SG1) fails to close
VHAISOLR	1.03E-02	1.01	Operators fail to attempt to close DH1A to isolate ISLOCA
ZHAISOLR	1.03E-02	1.01	Failure to find and isolate ISLOCA resulting from reverse flow through LPI injection line
FIV0100C	8.51E-03	1.009	MS100 (MSIV SG2) fails to close
ZOP007BR	9.05E-03	1.009	Failure to recover offsite power within one hour to prevent loss of DC
EMBEDG12	7.83E-03	1.008	EDG Train 2 in maintenance
XHABWMUE	7.93E-03	1.008	Operators fail to initiate makeup to the BWST during a SGTR.
EB300F1F	6.53E-03	1.007	Bus F1 local faults
EDG0012A	6.64E-03	1.007	EDG 1-2 fails to start
EMBSBODG	7.40E-03	1.007	SBO diesel generator in maintenance
LMV0011N	7.09E-03	1.007	Motor-operated valve DH 11 fails to open
LMV0012N	7.09E-03	1.007	Motor-operated valve DH 12 fails to open
QMBAFP12	6.78E-03	1.007	AFW train 2 in maintenance
VL20-IEF	6.47E-03	1.007	ISLOCA via Train 2 injection line reverse flow (initiating event)
XHOS-AMB->40F	7.27E-03	1.007	Ambient temperature is > 40
EC1BET9N	6.07E-03	1.006	CCF for failure of 13.8 kV breakers to open
EC1CC09N	6.07E-03	1.006	Breaker HX11A OR HX11B fails to open
EC2Z012R	5.58E-03	1.006	Breaker AD1DF12 fails to remain closed
EDG0011F	5.53E-03	1.006	EDG 1-1 fails to run
LMV0011X	6.02E-03	1.006	Motor-operated valve DH 11 fails to close while indicating closed
LMV0012X	6.02E-03	1.006	Motor-operated valve DH 12 fails to close while indicating closed
QMBAFP11	6.29E-03	1.006	AFW Train 1 in maintenance
VL10-IEF	6.45E-03	1.006	ISLOCA Via Train 1 injection line reverse flow (initiating event)
LCVF030R	5.42E-03	1.005	Internal leak develops in check valve cf 30 (per year)
LCVF031R	5.40E-03	1.005	Check valve fails to remain closed (per year)

Table E.5-3: Basic Event LERF Importance (continued)

Event Name	F-V	RRW	Description
NORCVRT3	4.70E-03	1.005	Off-site power recovery not possible after a tornado
ZHABWMUE	4.49E-03	1.005	Operators fail to initiate makeup to the BWST during a SGTR.

Table E.5-4: List of Initial SAMA Candidates

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
Enhancements Related to Alternate Current (AC) and DC Power			
AC/DC-01	Provide additional DC battery capacity.	This SAMA candidate would provide longer battery lifetime during SBO events.	[2, Table 14], [30, Table 5-5], [31, Table G-3], [35, Table 5-5]
AC/DC-02	Replace lead-acid batteries with fuel cells.	This SAMA candidate would replace batteries with fuel cells increase the time available for recovery of off-site power. Therefore, the likelihood of recovery of off-site power would be increased.	[2, Table 14], [30, Table 5-5], [35, Table 5-5], [38, Table 5-5]
AC/DC-03	Add a portable, diesel-driven battery charger to existing DC system.	This SAMA candidate would provide longer battery lifetime during SBO events. Increasing battery capacity would increase the time available for recovery of off-site or on-site power.	[2, Table 14]
AC/DC-04	Improve DC bus load shedding.	This SAMA candidate would extend battery lifetime during an SBO scenario, and thereby would increase the likelihood of recovering on-site or off-site power.	[2, Table 14]
AC/DC-05	Provide DC bus cross-ties.	This SAMA candidate would improve the availability of DC power system.	[2, Table 14], [30, Table 5-5]
AC/DC-06	Provide additional DC power to the 120/240V vital AC system.	This SAMA candidate would increase the availability of the vital AC buses.	[2, Table 14]
AC/DC-07	Add an automatic feature to transfer the 120V vital AC buses from normal to standby power.	This SAMA candidate would increase the availability of the 120V vital AC buses.	[2, Table 14]
AC/DC-08	Increase training on response to loss of 120V AC buses that cause inadvertent actuation signals.	This SAMA candidate would improve the chances of successful response to loss of 120V AC buses.	[2, Table 14]
AC/DC-09	Provide an additional diesel generator.	This SAMA candidate would increase the availability of on-site emergency AC power.	[2, Table 14], [32, Table 5-5], [34, Table 5-6]
AC/DC-10	Revise procedure to allow bypass of diesel generator trips.	This SAMA candidate would reduce the likelihood of unnecessary diesel generator trips during LOOP events.	[2, Table 14]
AC/DC-11	Improve 4.16kV bus cross-tie ability.	This SAMA candidate would increase the availability of on-site AC power.	[2, Table 14]
AC/DC-12	Create AC power cross-tie capability with other unit (multi-unit site).	This SAMA candidate would increase the availability of on-site AC power.	[2, Table 14], [30, Table 5-5], [31, Table G-3]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
AC/DC-13	Install an additional, buried off-site power source.	This SAMA candidate would reduce the probability of LOOP.	[2, Table 14], [30, Table 5-5], [35, Table 5-5], [38, Table 5-5]
AC/DC-14	Install a gas turbine generator.	Adding a gas turbine-powered generator would improve the reliability of emergency power through increased redundancy, and more importantly, by adding diversity.	[2, Table 14], [30, Table 5-5], [35, Table 5-5]
AC/DC-15	Install tornado protection on gas turbine generator.	Typically, additional on-site power sources have been classified as non-safety, and as such may not be housed in tornado-resistant structures. For those designs, this SAMA candidate would upgrade that structure to be tornado resistant.	[2, Table 14], [30, Table 5-5]
AC/DC-16	Improve uninterruptible power supplies.	This SAMA candidate would increase the availability of power supplies supporting front-line equipment.	[2, Table 14]
AC/DC-17	Create a cross-tie for diesel fuel oil (multi-unit site).	This SAMA candidate would increase availability of the diesel generators.	[2, Table 14]
AC/DC-18	Develop procedures for replenishing diesel fuel oil to the emergency and SBO diesel generators.	This SAMA candidate would increase availability of the diesel generators.	[2, Table 14], [5]
AC/DC-19	Use fire water system as a backup source for diesel cooling.	This SAMA candidate would provide an alternate cooling water supply to an EDG in the event of a LOOP concurrent with a loss of cooling water to the diesel generator.	[2, Table 14], [30, Table 5-5], [31, Table G-3]
AC/DC-20	Add a new backup source of diesel generator cooling.	This SAMA candidate would increase the availability of the diesel generators.	[2, Table 14], [31, Table G-3]
AC/DC-21	Develop procedures to repair or replace failed 4kV breakers.	In the event of a loss of bus due to a failed breaker, this SAMA candidate would provide the ability to repair or replace 4kV breakers in a timely manner to restore AC power to the affected division.	[2, Table 14], [30, Table 5-5], [33, Table 5-5], [35, Table 5-5], [38, Table 5-5]
AC/DC-22	In training, emphasize steps in recovery of off- site power after an SBO.	This SAMA candidate would reduce the human error probability (HEP) during off-site power recovery.	[2, Table 14]
AC/DC-23	Develop a severe weather conditions procedure.	This SAMA candidate would improve off-site power recovery following external weather-related events.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
AC/DC-24	Bury off-site power lines.	This SAMA candidate would reduce the likelihood of LOOP from severe weather by burying the cables.	[2, Table 14], [31, Table G-3]
AC/DC-25	Provide a dedicated DC power system (battery/battery charger) for TDAFW control.	This SAMA candidate would increase the reliability/availability of the TDAFW pumps in an SBO event.	[5]
AC/DC-26	Provide an alternator/generator that would be driven by each TDAFW pump to provide DC control power	This SAMA candidate would allow the TDAFW pumps to continue operation independent of other DC power supplies in the event of an SBO.	[5]
AC/DC-27	Increase the size of the SBO fuel oil tank.	This SAMA candidate would increase the reliability of the SBO diesel and allow more recovery time for off-site power or EDGs.	[5]
Enhancements Related to Anticipated Transient Without Scram (ATWS) Events			
AT-01	Add an independent boron injection system.	This SAMA candidate would improve the availability of boron injection during an ATWS.	[2, Table 14]
AT-02	Add a system of relief valves to prevent equipment damage from pressure spikes during an ATWS.	This SAMA candidate would improve the equipment availability after an ATWS.	[2, Table 14]
AT-03	Provide an additional control system for rod insertion (e.g., ATWS Mitigation System Actuation Circuitry (AMSAC)).	This SAMA candidate would add redundancy to the rod control system and reduce ATWS frequency.	[2, Table 14]
AT-04	Install an ATWS-sized filtered containment vent to remove decay heat.	This SAMA candidate would increase the ability to remove reactor heat during ATWS events.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
AT-05	Revise procedure to bypass MSIV isolation in turbine trip ATWS scenarios.	Discharge of a substantial fraction of steam to the main condenser (i.e., as opposed to into the primary containment) affords the operator more time to perform actions (e.g., lower water level, depressurize reactor pressure vessel (RPV)) than if the main condenser was unavailable, resulting in lower human error probabilities.	[2, Table 14]
AT-06	Revise procedure to allow override of LPI during an ATWS event.	Allows immediate control of LPI. On failure of high pressure core injection and condensate, some plants direct reactor depressurization followed by five minutes of automatic LPI.	[2, Table 14]
AT-07	Install motor generator set trip breakers in control room.	This SAMA candidate would reduce the frequency of core damage due to an ATWS.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
AT-08	Provide capability to remove power from the bus powering the control rods.	This SAMA candidate would decrease the time required to insert control rods if the reactor trip breakers fail (during a loss of feedwater ATWS that has a rapid pressure excursion).	[2, Table 14]
Enhancements Related to Containment Bypass			
CB-01	Install additional pressure or leak monitoring instruments for detection of ISLOCA.	This SAMA candidate would reduce the ISLOCA frequency.	[2, Table 14], [31, Table G-3]
CB-02	Add redundant and diverse limit switches to each CIV.	This SAMA candidate would reduce the frequency of containment isolation failure and ISLOCAs.	[2, Table 14], [30, Table 5-5], [31, Table G-3], [37, Table 5-5]
CB-03	Increase leak testing of valves in ISLOCA paths.	This SAMA candidate would reduce the ISLOCA frequency.	[2, Table 14], [30, Table 5-5], [37, Table 5-5]
CB-04	Install self-actuating CIVs.	This SAMA candidate would reduce the frequency of isolation failures.	[2, Table 14]
CB-05	Locate DHR system inside containment.	This SAMA candidate would reduce the frequency of ISLOCA.	[2, Table 14], [30, Table 5-5]
CB-06	Ensure ISLOCA releases are scrubbed. One method is to plug drains in potential break areas so that break point will be covered with water.	This SAMA candidate would provide the ability to scrub ISLOCA releases.	[2, Table 14], [30, Table 5-5], [31, Table G-3], [37, Table 5-5]
CB-07	Revise emergency operating procedures (EOPs) to improve ISLOCA identification.	This SAMA candidate would increase likelihood that LOCAs outside containment are identified. For example, a DHR ISLOCA could direct initial leakage back to the pressurizer relief tank, giving indication that the LOCA was inside containment.	[2, Table 14]
CB-08	Improve operator training on ISLOCA coping.	This SAMA candidate would decrease the ISLOCA consequences.	[2, Table 14], [30, Table 5-5], [5]
CB-09	Institute a maintenance practice to perform a 100% inspection of steam generator tubes during each refueling outage.	This SAMA candidate would reduce the frequency of a SGTR event.	[2, Table 14]
CB-10	Replace steam generators with a new design.	This SAMA candidate would reduce the frequency of a SGTR event.	[2, Table 14], [30, Table 5-5], [37, Table 5-5]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CB-11	Increase the pressure capacity of the secondary side so that a SGTR would not cause the relief valves to lift.	This SAMA candidate would prevent a direct release pathway to the environment in the event of a SGTR sequence.	[2, Table 14]
CB-12	Install a redundant spray system to depressurize the primary system during a SGTR.	This SAMA candidate would enhance depressurization capabilities during SGTR to reduce the duration of the release.	[2, Table 14]
CB-13	Proceduralize use of pressurizer vent valves during SGTR sequences.	This SAMA candidate would be a backup method to using pressurizer sprays to reduce primary system pressure following a SGTR.	[2, Table 14]
CB-14	Provide improved instrumentation to detect SGTR, such as Nitrogen-16 monitors.	This SAMA candidate would improve mitigation of SGTR.	[2, Table 14]
CB-15	Route the discharge from the MSSVs through a structure where a water spray would condense the steam and remove most of the fission products.	The intent of this SAMA candidate is to scrub the release to reduce the consequences of a SGTR.	[2, Table 14]
CB-16	Install a highly reliable (closed loop) steam generator shell-side heat removal system that relies on natural circulation and stored water sources.	The intent of this SAMA candidate is to reduce the consequences of a SGTR.	[2, Table 14]
CB-17	Revise EOPs to direct isolation of a faulted steam generator.	This SAMA candidate would reduce consequences of a SGTR.	[2, Table 14]
CB-18	Direct steam generator flooding after a SGTR, prior to core damage.	This SAMA candidate would provide for improved scrubbing of SGTR releases by maintaining adequate water coverage of a ruptured steam generator tube.	[2, Table 14]
CB-19	Vent MSSVs in containment.	This SAMA candidate would route the MSSVs steam releases back into containment to minimize releases to the environment due to a SGTR event.	[2, Table 14]
CB-20	Install relief valves in the CCW system.	This SAMA candidate would relieve pressure buildup from a RCP thermal barrier tube rupture and aid in preventing the onset of an ISLOCA.	[2, Table 14]
CB-21	Install pressure measurements between the two DHR suction valves in the line from the RCS hot leg.	This SAMA candidate would provide indication of failure of inboard isolation valves allowing time to initiate mitigating actions to prevent ISLOCA.	[2, Table 14]
Enhancements Related to Core Cooling Systems			
CC-01	Install an independent active or passive HPI system.	This SAMA candidate would improve the prevention of core melt sequences.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CC-02	Provide an additional HPI pump with independent diesel generator.	This SAMA candidate would reduce the frequency of core melt from small LOCA and SBO sequences.	[2, Table 14], [31, Table G-3], [35, Table 5-5], [37, Table 5-5], [38, Table 5-5]
CC-03	Revise procedure to allow operators to inhibit automatic vessel depressurization in non-ATWS scenarios.	This SAMA candidate would extend the use of high pressure and LPI systems.	[2, Table 14]
CC-04	Add a diverse LPI system.	This SAMA candidate would improve injection capability.	[2, Table 14]
CC-05	Provide capability for alternate LPI via diesel-driven fire pump.	This SAMA candidate would improve injection capability.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CC-06	Improve ECCS suction strainers.	During energetic large LOCA events, debris such as insulation could be dislodged and potentially block the ECCS strainers, thereby failing ECCS suction. This SAMA candidate would reduce the likelihood of strainer blockage during LOCA events.	[2, Table 14]
CC-07	Add the ability to manually align ECCS recirculation.	This SAMA candidate would enhance the reliability of ECCS suction.	[2, Table 14]
CC-08	Add the ability to automatically align ECCS to recirculation mode upon BWST depletion.	This SAMA candidate would enhance the reliability of ECCS suction.	[2, Table 14]
CC-09	Provide hardware and procedure to refill the BWST once it reaches a specified low level.	This SAMA candidate would extend BWST capacity in the event of a SGTR.	[2, Table 14], [5]
CC-10	Provide an in-containment reactor water storage tank.	This SAMA candidate would provide a continuous source of water to the safety injection pumps during a LOCA event. Water released from a breach of the primary system collects in the in-containment reactor water storage tank, and thereby eliminates the need to realign the safety injection pumps for long-term post LOCA recirculation.	[2, Table 14]
CC-11	Modify procedures to throttle LPI pumps earlier in medium or large break LOCAs to maintain BWST inventory.	This SAMA candidate would extend BWST capacity.	[2, Table 14]
CC-12	Emphasize timely recirculation alignment in operator training.	This SAMA candidate would reduce HEP associated with recirculation failure.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CC-13	Upgrade the chemical and volume control system to mitigate small break LOCAs.	An upgrade to the chemical and volume control system would decrease the frequency of core damage.	[2, Table 14]
CC-14	Change the in-containment reactor water storage tank suction from four check valves to two check and two air-operated valves.	This SAMA candidate would reduce common mode failure of injection paths.	[2, Table 14]
CC-15	Replace two of the four electric safety injection pumps with diesel-powered pumps.	This SAMA candidate would provide diversity within the high and low pressure safety injection systems.	[2, Table 14]
CC-16	Provide capability for remote, manual operation of secondary side pilot-operated relief valves in an SBO.	This SAMA candidate would improve the chance of successful operation during SBO events in which high area temperatures may be encountered.	[2, Table 14]
CC-17	Create a reactor coolant depressurization system.	This SAMA candidate would allow low pressure ECCS injection in the event of a small break LOCA and high pressure safety injection failure.	[2, Table 14]
CC-18	Make procedure changes for RCS depressurization.	This SAMA candidate would allow low pressure ECCS injection in the event of a small break LOCA and high pressure safety injection failure.	[2, Table 14]
CC-19	Provide automatic switchover of HPI and LPI suction from the BWST to containment sump for LOCAs.	This SAMA candidate will increase the reliability of switchover of suction from the BWST to the containment sump by providing both manual and automatic switchover.	
CC-20	Modify EOPs to allow using the make-up pumps for high pressure recirculation from the containment sump.	This SAMA candidate would improve the reliability of high pressure recirculation following the loss of HPI.	[5]
CC-21	Reduce the BWST level at which switchover to containment recirculation is initiated.	This SAMA candidate would extend the time available to accomplish BWST refill.	[5]
Enhancements Related to Containment Phenomena			
CP-01	Create a reactor cavity flooding system.	This SAMA candidate would enhance debris coolability, reduce core concrete interaction, and increase fission product scrubbing.	[2, Table 14], [31, Table G-3], [35, Table 5-5], [36, Table 5-6], [38, Table 5-5]
CP-02	Install a passive containment spray system.	This SAMA candidate would improve containment spray capability.	[2, Table 14], [35, Table 5-5], [37, Table 5-5], [38, Table 5-5]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CP-03	Use the fire water system as a backup source for the containment spray system.	This SAMA candidate would improve containment spray capability.	[2, Table 14], [33, Table 5-5], [35, Table 5-5], [38, Table 5-5]
CP-04	Install an unfiltered, hardened containment vent.	This SAMA candidate would increase decay heat removal capability for non-ATWS events, without scrubbing released fission products.	[2, Table 14]
CP-05	Install a filtered containment vent to remove decay heat. Option 1: Gravel Bed Filter Option 2: Multiple Venturi Scrubber	This SAMA candidate would increase decay heat removal capability for non-ATWS events, with scrubbing of released fission products.	[2, Table 14], [36, Table 5-6]
CP-06	Enhance fire protection system hardware and procedures.	This SAMA candidate would improve fission product scrubbing in severe accidents.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CP-07	Provide post-accident containment inerting capability.	This SAMA candidate would reduce the likelihood of hydrogen and carbon monoxide gas combustion.	[2, Table 14]
CP-08	Create a large concrete crucible with heat removal potential to contain molten core debris.	This SAMA candidate would increase cooling and containment of molten core debris. Molten core debris escaping from the vessel is contained within the crucible and a water cooling mechanism cools the molten core in the crucible, preventing melt-through of the base mat.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CP-09	Create a core melt source reduction system.	This SAMA candidate would increase cooling and containment of molten core debris. Refractory material would be placed underneath the reactor vessel such that a molten core falling on the material would melt and combine with the material. Subsequent spreading and heat removal from the vitrified compound would be facilitated, and concrete attack would not occur.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CP-10	Strengthen primary/secondary containment (e.g., add ribbing to containment shell).	This SAMA candidate would reduce the probability of containment over-pressurization.	[2, Table 14]
CP-11	Increase depth of the concrete base mat or use an alternate concrete material to ensure melt-through does not occur.	This SAMA candidate would reduce probability of base mat melt-through.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CP-12	Provide a reactor vessel exterior cooling system.	This SAMA candidate would increase potential to cool a molten core before it causes vessel failure, by submerging the lower head in water.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CP-13	Construct a building to be connected to primary/secondary containment and maintained at a vacuum.	This SAMA candidate would reduce the probability of containment over-pressurization.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CP-14	Institute simulator training for severe accident scenarios.	This SAMA candidate would improve arrest of core melt progress and prevention of containment failure.	[2, Table 14]
CP-15	Improve leak detection procedures.	This SAMA candidate would increase piping surveillance to identify leaks prior to complete failure. Improved leak detection would reduce LOCA frequency.	[2, Table 14]
CP-16	Delay containment spray actuation after a large break LOCA.	This SAMA candidate would lengthen time of BWST.	[2, Table 14]
CP-17	Install automatic containment spray pump header throttle valves.	This SAMA candidate would extend the time over which water remains in the BWST, when full containment spray flow is not needed.	[2, Table 14]
CP-18	Install a redundant containment spray system.	This SAMA candidate would increase containment heat removal ability.	[2, Table 14]
CP-19	Install a redundant containment fan system.	This SAMA candidate would increase containment heat removal ability.	
CP-20	Install or use an independent power supply to the hydrogen control system using either new batteries, a non-safety grade portable generator, existing station batteries, or existing AC/DC independent power supplies, such as the security system diesel generator.	This SAMA candidate would reduce the hydrogen detonation potential.	[2, Table 14]
CP-21	Install a passive hydrogen control system.	This SAMA candidate would reduce the hydrogen detonation potential.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CP-22	Erect a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at high pressure.	This SAMA candidate would reduce the probability of containment failure.	[2, Table 14]
Enhancements Related to Cooling Water			
CW-01	Add redundant DC control power for service water pumps.	This SAMA candidate would increase the availability of service water.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CW-02	Replace ECCS pump motors with air-cooled motors.	This SAMA candidate would replace the ECCS pump motors with air-cooled pump motors that would eliminate the ECCS dependency on the CCW system.	[2, Table 14], [31, Table G-3], [37, Table 5-5]
CW-03	Enhance procedural guidance for use of cross-tied component cooling or service water pumps.	This SAMA candidate would reduce the frequency of loss of CCW and service water.	[2, Table 14]
CW-04	Add a redundant service water pump.	This SAMA candidate would increase the availability of cooling water to one of the two safety divisions.	[2, Table 14]
CW-05	Enhance the screen wash system.	This SAMA candidate would reduce the potential for loss of service water due to clogging of screens.	[2, Table 14]
CW-06	Cap downstream piping of normally closed CCW drain and vent valves.	This SAMA candidate would reduce the frequency of loss of CCW initiating events, some of which can be attributed to catastrophic failure of the many single isolation valves.	[2, Table 14], [31, Table G-3]
CW-07	Enhance loss of CCW (or loss of service water) procedures to facilitate stopping the RCPs.	This SAMA candidate would reduce the potential for RCP seal damage due to pump bearing failure.	[2, Table 14]
CW-08	Enhance loss of CCW procedure to underscore the desirability of cooling down the RCS prior to seal LOCA.	This SAMA candidate would reduce the probability of RCP seal failure.	[2, Table 14]
CW-09	Additional training on loss of CCW.	This SAMA candidate would improve the success of operator actions after a loss of CCW.	[2, Table 14]
CW-10	Provide hardware connections to allow another essential raw cooling water system to cool charging pump seals.	This SAMA candidate would reduce the effect of loss of CCW by providing a means to maintain the charging pump seal injection following a loss of normal cooling water.	[2, Table 14]
CW-11	On loss of essential raw cooling water, proceduralize shedding CCW loads to extend the CCW heat-up time.	This SAMA candidate would increase the time before loss of CCW during a loss of essential raw cooling water sequences.	[2, Table 14]
CW-12	Increase charging pump lube oil capacity.	This SAMA candidate would increase the time before charging pump failure due to lube oil overheating in loss of cooling water sequences.	[2, Table 14]
CW-13	Install an independent RCP seal injection system, with dedicated diesel generator.	This SAMA candidate would reduce the frequency of core damage from loss of CCW, service water, or SBO.	[2, Table 14], [30, Table 5-5], [31, Table G-3], [37, Table 5-5]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
CW-14	Install an independent RCP seal injection system, without dedicated diesel generator.	This SAMA candidate would reduce the frequency of core damage from loss of CCW, service water, or SBO.	[2, Table 14], [30, Table 5-5], [31, Table G-3], [37, Table 5-5]
CW-15	Use existing hydro test pump for RCP seal injection.	This SAMA candidate would reduce the frequency of core damage from loss of CCW, service water, or SBO.	[2, Table 14], [30, Table 5-5], [37, Table 5-5]
CW-16	Install improved RCP seals.	This SAMA candidate would reduce the likelihood of RCP seal LOCA.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
CW-17	Install an additional CCW pump.	This SAMA candidate would reduce the likelihood of loss of CCW leading to a RCP seal LOCA.	[2, Table 14], [38, Table 5-5]
CW-18	Prevent make-up pump flow diversion through the relief valves.	If spurious HPI relief valve opens creating a flow diversion large enough to prevent RCP seal injection, then this SAMA would reduce the frequency of loss of RCP seal cooling.	[2, Table 14], [37, Table 5-5]
CW-19	Change procedures to isolate RCP seal return flow on loss of CCW, and provide (or enhance) guidance on loss of injection during seal LOCA.	This SAMA candidate would reduce the frequency of core damage due to a loss of RCP seal cooling.	[2, Table 14]
CW-20	Implement procedures to stagger high pressure safety injection pump use after a loss of service water.	This SAMA candidate would allow HPI to be extended prior to overheating following a loss of service water.	[2, Table 14]
CW-21	Use fire prevention system pumps as a backup RCP seal injection and high pressure make-up source.	This SAMA candidate would reduce the frequency of a RCP seal LOCA.	[2, Table 14]
CW-22	Implement procedure and hardware modifications to allow manual alignment of the fire water system to the CCW system.	This SAMA candidate would improve the ability to cool DHR heat exchangers.	[2, Table 14]
CW-23	Install a CCW header cross-tie.	This SAMA candidate would improve the ability to cool DHR heat exchangers.	[2, Table 14]
CW-24	Replace the standby CCW pump with a pump diverse from the other two CCW pumps.	This SAMA candidate would improve CCW reliability by reducing the likelihood of a CCF of all three CCW pumps.	
CW-25	Provide the ability to cool make-up pumps using fire water in the event of loss of CCW.	This SAMA candidate would allow continued injection of RCP seal water in the event of loss of CCW.	

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
Enhancements Related to Internal Flooding			
FL-01	Improve inspection of rubber expansion joints on main condenser.	This SAMA candidate would reduce the frequency of internal flooding due to failure of circulating water system expansion joints.	[2, Table 14]
FL-02	Modify swing direction of doors separating turbine building basement from areas containing safeguards equipment.	This SAMA candidate would prevent flood propagation.	[2, Table 14]
Enhancements to Reduce Fire Risk			
FR-01	Replace mercury switches in fire protection system.	This SAMA candidate would decrease the probability of spurious fire suppression system actuation.	[2, Table 14]
FR-02	Upgrade fire compartment barriers.	This SAMA candidate would decrease the consequences of a fire.	[2, Table 14]
FR-03	Install additional transfer and isolation switches.	This SAMA candidate would reduce the number of spurious actuations during a fire.	[2, Table 14]
FR-04	Enhance fire brigade awareness.	This SAMA candidate would decrease the consequences of a fire.	[2, Table 14]
FR-05	Enhance control of combustibles and ignition sources.	This SAMA candidate would decrease the fire frequency and consequences.	[2, Table 14]
Enhancements Related to Feedwater and Condensate			
FW-01	Install a digital feedwater upgrade.	This SAMA candidate would reduce the chance of loss of MFW following a plant trip.	[2, Table 14], [30, Table 5-5], [31, Table G-3], [35, Table 5-5]
FW-02	Create ability for emergency connection of existing or new water sources to feedwater and condensate systems.	This SAMA candidate would increase the availability of feedwater.	[2, Table 14]
FW-03	Install an independent diesel for the CST make-up pumps.	This SAMA candidate would extend the inventory in the CST during an SBO.	[2, Table 14]
FW-04	Add a MDFP.	This SAMA candidate would increase the availability of feedwater.	[2, Table 14]
FW-05	Install manual isolation valves around the TDAFW pump steam admission valves.	This SAMA candidate would reduce dual turbine-driven pump maintenance unavailability.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
FW-06	Install accumulators for TDAFW pump flow control valves.	This SAMA candidate would provide control air accumulators for the TDAFW pump flow control valves. These accumulators would eliminate the need for local manual action to align nitrogen bottles for control air following a LOOP.	[2, Table 14]
FW-07	Install a new CST (AFW storage tank).	This SAMA candidate would increase the reliability of the AFW system.	[2, Table 14]
FW-08	Modify the TDAFW pump to be self-cooled.	This SAMA candidate would improve the success probability during an SBO.	[2, Table 14]
FW-09	Proceduralize local manual operation of AFW system when control power path is lost.	This SAMA candidate would improve AFW availability during an SBO. Also would provide a success path should AFW control power be lost in non-SBO sequences.	[2, Table 14]
FW-10	Provide hookup for portable diesel generators to power the TDAFW pump after station batteries are depleted.	This SAMA candidate would extend the availability of AFW.	[2, Table 14], [30, Table 5-5], [35, Table 5-5], [38, Table 5-5]
FW-11	Use fire water system as a backup for steam generator inventory.	This SAMA candidate would create a backup to main and AFW for steam generator water supply.	[2, Table 14]
FW-12	Change failure position of condenser make-up valve if the condenser make-up valve fails open on loss of air or power.	This SAMA candidate would allow greater inventory for the AFW pumps by preventing CST flow diversion to the condenser if the condenser make-up valve fails open on loss of air or power.	[2, Table 14]
FW-13	Provide a passive, secondary-side heat-rejection loop consisting of a condenser and heat sink.	This SAMA candidate would reduce the potential for core damage due to a loss of feedwater event.	[2, Table 14]
FW-14	Modify the startup feedwater pump so that it can be used as a backup to the AFW system, including during an SBO.	This SAMA candidate would increase the reliability of decay heat removal.	[2, Table 14]
FW-15	Replace existing pilot-operated relief valves with larger ones, such that only one is required for successful feed and bleed.	This SAMA candidate would increase the probability of a successful feed and bleed.	[2, Table 14]
FW-16	Perform surveillances on manual valves used for backup AFW pump suction.	This SAMA candidate would improve the success probability for providing an alternate water supply to the AFW pumps.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
Enhancements Related to Heating, Ventilation and Air Conditioning (HVAC)			
HV-01	Provide a redundant train or means of ventilation.	This SAMA candidate would provide either a redundant cooling train to the critical switchgear room or a cross-tie to the critical switchgear room from another cooling train.	[2, Table 14]
HV-02	Add a diesel building high temperature alarm or redundant louver and thermostat.	This SAMA candidate would improve the diagnosis of a loss of diesel building HVAC.	[2, Table 14]
HV-03	Stage backup fans in switchgear rooms.	This SAMA candidate would increase the availability of ventilation in the event of a loss of switchgear ventilation.	[2, Table 14]
HV-04	Add a switchgear room high temperature alarm.	This SAMA candidate would improve the diagnosis of a loss of switchgear HVAC.	[2, Table 14], [35, Table 5-5], [38, Table 5-5]
HV-05	Create ability to switch emergency feedwater room fan power supply to station batteries in an SBO.	This SAMA candidate would allow continued fan operation in an SBO.	[2, Table 14], [31, Table G-3]
HV-06	Provide procedural guidance for establishing an alternate means of room ventilation to the service water pump room.	This SAMA candidate would prevent the loss of one train of service water in the event of loss of one HVAC fan for the service water pump room.	[5]
Enhancements Related to Instrument Air and Nitrogen Supply			
IA-01	Provide cross-unit connection of uninterruptible compressed air supply (multi-unit).	This SAMA candidate would increase the ability to vent containment using the hardened vent.	[2, Table 14]
IA-02	Modify procedure to provide ability to align diesel power to more air compressors.	This SAMA candidate would increase the availability of instrument air after a LOOP.	[2, Table 14], [30, Table 5-5]
IA-03	Replace service and instrument air compressors with more reliable compressors that have self-contained air cooling by shaft-driven fans.	This SAMA candidate would eliminate the dependence of instrument air system on CCW and service water cooling.	[2, Table 14], [30, Table 5-5], [31, Table G-3]
IA-04	Install nitrogen bottles as backup gas supply for safety relief valves (SRVs).	This SAMA candidate would extend the SRV operation time.	[2, Table 14]
IA-05	Improve SRV and MSIV pneumatic components.	This SAMA candidate would improve the availability of SRVs and MSIVs.	[2, Table 14]

Table E.5-4: List of Initial SAMA Candidates (continued)

SAMA Candidate Identifier	SAMA Candidate Description	Derived Benefit	Source
Enhancements Related to Seismic Risk			
SR-01	Increase seismic ruggedness of plant components.	This SAMA candidate would increase the availability of necessary plant equipment during and after a seismic event.	[2, Table 14]
SR-02	Provide additional restraints for CO_2 tanks.	This SAMA candidate would increase the availability of fire protection given a seismic event.	[2, Table 14]
Other Enhancements			
OT-01	Install digital large break LOCA protection system.	This SAMA candidate would reduce the probability of a large break LOCA (a leak before break).	[2, Table 14], [30, Table 5-5], [35, Table 5-5], [38, Table 5-5]
OT-02	Enhance procedures to mitigate large break LOCA.	This SAMA candidate would reduce the consequences of a large break LOCA.	[2, Table 14]
OT-03	Install computer-aided instrumentation system to assist the operator in assessing post-accident plant status.	This SAMA candidate would improve the prevention of core melt sequences by making operator actions more reliable.	[2, Table 14]
OT-04	Improve maintenance procedures.	This SAMA candidate would improve the prevention of core melt sequences by increasing reliability of important equipment.	[2, Table 14]
OT-05	Increase training and operating experience feedback to improve operator response.	This SAMA candidate would improve the likelihood of success of operator actions taken in response to abnormal conditions.	[2, Table 14]
OT-06	Develop procedures for transportation and nearby facility accidents.	This SAMA candidate would reduce the consequences of transportation and nearby facility accidents.	[2, Table 14]
OT-07	Install secondary side guard pipes up to the MSIVs.	This SAMA candidate would prevent secondary side depressurization should a steam line break occur upstream of the MSIVs. This SAMA candidate would also guard against or prevent consequential multiple SGTRs following a main steam line break event.	[2, Table 14], [30, Table 5-5], [35, Table 5-5], [38, Table 5-5]

Table E.6-1: Qualitative Screening of SAMA Candidates

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to AC and DC Power			
AC/DC-01	Provide additional DC battery capacity.	Criterion F Considered for Further Evaluation	This SAMA candidate would provide DC power for extended periods of time during an SBO event to allow for a greater likelihood of recovery of either on-site or off-site power. Therefore, this SAMA candidate is considered for further evaluation.
AC/DC-02	Replace lead-acid batteries with fuel cells.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $2,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
AC/DC-03	Add a portable, diesel-driven battery charger to existing DC system.	Criterion F Considered for Further Evaluation	This SAMA candidate would provide DC power for extended periods of time during an SBO event to allow for a greater likelihood of recovery of either on-site or off-site power. Therefore, this SAMA candidate is considered for further evaluation.
AC/DC-04	Improve DC bus load shedding.	Criterion B Already Implemented	If power is lost to DC MCC 1 or DC MCC 2, selective battery load shedding is performed in accordance with Attachment 5 of DB-OP-02521. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-05	Provide DC bus cross-ties.	Criterion B Already Implemented	DC cross-ties already exist at Davis-Besse. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-06	Provide additional DC power to the 120/240V vital AC system.	Criterion E Subsumed	This SAMA candidate would provide DC power for extended periods of time during an SBO event to allow for a greater likelihood of recovery of either on-site or off-site power. This SAMA candidate will be subsumed in AC/DC-01.
AC/DC-07	Add an automatic feature to transfer the 120V vital AC buses from normal to standby power.	Criterion B Already Implemented	The Davis-Besse 120V vital AC is normally aligned to emergency power backed up by EDGs. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
AC/DC-08	Increase training on response to loss of 120V AC buses that cause inadvertent actuation signals.	Criterion D Very Low Benefit	Abnormal Procedure DB-OP-2532 addresses the loss of both AC and DC power to both the Non-Nuclear Instrumentation (NNI) and the ICS that are powered from uninterruptible AC instrumentation distribution panels YAU and YBU. It is judged that operator awareness to the required actions is well established.
AC/DC-09	Provide an additional diesel generator.	Criterion E Subsumed	Davis-Besse has an SBO diesel in addition to the two EDGs. A large contributor to loss of all diesel generators is operator failure to manually start the SBO diesel. Therefore, an additional EDG may be of low value, but for conservatism, this SAMA is subsumed in SAMA candidate AC/DC-14.
AC/DC-10	Revise procedure to allow bypass of diesel generator trips.	Criterion B Already Implemented	Procedure DB-OP-02043, "Emergency Diesel Generator 1 Alarm Panel 43 Annunciator," instructs operators to reset any protection relays, and clear and reset any alarms when the EDG is running in "Emergency Mode." Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-11	Improve 4.16kV bus cross-tie ability.	Criterion B Already Implemented	The 4.16 kV safety buses C1 and D1 can be cross tied in numerous ways. For example, Bus C1 can be powered from either 13.8 kV non-safety bus, the SBO diesel, EDG 1 or EDG2 and Bus D1. Bus D1 can similarly be supplied. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-12	Create AC power cross-tie capability with other unit (multi-unit site).	Criterion A Not Applicable	Davis-Besse is a single unit site. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
AC/DC-13	Install an additional, buried off-site power source.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require more than $25,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
AC/DC-14	Install a gas turbine generator.	Criterion F Considered for Further Evaluation	This SAMA candidate would increase the reliability of emergency power during a LOOP event by adding a diverse AC power source. Therefore, this SAMA candidate is considered for further evaluation.
AC/DC-15	Install tornado protection on gas turbine generator.	Criterion A Not Applicable	Davis-Besse does not have a gas turbine. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
AC/DC-16	Improve uninterruptible power supplies.	Criterion D Very Low Benefit	Uninterruptible power supplies have been updated and have proven to be very reliable. Based on dominant cutsets and component importance values, UPS failure is not a significant risk contributor at Davis-Besse.
AC/DC-17	Create a cross-tie for diesel fuel oil (multi-unit site).	Criterion A Not Applicable	Davis-Besse is not a multi-unit site. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
AC/DC-18	Develop procedures for replenishing diesel fuel oil to the emergency and SBO diesel generators.	Criterion B Already Implemented	Davis-Besse procedures provide adequate guidance to replenish SBO diesel fuel oil during a LOOP event. A more beneficial SAMA candidate is to increase the size of the SBO day tank. This is described in SAMA candidate AC/DC-27. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-19	Use fire water system as a backup source for diesel cooling.	Criterion F Considered for Further Evaluation	Davis-Besse has the capability to use fire water to cool the Train 2 ECCs pumps (including makeup pump) and the Train 2 decay heat removal heat exchanger. By providing the ability to supply the Train 2 EDG, this alignment could also operate in LOOP conditions.
AC/DC-20	Add a new backup source of diesel generator cooling.	Criterion E Subsumed	Davis-Besse has the capability to use fire water to cool the Train 2 ECCs pumps (including makeup pump) and the Train 2 decay heat removal heat exchanger. By providing the ability to supply the Train 2 EDG, this alignment could also operate in LOOP conditions. This SAMA candidate will be subsumed in SAMA candidate AC/DC-19.
AC/DC-21	Develop procedures to repair or replace failed 4kV breakers.	Criterion F Considered for Further Evaluation	By pre-staging safety-related breakers and developing procedures to replace failed breakers, many components/buses could be restored in a timely manner if they have failed due to breaker failure. Therefore, this SAMA candidate is considered for further evaluation.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
AC/DC-22	In training, emphasize steps in recovery of off-site power after an SBO.	Criterion B Already Implemented	On loss of power to the startup transformers, the procedure directs the operators to inform the System Dispatcher all necessary steps were taken to restore power to the startup transformers. This occurs whether or not an SBO occurs. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-23	Develop a severe weather conditions procedure.	Criterion B Already Implemented	Procedure RA-EP-02810, "Tornado," is initiated whenever a tornado watch or warning has been issued. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AC/DC-24	Bury off-site power lines.	Criterion C Excessive Implementation Cost	In order to realize a significant benefit from this SAMA, the length of power lines buried must be significant. The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require more than $25,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
AC/DC-25	Provide a dedicated DC power system (battery/battery charger) for TDAFW control valve and NNI-X for SG level indication.	Criterion F Considered for Further Evaluation	For SBO scenarios, this SAMA increases the time available before manual control of the TDAFW pumps would be required. Therefore, this SAMA candidate is considered for further evaluation.
AC/DC-26	Provide an alternator/generator that would be driven by each TDAFW pump.	Criterion F Considered for Further Evaluation	For SBO scenarios, this SAMA candidate would eliminate the need to assume manual control of the TDAFW pumps. Therefore, this SAMA candidate is considered for further evaluation.
AC/DC-27	Increase the size of the SBO fuel oil tank.	Criterion F Considered for Further Evaluation	This SAMA candidate would extend the time before the SBO fuel tank would require filling, thereby increasing the reliability of the SBO diesel and offering more time for recovery of either off-site power or the EDGs. Therefore, this SAMA candidate is considered for further evaluation.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to ATWS Events			
AT-01	Add an independent boron injection system.	Criterion D Very Low Benefit	Based on the top 100 cutsets and the component importance measures, loss of emergency boration is not a significant risk contributor at Davis-Besse.
AT-02	Add a system of relief valves to prevent equipment damage from pressure spikes during an ATWS.	Criterion D Very Low Benefit	Based on the top 100 cutsets and the component importance measures, inadequate pressure relief during an ATWS event is not a significant risk contributor at Davis-Besse.
AT-03	Provide an additional control system for rod insertion (e.g., AMSAC).	Criterion B Already Implemented	Davis-Besse has an equivalent system - the Diverse Scram System. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AT-04	Install an ATWS-sized filtered containment vent to remove decay heat.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Vermont Yankee was estimated by Entergy Nuclear to require more than $2,000,000 in 2007. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
AT-05	Revise procedure to bypass MSIV isolation in turbine trip ATWS scenarios.	Criterion B Already Implemented	Davis-Besse already has the ability and procedures in place to open the MSIV bypass valves, equalize pressure around the MSIVs and re-open the MSIVs. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
AT-06	Revise procedure to allow override of LPI during an ATWS event.	Criterion A Not Applicable	ATWS scenarios at Davis-Besse would not be mitigated by RCS depressurization and LPI. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
AT-07	Install motor generator set trip breakers in control room.	Criterion D Very Low Benefit	Based on the top 100 cutsets and component basic event importance, failure to trip the reactor is not significant risk contributor at Davis-Besse. Also, if the reactor power is not decreasing, procedures instruct the operators to first de-energize substations E2 and F2, and if necessary locally open reactor trip breakers in the Low Voltage Switchgear room.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
AT-08	Provide capability to remove power from the bus powering the control rods.	Criterion B Already Implemented	Davis-Besse procedures call for de-energizing 480 V substations E2 and F2 if reactor power is not decreasing. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
Enhancements Related to Containment Bypass			
CB-01	Install additional pressure or leak monitoring instruments for detection of ISLOCA.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $2,300,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CB-02	Add redundant and diverse limit switches to each CIV.	Criterion D Very Low Benefit	LERF results are dominated by containment bypass events such as SGTR and ISLOCA events. Containment isolation is not a significant contributor to LERF.
CB-03	Increase leak testing of valves in ISLOCA paths.	Criterion D Very Low Benefit	HPI and LPI injection check valves are leak tested per Appendix J. DHR suction lines are not tested, but rather than a leakage test, it is judged that continuously monitoring these valves at power would be preferable to leakage test. A SAMA candidate to continuously monitor the DHR suction valves is provided in SAMA candidate CB-21.
CB-04	Install self-actuating CIVs.	Criterion D Very Low Benefit	Important CIVs receive a close signal from the safety actuation system. Many are air-operated and fail in the closed position. It is judged that self-actuating valves would not provide any significant increase in the reliability of isolation.
CB-05	Locate DHR system inside containment.	Criterion C Excessive Implementation Cost	This would require relocating DHR pumps within the primary containment. These pumps would need to be protected from the hostile environment resulting from a significant LOCA. This would require extensive modifications within the primary containment, which are judged to be excessive in cost.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CB-06	Ensure ISLOCA releases are scrubbed. One method is to plug drains in potential break areas so that break point will be covered with water.	Criterion D Very Low Benefit	This SAMA candidate would have very little benefit. It is likely that the break would be well above floor drain level. Therefore, a significant height of water would be required before any scrubbing took place. At these levels, the water level would likely have undesirable effects such as threatening mitigating equipment due to flooding.
CB-07	Revise EOPs to improve ISLOCA identification.	Criterion B Already Implemented	Davis-Besse has in place procedures that take steps to identify any resulting leaks. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CB-08	Improve operator training on ISLOCA coping.	Criterion E Subsumed	This SAMA would reduce the risk of ISLOCA events by improving the likelihood of timely identification and diagnosis of ISLOCA events and thereby increasing the likelihood of successful mitigating actions. This SAMA will be subsumed in CB-07.
CB-09	Institute a maintenance practice to perform a 100% inspection of steam generator tubes during each refueling outage.	Criterion D Very Low Benefit	Davis-Besse is scheduled to replace the steam generators in 2013, which would result in inspecting new steam generator tubes. Therefore, this SAMA candidate is considered very low benefit for Davis-Besse.
CB-10	Replace steam generators with a new design.	Criterion B Already Implemented	Davis-Besse is scheduled to replace the steam generators in 2013. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CB-11	Increase the pressure capacity of the secondary side so that a SGTR would not cause the relief valves to lift.	Criterion C Excessive Implementation Cost	Increasing the secondary side pressure capacity would potentially require significant design changes. Increasing atmospheric and safety valve setpoints would impact heat removal and AFW pump performance, and plant response to various transients. Pressure capacity of the steam generators and piping could not be increased without significant implementation cost. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CB-12	Install a redundant spray system to depressurize the primary system during a SGTR.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $5,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CB-13	Proceduralize use of pressurizer vent valves during SGTR sequences.	Criterion B Already Implemented	Davis-Besse has a procedure in place that directs the operator to use of the PORV or Pressurizer Vent Valve for large SGTR tube leaks. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CB-14	Provide improved instrumentation to detect SGTRs, such as Nitrogen-16 monitors.	Criterion B Already Implemented	Main steam lines include radiation monitors (RE600, RE609). Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CB-15	Route the discharge from the MSSVs through a structure where a water spray would condense the steam and remove most of the fission products.	Criterion C Excessive Implementation Cost	The cost of implementing this at Davis-Besse was estimated by FirstEnergy to require more than $8,500,000 in 2009. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CB-16	Install a highly reliable (closed loop) steam generator shell-side heat removal system that relies on natural circulation and stored water sources.	Criterion C Excessive Implementation Cost	The cost of implementing this at Davis-Besse was estimated by FirstEnergy to require more than $11,500,000 in 2009. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CB-17	Revise EOPs to direct isolation of a faulted steam generator.	Criterion B Already Implemented	The preferred method to respond to a SGTR at Davis-Besse is to cooldown to 500^{o}F using both steam generators, then isolate the affected steam generator and continue plant cooldown using the unaffected steam generator. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CB-18	Direct steam generator flooding after a SGTR, prior to core damage.	Criterion D Very Low Benefit	Flooding the SG prior to core damage could impact efforts to mitigate the SGTR. For example, flooding may present a risk to the operation of the TDAFW pumps by risking steam generator overfill.
CB-19	Vent MSSVs in containment.	Criterion D Very Low Benefit	This SAMA candidate would result in plant decay heat being deposited into primary containment, resulting in a harsh environment. The possible advantages for SGTR will be offset by the negative impacts for other events where secondary steam is deposited into containment with intact steam generators.
CB-20	Install relief valves in the CCW system.	Criterion D Very Low Benefit	Based on the top 100 cutsets and component basic event importance, ISLOCA in the CCW is not significant risk contributor at Davis-Besse.
CB-21	Install pressure measurements between the two DHR suction valves in the line from the RCS hot leg.	Criterion F Considered for Further Evaluation	This would provide operators with indication of failure of inboard isolation valves and provide them time to initiate mitigating actions to prevent an ISLOCA through these valves. Therefore, this SAMA candidate is considered for further evaluation.
Enhancements Related to Core Cooling Systems			
CC-01	Install an independent active or passive HPI system.	Criterion F Considered for Further Evaluation	This SAMA would increase the reliability of HPI for smaller break LOCA scenarios. Therefore, this SAMA candidate is considered for further evaluation.
CC-02	Provide an additional HPI pump with independent diesel generator.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $5,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CC-03	Revise procedure to allow operators to inhibit automatic vessel depressurization in non-ATWS scenarios.	Criterion A Not Applicable	Davis-Besse does not have an automatic vessel depressurization system. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CC-04	Add a diverse LPI system.	Criterion F Considered for Further Evaluation	Examination of dominant cutsets and component basic event importance shows the failure of LPI pumps to have moderate risk significance at Davis-Besse. This SAMA candidate would improve the reliability of the LPI/DHR system. Therefore, this SAMA candidate is considered for further evaluation.
CC-05	Provide capability for alternate LPI via diesel-driven fire pump.	Criterion F Considered for Further Evaluation	This SAMA would initiate LPI during an SBO event. Therefore, this SAMA candidate is considered for further evaluation.
CC-06	Improve ECCS suction strainers.	Criterion B Already Implemented	ECCS suction strainers have been replaced at Davis-Besse. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CC-07	Add the ability to manually align ECCS recirculation.	Criterion B Already Implemented	Davis-Besse manually aligns ECCS to the recirculation mode after the BWST inventory has been exhausted. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CC-08	Add the ability to automatically align ECCS to recirculation mode upon BWST depletion.	Criterion E Subsumed	Davis-Besse currently has the ability to initiate automatic switchover from the BWST to the containment sump on low BWST level, but this feature has been deactivated. The cost would by minor to reactivate this feature. This SAMA candidate will be subsumed in SAMA candidate CC-19.
CC-09	Provide hardware and procedure to refill the BWST once it reaches a specified low level.	Criterion B Already Implemented	Davis-Besse has the ability to refill the BWST using the Clean Waste Receiver Tank (CWRT). The CWRT contains borated water. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CC-10	Provide an in-containment reactor water storage tank.	Criterion C Excessive Implementation Cost	This SAMA candidate is intended to increase reliability by eliminating the need to switch from the BWST to the containment sump. Implementing major modifications inside containment is estimated to require excessive implementation costs. A SAMA candidate to implement the automatic switchover from the BWST to the containment sump is considered a much more cost-effective way to address this issue.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CC-11	Modify procedures to throttle LPI pumps earlier in medium or large break LOCAs to maintain BWST inventory.	Criterion D Very Low Benefit	Davis-Besse Operators are prohibited from throttling LPI pumps earlier in medium or large break LOCAs to maintain BWST inventory. If BWST flow was throttled down to reduce flowrate, the additional time gained is approximately 20 minutes, which, from a PRA perspective, is of low benefit for a LOCA condition.
CC-12	Emphasize timely recirculation alignment in operator training.	Criterion B Already Implemented	Alignment to ECCS containment recirculation is a critical action in response to a LOCA event. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CC-13	Upgrade the chemical and volume control system to mitigate small break LOCAs.	Criterion D Very Low Benefit	The make-up system can be used to provide make-up to the RCS in the event of a small LOCA. Because of the separate HPI and make-up systems, the plant has essentially four separate systems capable of injecting from the BWST into the RCS at high pressure. This was identified as a unique safety feature in the IPE.
CC-14	Change the in-containment reactor water storage tank suction from four check valves to two check and two air-operated valves.	Criterion A Not Applicable	Davis-Besse does not have an in-containment reactor water storage tank. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
CC-15	Replace two of the four electric safety injection pumps with diesel-powered pumps.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $2,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CC-16	Provide capability for remote, manual operation of secondary side pilot-operated relief valves in an SBO.	Criterion B Already Implemented	Davis-Besse procedure includes operator action to provide manual control of atmospheric vent valves. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CC-17	Create a reactor coolant depressurization system.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $4,600,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CC-18	Make hardware and procedure changes to allow RCS depressurization.	Criterion B Already Implemented	There currently exist several ways to depressurizing the RCS. The one uses the normal pressurizer spray, and two methods use the vent path. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CC-19	Provide automatic switchover of HPI and LPI suction from the BWST to containment sump for LOCAs.	Criterion F Considered for Further Evaluation	Davis-Besse currently has the ability to initiate automatic switchover from the BWST to the containment sump on low BWST level, but this feature has been deactivated. The cost would by minor to reactivate this feature. Therefore, this SAMA candidate is considered for further evaluation.
CC-20	Modify hardware and procedures to allow using the make-up pumps for high pressure recirculation from the containment sump.	Criterion C Excessive Implementation Cost	The cost of implementing this at Davis-Besse was estimated by FirstEnergy to require more than $10,000,000 in 2009. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CC-21	Reduce the BWST level at which switchover to containment recirculation is initiated.	Criterion D Very Low Benefit	Reducing the level at which switchover occurs (nine feet) would not significantly extend the time to switchover, and would increase the probability of pump failure due to loss of suction head. Davis-Besse has installed more accurate BWST level instrumentation which allows reaching a lower level prior to switchover to recirculation.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to Containment Phenomena			
CP-01	Create a reactor cavity flooding system.	Criterion B Already Implemented	The capability exists to dump BWST water into the containment. Severe Accident Management Guidelines (SAMGs) describes the strategy for performing, including several methods to move the contents of the BWST into the containment. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CP-02	Install a passive containment spray system.	Criterion C Excessive Implementation Cost	Installing a passive containment system is considered prohibitively expensive. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-03	Use the fire water system as a backup source for the containment spray system.	Criterion D Very Low Benefit	Davis-Besse has a very large dry containment. Containment over-pressurization is not a significant risk contributor.
CP-04	Install an unfiltered, hardened containment vent.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $3,100,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-05	Install a filtered containment vent to remove decay heat. Option 1: Gravel Bed Filter Option 2: Multiple Venturi Scrubber	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $5,700,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CP-06	Enhance fire protection system hardware and procedures.	Criterion D Very Low Benefit	This SAMA candidate addresses the scrubbing of radioactive releases into certain areas by actuating the fire protection system. Although some scrubbing benefits might be realized, this SAMA candidate presents the risk of impacting required equipment by spray or flooding. This could only be performed with fire protection systems that could be remotely actuated. If the temperature in certain areas became high enough, some existing fire protection systems may automatically actuate.
CP-07	Provide post-accident containment inerting capability.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $10,900,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-08	Create a large concrete crucible with heat removal potential to contain molten core debris.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $108,000,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-09	Create a core melt source reduction system.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at J.A. Fitzpatrick was estimated to cost more than $5,000,000. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-10	Strengthen primary/secondary containment (e.g., add ribbing to containment shell).	Criterion C Excessive Implementation Cost	Significant modifications to the primary/secondary containment, if possible, are considered prohibitively expensive. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CP-11	Increase depth of the concrete base mat or use an alternate concrete material to ensure melt-through does not occur.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Vermont Yankee was estimated by Entergy Nuclear to require more than $5,000,000 in 2007. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-12	Provide a reactor vessel exterior cooling system.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $2,500,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-13	Construct a building to be connected to primary/secondary containment and maintained at a vacuum.	Criterion C Excessive Implementation Cost	Construction of a building connected to the primary/secondary containment, if possible, is considered to be prohibitively expensive. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-14	Institute simulator training for severe accident scenarios.	Criterion B Already Implemented	Davis-Besse currently does not have severe accidents modeled on the plant simulator. Training on severe accidents is accomplished by other means, such as table-top exercises, computer-based training and in Emergency Response Organization training. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CP-15	Improve leak detection procedures.	Criterion B Already Implemented	Davis-Besse has a Reactor Coolant System Integrated Leakage Program. Davis-Besse also has a Containment Leak Detection System and associated procedures. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CP-16	Delay containment spray actuation after a large break LOCA.	Criterion D Very Low Benefit	The delay time that could be realized if containment spray was delayed would be less than 10 minutes. This SAMA candidate is considered to be of very low benefit.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CP-17	Install automatic containment spray pump header throttle valves.	Criterion D Very Low Benefit	The capability already exists at Davis-Besse to throttle containment spray after the switchover to the sump. The delay time that could be realized if containment spray was throttled would be less than 10 minutes. This SAMA candidate is considered to be of very low benefit.
CP-18	Install a redundant containment spray system.	Criterion C Excessive Implementation Cost	Significant modifications to the containment, if possible, are considered prohibitively expensive. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CP-19	Install a redundant containment fan system.	Criterion D Very Low Benefit	Based on component basic event importance, containment fan coolers are not significant risk contributors at Davis-Besse. This SAMA candidate is considered to be very low benefit.
CP-20	Install or use an independent power supply to the hydrogen control system using either new batteries, a non-safety grade portable generator, existing station batteries, or existing AC/DC independent power supplies, such as the security system diesel generator.	Criterion D Very Low Benefit	Davis-Besse has a very large dry containment. Hydrogen burn does not present a significant risk. This SAMA candidate is considered to be very low benefit.
CP-21	Install a passive hydrogen control system.	Criterion D Very Low Benefit	LERF is dominated by containment bypass events such as SGTR and ISLOCA. Failure of containment is not a significant contributor to LERF. This SAMA candidate is considered to be very low benefit.
CP-22	Erect a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at high pressure.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Vermont Yankee was estimated by Entergy Nuclear to require more than $12,000,000 in 2007. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to Cooling Water			
CW-01	Add redundant DC control power for service water pumps.	Criterion D Very Low Benefit	Based on the top 100 cutsets and component basic event importance, the most risk significant impact from service water pumps is failure to run. This would likely not be impacted by DC power failure. Failure of DC power would impact much more than service water and improving the reliability of DC power to only service water would have very limited value.
CW-02	Replace ECCS pump motors with air-cooled motors.	Criterion B Already Implemented	The ECCS pump motors at Davis-Besse are air-cooled. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-03	Enhance procedural guidance for use of cross-tied component cooling or service water pumps.	Criterion B Already Implemented	Procedure DB-OP-02523, “Component Water System Malfunctions,” provides steps to cross connect CCW. For example, CCW Loop 1 can be cross connected to HPI Pump 2, LPI Pump 2 and CTMT Hydrogen Analyzer 2. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-04	Add a redundant service water pump.	Criterion D Very Low Benefit	Davis-Besse has three service water pumps. In addition, the normally running cooling tower makeup pump is the preferred supply of service water following loss of service water.
CW-05	Enhance the screen wash system.	Criterion D Very Low Benefit	The Davis-Besse water supply from Lake Erie travels through a long canal before reaching the intake structure. There is a screen at the intake from Lake Erie. The long distance traveled through the canal results in a significant fraction of material passing through the initial screen settling out prior to reaching the intake structure.
CW-06	Cap downstream piping of normally closed CCW drain and vent valves.	Criterion D Very Low Benefit	Loss of CCW through drain and vent lines is not considered to be a significant contributor to loss of CCW. These lines are small, and any leakage would likely be low.
CW-07	Enhance loss of CCW (or loss of service water) procedures to facilitate stopping the RCPs.	Criterion B Already Implemented	Procedure DB-OP-02511, “Loss of Service Water Pumps/System” and procedure DP-OP-02523, “Component Cooling Water System Malfunctions,” call for tripping all RCPs when specific conditions are met. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CW-08	Enhance loss of CCW procedure to underscore the desirability of cooling down the RCS prior to seal LOCA.	Criterion D Very Low Benefit	Seal LOCA is not a concern at Davis-Besse if the RCPs are tripped. On loss of CCW, the makeup pumps can continue operation for at least one hour. Therefore, if operators trip the RCPs within one hour of loss of CCW, an RCP seal LOCA is not a risk concern.
CW-09	Additional training on loss of CCW.	Criterion D Very Low Benefit	Seal LOCA is not a concern at Davis-Besse if the RCPs are tripped. On loss of CCW, the makeup pumps can continue operation for at least one hour. Therefore, if operators trip the RCPs within one hour of loss of CCW, an RCP seal LOCA is not a risk concern.
CW-10	Provide hardware connections to allow another essential raw cooling water system to cool charging pump seals.	Criterion B Already Implemented	Davis-Besse has the capability to provide cooling to Train 2 ECCS components (including makeup pumps) and Train 2 decay heat coolers. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-11	On loss of essential raw cooling water, proceduralize shedding CCW loads to extend the CCW heat-up time.	Criterion B Already Implemented	Significant CCW loads are shed if CCW temperature limits are reached. Letdown flow is reduced on high letdown temperature. RCPs are tripped on high temperature. If an SFAS signal is generated, numerous non-essential CCW loads will be automatically isolated. If required, LPI and HPI pumps can operate for up to one hour without CCW cooling. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-12	Increase charging pump lube oil capacity.	Criterion D Very Low Benefit	Davis-Besse makeup pumps can operate for at least one hour on loss of CCW.
CW-13	Install an independent RCP seal injection system, with dedicated diesel generator.	Criterion C Excessive Implementation Cost	Davis-Besse estimated the cost for a major safety-related modification with calculation support and procedure changes with engineering support and testing or training required to be $1,500,000. Once cost of the equipment is included in the implementation cost, it will exceed the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CW-14	Install an independent RCP seal injection system, without dedicated diesel generator.	Criterion C Excessive Implementation Cost	Davis-Besse estimated the cost for a major safety-related modification with calculation support and procedure changes with engineering support and testing or training required to be $1,500,000. Once cost of the equipment is included in the implementation cost, it will exceed the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CW-15	Use existing hydro test pump for RCP seal injection.	Criterion D Very Low Benefit	Seal LOCA is not a concern at Davis-Besse if the RCPs are tripped. On loss of CCW, the makeup pumps can continue operation for at least one hour. Therefore, if operators trip the RCPs within one hour of loss of CCW, an RCP seal LOCA is not a risk concern.
CW-16	Install improved RCP seals.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Arkansas Nuclear One Unit 2 was estimated by Entergy Operations to require $2,500,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CW-17	Install an additional CCW pump.	Criterion C Excessive Implementation Cost	Davis-Besse estimated installing a diverse CCW pump for $7,500,000 in 2009. This cost estimate bounds this SAMA candidate. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CW-18	Prevent make-up pump flow diversion through the relief valves.	Criterion D Very Low Benefit	The make-up system is continuously operating. Malfunctions of relief valves would be immediately detected during operation and corrected.
CW-19	Change procedures to isolate RCP seal return flow on loss of CCW, and provide (or enhance) guidance on loss of injection during seal LOCA.	Criterion B Already Implemented	Procedure DB-OP-025 15, “Reactor Coolant Pump and Motor Abnormal Operation,” instructs the operators to isolate the seal return line if various conditions are present. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
CW-20	Implement procedures to stagger high pressure safety injection pump use after a loss of service water.	Criterion B Already Implemented	Procedure DB-OP-02523 provides caution that HPI, LPI, and makeup pumps can be operated for one hour without CCW cooling. Operators are aware of limited running time of pumps without cooling water. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-21	Use fire prevention system pumps as a backup RCP seal injection and high pressure make-up source.	Criterion B Already Implemented	The fire protection system is not a high pressure system capable of providing seal injection. Davis-Besse has the capability to provide cooling to Train 2 ECCS components (including makeup pumps) and Train 2 decay heat coolers. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-22	Implement procedure and hardware modifications to allow manual alignment of the fire water system to the CCW system.	Criterion B Already Implemented	Davis-Besse has the capability to align fire protection water to cool the Train 2 ECCS pumps and decay heat removal heat exchanger. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-23	Install a CCW header cross-tie.	Criterion B Already Implemented	Davis-Besse has the ability to align the standby CCW pump at either Train 1 or Train 2. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
CW-24	Replace the standby CCW pump with a pump diverse from the other two CCW pumps.	Criterion C Excessive Implementation Cost	The cost of implementing this at Davis-Besse was estimated by FirstEnergy to require more than $7,500,000 in 2009. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
CW-25	Provide the ability to cool make-up pumps using fire water in the event of loss of CCW.	Criterion B Already Implemented	Davis-Besse has the capability to align fire protection water to cool Train 2 Makeup pump. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to Internal Flooding			
FL-01	Improve inspection of rubber expansion joints on main condenser.	Criterion D Very Low Benefit	Based on the top 100 cutsets and component basic event importance, circulating water breaks are not a significant risk contributor at Davis-Besse.
FL-02	Modify swing direction of doors separating turbine building basement from areas containing safeguards equipment.	Criterion B Already Implemented	In defense against steam line breaks in the turbine building doors from the turbine building to areas containing safety equipment open such that they seal against the frame during steam line breaks. This configuration will also provide resistance to flood propagation from the turbine building to areas with safety related equipment. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
Enhancements Related to Fire Risk			
FR-01	Replace mercury switches in fire protection system.	Criterion D Very Low Benefit	Inadvertent actuation of fire protection water is not considered risk significant and currently not modeled in the PRA. Any fire protection system water should be handled by existing drains and is not considered a significant flooding threat.
FR-02	Upgrade fire compartment barriers.	Criterion D Very Low Benefit	The Davis-Besse IPEEE did not identify any weakness in the fire barrier performance.
FR-03	Install additional transfer and isolation switches.	Criterion D Very Low Benefit	Currently isolation switches exist for a control evacuation. Some manual actions beyond operation of isolation switches are required (e.g., plugging connectors, removing/inserting fuse blocks). Adding additional transfer/isolation switches is not considered to be of significant benefit.
FR-04	Enhance fire brigade awareness.	Criterion D Very Low Benefit	The Davis-Besse IPEEE did not identify any weakness in fire brigade performance.
FR-05	Enhance control of combustibles and ignition sources.	Criterion D Very Low Benefit	The Davis-Besse IPEEE did not identify any weakness in the combustible control program.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to Feedwater and Condensate			
FW-01	Install a digital feedwater upgrade.	Criterion B Already Implemented	Although Davis-Besse currently does not have a digital feedwater control system, it is planning to install one. This need not be considered further.
FW-02	Create ability for emergency connection of existing or new water sources to feedwater and condensate systems.	Criterion B Already Implemented	The fire water system can be used a backup to the AFW pump suction. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
FW-03	Install an independent diesel for the CST make-up pumps.	Criterion D Very Low Benefit	Davis-Besse has the capability of replenishing the CST using fire protection water. This can be done even on loss of AC power. Adding diesel for condensate makeup pumps would not add much benefit.
FW-04	Add a MDFP.	Criterion B Already Implemented	The MDFP can supply steam generator following loss of MFW the TDAFW pumps. The MDFP can be supplied by either EDG in the event of a LOOP. In addition, the startup feed pump can be used to supply the steam generators in the loss of all AFW. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
FW-05	Install manual isolation valves around the TDAFW pump steam admission valves.	Criterion D Very Low Benefit	The purpose of the SAMA candidate was to reduce dual turbine-driven pump maintenance unavailability. Although manual isolation valves do not exist, Davis-Besse has valves within the steam lines that allow isolation of one TDAFW pump for maintenance while leaving the second TDAFW pump available.
FW-06	Install accumulators for TDAFW pump flow control valves.	Criterion A Not Applicable	Davis-Besse TDAFW pump flow control valves are solenoid-operated flow control valves that would not benefit from the use of an accumulator. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
FW-07	Install a new CST (AFW storage tank).	Criterion D Very Low Benefit	Based on the top 100 cutsets and component basic event importance, failure of the CST or lack of condensate storage capacity is not significant risk contributor at Davis-Besse

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
FW-08	Modify the TDAFW pump to be self-cooled.	Criterion B Already Implemented	The TDAFW pumps are self-cooled, with service water cooling available as a backup. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
FW-09	Proceduralize local manual operation of AFW system when control power path is lost.	Criterion B Already Implemented	Procedure DB-OP-02521 addresses manual control of AFW in the event of loss of AC and DC power. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
FW-10	Provide hookup for portable diesel generators to power the TDAFW pump after station batteries are depleted.	Criterion B Already Implemented	A portable generator is placed on the turbine deck and cables are run to provide power for steam generator level information. The TDAFW pump is then run manually at the pump. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
FW-11	Use fire water system as a backup for steam generator inventory.	Criterion B Already Implemented	Davis-Besse has the ability to align fire protection water to the AFW system. In addition, service water will automatically be aligned to the AFW system on low system pressure. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
FW-12	Change failure position of condenser make-up valve if the condenser make-up valve fails open on loss of air or power.	Criterion D Very Low Benefit	On loss of air or electric power, several components required for secondary heat removal would be lost, therefore the state of the condenser make-up valve is not relevant.
FW-13	Provide a passive, secondary-side heat-rejection loop consisting of a condenser and heat sink.	Criterion C Excessive Implementation Cost	The cost of implementing a similar SAMA candidate at Shearon Harris was estimated by Carolina Power & Light Company to require $1,700,000 in 2005. The cost associated with the implementation of this SAMA candidate exceeds the attainable benefit for all SAMA candidates. Therefore, this SAMA candidate is not considered cost beneficial to implement at Davis-Besse.
FW-14	Modify the startup feedwater pump so that it can be used as a backup to the AFW system, including during an SBO.	Criterion B Already Implemented	The startup feed pump can be used to supply the steam generators in the loss of all AFW. The startup feed pump can be supplied by emergency AC from the EDGs or the SBO diesel generator using bus ties. Therefore, this SAMA candidate is already implemented.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
FW-15	Replace existing pilot-operated relief valves with larger ones, such that only one is required for successful feed and bleed.	Criterion D Very Low Benefit	Failure of the PORV to open only shows up in the Level 1 importance with a RRW of 1.006 (cutoff 1.005). It does not show up in the top cutsets or the LERF importance list. Therefore, it is judged to be very low benefit.
FW-16	Perform surveillances on manual valves used for backup AFW pump suction.	Criterion B Already Implemented	These valves are cycled, cleaned and lubricated annually. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
Enhancements Related to Heating, Ventilation and Air Conditioning (HVAC)			
HV-01	Provide a redundant train or means of ventilation.	Criterion F Considered for Further Evaluation	Loss of switchgear ventilation is a risk significant contributor for Davis-Besse. Therefore, this SAMA candidate is considered for further evaluation.
HV-02	Add a diesel building high temperature alarm or redundant louver and thermostat.	Criterion B Already Implemented	Davis-Besse has a diesel building high temperature alarm installed. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
HV-03	Stage backup fans in switchgear rooms.	Criterion F Considered for Further Evaluation	Loss of switchgear ventilation is a risk significant contributor for Davis-Besse. Therefore, this SAMA candidate is considered for further evaluation.
HV-04	Add a switchgear room high temperature alarm.	Criterion D Very Low Benefit	The high voltage switchgear rooms do not require forced ventilation. Low voltage switchgear rooms require forced ventilation. Operators monitor the temperature of the low voltage switchgear rooms during their plant tours. Loss of ventilation to the low voltage switchgear is shown to not be risk significant.
HV-05	Create ability to switch emergency feedwater room fan power supply to station batteries in an SBO.	Criterion D Very Low Benefit	Loss of ventilation to AFW is not a risk significant contributor at Davis-Besse.
HV-06	Provide procedural guidance for establishing an alternate means of room ventilation to the service water pump room.	Criterion D Very Low Benefit	Service Water ventilation includes four 50% fans. Loss of service water ventilation is not a significant risk contributor at Davis-Besse.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
Enhancements Related to Instrument Air and Nitrogen Supply			
IA-01	Provide cross-unit connection of uninterruptible compressed air supply (multi-unit).	Criterion A Not Applicable	Davis-Besse is a single unit site. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
IA-02	Modify procedure to provide ability to align diesel power to more air compressors.	Criterion D Very Low Benefit	Service Air and Instrument Air are not significant risk contributors based on top cutsets and risk importance measures.
IA-03	Replace service and instrument air compressors with more reliable compressors that have self-contained air cooling by shaft-driven fans.	Criterion D Very Low Benefit	Service Air and Instrument Air are not significant risk contributors based on top cutsets and risk importance measures.
IA-04	Install nitrogen bottles as backup gas supply for PORV.	Criterion A Not Applicable	The PORVs at Davis-Besse are electric powered. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
IA-05	Improve PORVs pneumatic components.	Criterion A Not Applicable	The PORVs at Davis-Besse are electric powered. Therefore, the intent of the SAMA candidate is not applicable to Davis-Besse.
Enhancements Related to Seismic Risk			
SR-01	Increase seismic ruggedness of plant components.	Criterion D Very Low Benefit	The Seismic Qualifications Utility Group (SQUG) previously identified the need for additional seismic restraints in the plant. These restraints have already been added.
SR-02	Provide additional restraints for CO_2 tanks.	Criterion D Very Low Benefit	The CO_2 tanks are located outdoors. These tanks supply only the turbine generator. No other components are protected with CO_2. A seismic failure of the CO_2 tanks has minimal risk.
Other Enhancements			
OT-01	Install digital large break LOCA protection system.	Criterion D Very Low Benefit	Large break LOCA is not a significant risk contributor (0.2% CDF). Davis-Besse has a Containment Leakage Detection System (FLUS) to identify leaks from vessel penetrations and nozzles.

Table E.6-1: Qualitative Screening of SAMA Candidates (continued)

SAMA ID	Modification (Potential Enhancement)	Screening Criteria	Basis for Screening/Modification Enhancements
OT-02	Enhance procedures to mitigate large break LOCA.	Criterion B Already Implemented	Large break LOCAs must be mitigated by automatic actions. Also, review of the top cutsets and component basic event importance verified that a large break LOCA is not a significant risk contributor at Davis-Besse. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
OT-03	Install computer-aided instrumentation system to assist the operator in assessing post-accident plant status.	Criterion B Already Implemented	The Davis-Besse computer system includes a Safety Parameter and Display System (SPDS) and a Post Accident Monitoring System (PAMS). Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
OT-04	Improve maintenance procedures.	Criterion D Very Low Benefit	Davis-Besse has a qualified Maintenance Rule program in place. No deficiencies in maintenance practices have been identified.
OT-05	Increase training and operating experience feedback to improve operator response.	Criterion D Very Low Benefit	No deficiencies in operator training or feedback are identified.
OT-06	Develop procedures for transportation and nearby facility accidents.	Criterion B Already Implemented	Davis-Besse already has procedures to respond to off-site events such as chemical and oil spills or other events that could impact the station or personnel. Therefore, the intent of the SAMA candidate has already been implemented at Davis-Besse.
OT-07	Install secondary side guard pipes up to the MSIVs.	Criterion D Very Low Benefit	Steam line breaks are not a significant contributor to LERF. The derived benefit would not justify the implementation cost required.

Table E.7-1: Summary of PRA Cases

Case #	Description	Model Approach	Enhanced Internal Events CDF (1/yr)
AC/DC-01	Provide additional DC battery capacity.	The off-site power non-recovery probabilities were recalculated based on seven hours of battery life.	9.4E-06
AC/DC-03	Add a portable, diesel-driven battery charger to existing DC system.	Removed the station batteries' dependence on charging to prevent the batteries from being depleted.	7.8E-06
AC/DC-14	Install a gas turbine generator.	Made the SBO diesel generator and corresponding HRA events perfectly reliable.	9.0E-06
AC/DC-19	Use fire water system as a backup source for diesel cooling.	Each EDG was modeled independent of cooling from the CCW system.	9.8E-06
AC/DC-21	Develop procedures to repair or replace failed 4kV breakers.	All 4kV breakers were made perfectly reliable.	9.7E-06
AC/DC-25	Provide a dedicated DC power system (battery/battery charger) for TDAFW control.	Made the TDAFW system independent of the station DC power.	8.5E-06
AC/DC-26	Provide an alternator/generator that would be driven by each TDAFW pump to provide DC control power.	Made the TDAFW system independent of the station DC power.	8.5E-06
AC/DC-27	Increase the size of the SBO fuel oil tank.	Operator actions to refuel the tank were made perfectly reliable.	1.0E-05
CB-21	Install pressure measurements between the two DHR suction valves in the line from the RCS hot leg.	Removed all latent failures of the upstream DHR suction valve.	1.0E-05
CC-01	Install an independent active or passive HPI system.	Made one train of HPI perfectly reliable.	1.0E-05
CC-04	Add a diverse LPI system.	Made one train of LPI perfectly reliable.	1.0E-05
CC-05	Provide capability for alternate LPI via diesel-driven fire pump.	Made one train of LPI perfectly reliable and independent of AC/DC power.	1.0E-05
CC-19	Provide automatic switchover of HPI and LPI suction from the BWST to containment sump for LOCAs.	HRA events for switchover were made perfectly reliable.	9.9E-06

Table E.7-1: Summary of PRA Cases (continued)

Case #	Description	Model Approach	Enhanced Internal Events CDF (1/yr)
HV-01	Provide a redundant train or means of ventilation.	Low voltage switchgear room ventilation was made perfectly reliable.	1.0E-05
HV-03	Stage backup fans in switchgear rooms.	Low voltage switchgear room ventilation was made perfectly reliable.	1.0E-05

Table E.7-2: Internal Events Benefit Results for Analysis Cases

Case	AC/DC-01 (DCBattery)	AC/DC-03 (Battery Charger)	AC/DC-14 (GasTurbineGen)	AC/DC-19 (FireWaterBackup)	AC/DC-21 (RepairBreakers)
Off-site Annual Dose (rem)	2.0E+00	1.8E+00	1.8E+00	2.0E+00	2.0E+00
Off-site Annual Property Loss ($)	$1,588	$1,430	$1,464	$1,591	$1,593
Comparison CDF[4]	1.0E-05	1.0E-05	1.0E-05	1.0E-05	1.0E-05
Comparison Dose (rem)	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00
Comparison Cost ($)	$1,600	$1,600	$1,600	$1,600	$1,600
Enhanced CDF	9.4E-06	7.8E-06	9.0E-06	9.8E-06	9.7E-06
Reduction in CDF	**6.00%**	**22.00%**	**10.00%**	**2.00%**	**3.00%**
Reduction in Off-site Dose	**0.00%**	**10.00%**	**10.00%**	**0.00%**	**0.00%**
Immediate Dose Savings (On-site)	$49	$178	$81	$16	$24
Long Term Dose Savings (On-site)	$212	$777	$353	$71	$106
Total Accident Related Occupational Exposure **(AOE)**	$260	$955	$434	$87	$130
Cleanup/Decontamination Savings (On-site)	$7,942	$29,120	$13,236	$2,647	$3,971
Replacement Power Savings (On-site)	$8,035	$29,462	$13,392	$2,678	$4,018
Averted Costs of On-site Property Damage **(AOSC)**	$15,977	$58,581	$26,628	$5,326	$7,988
Total On-site Benefit	**$16,237**	**$59,536**	**$27,062**	**$5,412**	**$8,119**
Averted Public Exposure **(APE)**	$0	$4,908	$4,908	$0	$0
Averted Off-site Damage Savings **(AOC)**	$147	$2,086	$1,669	$110	$86
Total Off-site Benefit	**$147**	**$6,994**	**$6,577**	**$110**	**$86**
Total Benefit (On-site + Off-site)	**$16,384**	**$66,530**	**$33,639**	**$5,523**	**$8,204**

[4] The sum of the Containment Systems State frequencies calculated by the Level 2 PRA model is slightly different than the CDF calculated by the Level 1 PRA due to the delete term approximation and the additional systems included in the Level 2 models.

Table E.7-2: Internal Events Benefit Results for Analysis Cases (continued)

Case	AC/DC-25 (DedDCPower)	AC/DC-26 (Generator_TDAFW)	AC/DC-27 (SBO_DieselTank)	CB-21 (DHR_valves)	CC-01 (HPI_System)
Off-site Annual Dose (rem)	2.0E+00	2.0E+00	2.0E+00	1.8E+00	2.0E+00
Off-site Annual Property Loss ($)	$1,579	$1,579	$1,600	$1,516	$1,589
Comparison CDF[4]	1.0E-05	1.0E-05	1.0E-05	1.0E-05	1.0E-05
Comparison Dose (rem)	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00
Comparison Cost ($)	$1,600	$1,600	$1,600	$1,600	$1,600
Enhanced CDF	8.5E-06	8.5E-06	1.0E-05	1.0E-05	1.0E-05
Reduction in CDF	**15.00%**	**15.00%**	**0.00%**	**0.00%**	**0.00%**
Reduction in Off-site Dose	**0.00%**	**0.00%**	**0.00%**	**10.00%**	**0.00%**
Immediate Dose Savings (On-site)	$121	$121	$0	$0	$0
Long Term Dose Savings (On-site)	$529	$529	$0	$0	$0
Total Accident Related Occupational Exposure **(AOE)**	$651	$651	$0	$0	$0
Cleanup/Decontamination Savings (On-site)	$19,854	$19,854	$0	$0	$0
Replacement Power Savings (On-site)	$20,088	$20,088	$0	$0	$0
Averted Costs of On-site Property Damage **(AOSC)**	$39,942	$39,942	$0	$0	$0
Total On-site Benefit	**$40,593**	**$40,593**	**$0**	**$0**	**$0**
Averted Public Exposure **(APE)**	$0	$0	$0	$4,908	$0
Averted Off-site Damage Savings **(AOC)**	$258	$258	$0	$1,031	$135
Total Off-site Benefit	**$258**	**$258**	**$0**	**$5,939**	**$135**
Total Benefit (On-site + Off-site)	**$40,850**	**$40,850**	**$0**	**$5,939**	**$135**

[4] The sum of the Containment Systems State frequencies calculated by the Level 2 PRA model is slightly different than the CDF calculated by the Level 1 PRA due to the delete term approximation and the additional systems included in the Level 2 models.

Table E.7-2: Internal Events Benefit Results for Analysis Cases (continued)

Case	CC-04 (LPI_pump)	CC-05 (LPI_Diesel_pump)	CC-19 (BWST_to_Sump)	HV-01 (Redundant_HVAC)	HV-03 (Backup_fans)
Off-site Annual Dose (rem)	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00
Off-site Annual Property Loss ($)	$1,600	$1,600	$1,599	$1,599	$1,599
Comparison CDF[4]	1.0E-05	1.0E-05	1.0E-05	1.0E-05	1.0E-05
Comparison Dose (rem)	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00
Comparison Cost ($)	$1,600	$1,600	$1,600	$1,600	$1,600
Enhanced CDF	1.0E-05	1.0E-05	9.9E-06	1.0E-05	1.0E-05
Reduction in CDF	**0.00%**	**0.00%**	**1.00%**	**0.00%**	**0.00%**
Reduction in Off-site Dose	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**
Immediate Dose Savings (On-site)	$0	$0	$8	$0	$0
Long Term Dose Savings (On-site)	$0	$0	$35	$0	$0
Total Accident Related Occupational Exposure **(AOE)**	$0	$0	$43	$0	$0
Cleanup/Decontamination Savings (On-site)	$0	$0	$1,324	$0	$0
Replacement Power Savings (On-site)	$0	$0	$1,339	$0	$0
Averted Costs of On-site Property Damage **(AOSC)**	$0	$0	$2,663	$0	$0
Total On-site Benefit	**$0**	**$0**	**$2,706**	**$0**	**$0**
Averted Public Exposure **(APE)**	$0	$0	$0	$0	$0
Averted Off-site Damage Savings **(AOC)**	$0	$0	$12	$12	$12
Total Off-site Benefit	**$0**	**$0**	**$12**	**$12**	**$12**
Total Benefit (On-site + Off-site)	**$0**	**$0**	**$2,718**	**$12**	**$12**

[4] The sum of the Containment Systems State frequencies calculated by the Level 2 PRA model is slightly different than the CDF calculated by the Level 1 PRA due to the delete term approximation and the additional systems included in the Level 2 models.

Table E.7-3: Total Benefit Results for Analysis Cases

	AC/DC-01 (DCBattery)	AC/DC-03 (Battery Charger)	AC/DC-14 (GasTurbineGen)	AC/DC-19 (FireWaterBackup)	AC/DC-21 (RepairBreakers)	AC/DC-25 (DedDCPower)	AC/DC-26 (Generator_TDAFW)
Internal Events	$16,384	$66,530	$33,639	$5,523	$8,204	$40,850	$40,850
Fires, Seismic, Other	$49,153	$199,590	$100,916	$16,568	$24,613	$122,551	$122,551
Total Benefit	$65,537	$266,120	$134,554	$22,091	$32,818	$163,402	$163,402

	AC/DC-27 (SBO_DieselTank)	CB-21 (DHR_valves)	CC-01 (HPI_System)	CC-04 (LPI_pump)	CC-05 (LPI_Dieselpump)	CC-19 (BWST_to_Sump)	HV-01 (Redundant_HVAC)
Internal Events	$0	$5,939	$135	$0	$0	$2,718	$12
Fires, Seismic, Other	$0	$17,819	$405	$0	$0	$8,155	$37
Total Benefit	$0	$23,755	$540	$0	$0	$10,874	$49

	HV-03 (Backup_fans)
Internal Events	$12
Fires, Seismic, Other	$37
Total Benefit	$49

Table E.7-4: Implementation Cost Estimates

SAMA Candidate ID	Potential Enhancement	Cost Estimate
AC/DC-01	Provide additional DC battery capacity.	$1,750,000
AC/DC-03	Add a portable, diesel-driven battery charger to existing DC system.	$330,000
AC/DC-14	Install a gas turbine generator.	$2,000,000
AC/DC-19	Use fire water system as a backup source for diesel cooling.	$700,000
AC/DC-21	Develop procedures to repair or replace failed 4kV breakers.	$100,000
AC/DC-25	Provide a dedicated DC power system (battery/battery charger) for the TDAFW control valve and NNI-X for steam generator level indication.	$2,000,000
AC/DC-26	Provide an alternator/generator that would be driven by each TDAFW pump.	$2,000,000
AC/DC-27	Increase the size of the SBO fuel oil tank.	$550,000
CB-21	Install pressure measurements between the two DHR suction valves in the line from the RCS hot leg.	$550,000
CC-01	Install an independent active or passive HPI system.	$6,500,000
CC-04	Add a diverse LPI system.	$5,500,000
CC-05	Provide capability for alternate LPI via diesel-driven fire pump.	$6,500,000
CC-19	Provide automatic switchover of HPI and LPI suction from the BWST to containment sump for LOCAs.	$1,500,000
HV-01	Provide a redundant train or means of ventilation.	$50,000
HV-03	Stage backup fans in switchgear rooms.	$400,000

Table E.7-5: Final Results of Cost-Benefit Evaluation

SAMA Candidate ID	Modification	Estimated Benefit	2009 Estimate Cost	Conclusion
AC/DC-01	Provide additional DC battery capacity.	$65,537	$1,750,000	Not Cost Effective
AC/DC-03	Add a portable, diesel-driven battery charger to existing DC system.	$266,120	$330,000	Not Cost Effective
AC/DC-14	Install a gas turbine generator.	$134,554	$2,000,000	Not Cost Effective
AC/DC-19	Use fire water system as a backup source for diesel cooling.	$22,091	$700,000	Not Cost Effective
AC/DC-21	Develop procedures to repair or replace failed 4kV breakers.	$32,818	$100,000	Not Cost Effective
AC/DC-25	Provide a dedicated DC power system (battery/battery charger) for the TDAFW control valve and NNI-X for steam generator level indication.	$163,402	$2,000,000	Not Cost Effective
AC/DC-26	Provide an alternator/generator that would be driven by each TDAFW pump.	$163,402	$2,000,000	Not Cost Effective
AC/DC-27	Increase the size of the SBO fuel oil tank.	$0	$550,000	Not Cost Effective
CB-21	Install pressure measurements between the two DHR suction valves in the line from the RCS hot leg.	$23,755	$550,000	Not Cost Effective
CC-01	Install an independent active or passive HPI system.	$540	$6,500,000	Not Cost Effective
CC-04	Add a diverse LPI system.	$0	$5,500,000	Not Cost Effective
CC-05	Provide capability for alternate LPI via diesel-driven fire pump.	$0	$6,500,000	Not Cost Effective
CC-19	Provide automatic switchover of HPI and LPI suction from the BWST to containment sump for LOCAs.	$10,874	$1,500,000	Not Cost Effective
HV-01	Provide a redundant train or means of ventilation.	$49	$50,000	Not Cost Effective
HV-03	Stage backup fans in switchgear rooms.	$49	$400,000	Not Cost Effective

Table E.8-1: Final Results of the Sensitivity Cases

SAMA Candidate ID	Repair Case	Low Discount Rate Case	High Discount Rate Case	On-site Dose Case	On-site Cleanup Case	Replacement Power Case	Multiplier Case	2009 Estimated Cost	Conclusion
AC/DC-01	$39,825	$98,897	$44,950	$66,591	$76,126	$87,110	$98,306	$1,750,000	Not Cost Effective
AC/DC-03	$171,842	$402,477	$184,578	$269,984	$304,946	$345,221	$399,180	$330,000	Cost Effective
AC/DC-14	$91,701	$203,926	$94,302	$136,310	$152,203	$170,509	$201,831	$2,000,000	Not Cost Effective
AC/DC-19	$13,521	$33,344	$15,171	$22,442	$25,621	$29,282	$33,137	$700,000	Not Cost Effective
AC/DC-21	$19,962	$49,524	$22,513	$33,345	$38,112	$43,604	$49,227	$100,000	Not Cost Effective
AC/DC-25	$99,122	$246,559	$112,037	$166,036	$189,874	$217,334	$245,103	$2,000,000	Not Cost Effective
AC/DC-26	$99,122	$246,559	$112,037	$166,306	$189,874	$217,334	$245,103	$2,000,000	Not Cost Effective
AC/DC-27	$0	$0	$0	$0	$0	$0	$0	$550,000	Not Cost Effective
CB-21	$23,755	$36,674	$18,183	$23,755	$23,755	$23,755	$35,632	$550,000	Not Cost Effective
CC-01	$540	$833	$413	$540	$540	$540	$810	$6,500,000	Not Cost Effective
CC-04	$0	$0	$0	$0	$0	$0	$0	$5,500,000	Not Cost Effective
CC-05	$0	$0	$0	$0	$0	$0	$0	$6,500,000	Not Cost Effective
CC-19	$6,588	$16,407	$7,454	$11,049	$12,639	$14,469	$16,311	$1,5000,000	Not Cost Effective
HV-01	$49	$76	$38	$49	$49	$49	$74	$50,000	Not Cost Effective
HV-03	$49	$76	$38	$49	$49	$49	$74	$400,000	Not Cost Effective

Table E.8-1: Final Results of the Sensitivity Cases (continued)

SAMA Candidate ID	Evacuation Speed	Off-site Economic Cost	2009 Estimated Cost	Conclusion
AC/DC-01	$67,501	$85,169	$1,750,000	Not Cost Effective
AC/DC-03	$268,083	$285,752	$330,000	Cost Effective
AC/DC-14	$136,517	$154,186	$2,000,000	Not Cost Effective
AC/DC-19	$24,054	$41,723	$700,000	Not Cost Effective
AC/DC-21	$34,781	$52,450	$100,000	Not Cost Effective
AC/DC-25	$165,365	$183,034	$2,000,000	Not Cost Effective
AC/DC-26	$165,365	$183,034	$2,000,000	Not Cost Effective
AC/DC-27	$1,963	$19,632	$550,000	Not Cost Effective
CB-21	$25,718	$43,387	$550,000	Not Cost Effective
CC-01	$2,503	$20,172	$6,500,000	Not Cost Effective
CC-04	$1,963	$19,632	$5,500,000	Not Cost Effective
CC-05	$1,963	$19,632	$6,500,000	Not Cost Effective
CC-19	$12,837	$30,506	$1,5000,000	Not Cost Effective
HV-01	$2,012	$19,681	$50,000	Not Cost Effective
HV-03	$2,012	$19,681	$400,000	Not Cost Effective

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