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September 8, 1986

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Administrative Judge

In the Matter of	)	
	)	
TOLEDO EDISON COMPANY, et al.	)	Docket No. 50-346-ML
	)	
(Davis-Besse Nuclear Power Station, Unit No. 1)	)	

LICENSEE'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW IN THE FORM OF AN INITIAL DECISION

In accordance with the Presiding Officer's instruction (Tr. 959 and Order dated August 11, 1986), Licensee submits the following proposed findings of fact and conclusions of law. These findings are presented in the form of an initial decision.

Respectfully submitted,

SHAW, PITTMAN, POTTS & TROWBRIDGE

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Counsel for The Toledo Edison Company

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Helen F. Hoyt
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INITIAL DECISION ON THE DISPOSAL OF WASTE AT DAVIS-BESSE

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I. INTRODUCTION

A. Nature of the Proceeding

1. This Initial Decision involves the authority granted to The Toledo Edison Company (hereinafter "Licensee") to dispose of water treatment sludge and secondary-side demineralizer resins at the site of the Davis-Besse Nuclear Station. The Davis-Besse Nuclear Station is located at Locust Point, Ohio, on the shore of Lake Erie, approximately 25 miles east of Toledo. The waste is material produced by the operation of the Davis-Besse plant and contains very low levels of radioactivity.

2. Licensee's application for authority to dispose of the waste at the Davis-Besse site was filed on July 14, 1983, in accordance with 10 C.F.R. § 20.302(a) and I&E Information Notice No. 83-05 (February 24, 1983). On October 15, 1985, the Nuclear Regulatory Commission approved the request and issued an environmental assessment containing a finding of no significant impact. 50 Fed. Reg. 41,265 (1985).

3. Subsequent to this approval, several individuals and organizations requested a hearing. On February 20, 1986, the Commission instituted a proceeding upon these requests. Commission Order (February 20, 1986). Since the proceeding involved a materials license, the Commission chose to employ informal procedures, in accordance with its decision in Kerr-McGee Corp. (West Chicago Rare Earths Facility), CLI-82-2, 15 N.R.C. 232 (1982),

aff'd, City of West Chicago v. NRC, 701 F.2d 632 (7th Cir. 1983). The Commission further stated that a petitioner's right to intervene would be governed by existing NRC precedents governing standing.

4. On February 25, 1986, the Chief Administrative Judge of the Atomic Safety and Licensing Board Panel appointed the Presiding Officer to conduct the informal proceeding. On March 10, 1986, the Presiding Officer published an order which provided notice of the proceeding, provided interested persons an opportunity to intervene, and set forth pleading requirements. 51 Fed. Reg. 8,920 (1986).

B. Identification of the Parties

5. Eight petitions for intervention were filed. Four of the petitioners lacked standing. The other four were admitted as parties to the proceeding. These were: the State of Ohio (hereinafter "the State"); Toledo Coalition for Safe Energy and Susan A. Carter (hereinafter "TCSE"); Western Reserve Alliance (hereinafter "WRA"); and Save Our State From Nuclear Waste, Consumers League of Ohio, Arnold Gleisser, and Genevieve S. Cook (hereinafter "SOS/CLO"). Memorandum and Order (May 29, 1986), printed in 51 Fed. Reg. 20,562 (1986).1/

1/ In addition to the petitions, a number of individuals, organizations, and municipalities submitted letters and resolutions expressing their views. These submittals, which neither requested intervention nor conformed to acceptable standards of pleading, were accepted as limited appearance statements.

C. Procedural Posture of the Case

6. The petitions of the four intervenors contained a number of allegations. Not all of these allegations were relevant. The jurisdiction of the Nuclear Regulatory Commission extends only to two ultimate issues: (1) whether the waste disposal poses an acceptable radiological risk; and (2) whether the requirements of the National Environmental Policy Act have been met. Thus, for example, the State's allegations that Ohio regulatory requirements had to be met were not considered further in this proceeding.2/

7. Based on the allegations in the petitions, the Presiding Officer's Memorandum and Order of May 29, 1986, designated twenty factual issues for litigation. 51 Fed. Reg. at 20,563. These issues are set forth below. The May 29, 1986 Memorandum and Order required that the parties submit prefiled written testimony.3/ Id. at 20,564.

2/ Licensee's testimony in this proceeding clearly indicates that it intends to apply to the State for a Permit To Install. Compliance with state requirements is appropriately left for that forum. Southern California Edison Co. (San Onofre Nuclear Generating Station, Units 2 and 3), ALAB-189, 7 A.E.C. 410 (1974).

3/ The submission of prefiled testimony was originally scheduled for June 19, 1986, but because of a strike at the Davis-Besse Station, was rescheduled for July 21, 1986. Order (July 10, 1986).

8. Testimony was prefiled by Licensee, the State, and SOS/CLO. Only Licensee submitted testimony addressing all of the issues designated for hearing. TCSE and WRA submitted no testimony. Hearings were held in Sandusky, Ohio on August 5-7, 1986. Limited appearance sessions were also held. At the close of the record, the parties were directed to file proposed findings. Tr. 959.

9. Based on consideration of the proposed findings submitted by the parties and of the entire record in this matter, the Presiding Officer makes the findings of fact and conclusions of law below. Any proposed finding of fact or conclusion of law submitted by a party that is not incorporated directly or inferentially in this Decision is rejected as unsupported in law or fact or as unnecessary to the rendering of the Decision.

II. Findings of Fact on Individual Issues

A. Background

10. The Davis-Besse nuclear plant is a pressurized water reactor (PWR). A PWR has two principal systems, which are physical separated: the primary system and the secondary system. The physical separation between these systems provides a barrier for the control of the radioactive material. The secondary system remains essentially non-radioactive. Licensee's Testimony on the Burial of Very Low Level Waste at Davis-Besse ("Lic. Testimony"), ff. Tr. 31, at 11-12 (Briden).

11. The Davis-Besse Station has its own water supply treatment facility. The water supply treatment facility purifies water from Lake Erie both for use in plant systems, including the secondary system, and for personal use. In the water treatment facility, Lake Erie water is chlorinated. Lime for softening and sodium aluminate for clarification are added. Suspended solids, hardness, and other impurities precipitate out. The precipitate is removed, producing sludge,4/ which is discharged to a settling basin. Id. at 10-11, 95 (Briden).

12. The water in the secondary side of the plant is further purified by demineralization. Demineralization occurs in the Condensate Demineralizer System. In the Condensate Demineralizer System, powdered ion-exchange resins remove impurities. Id. at 12-13 (Briden).

13. While the secondary system is separated from the radioactive primary system, primary to secondary system leakage can occur through the steam generator tubes. In March, 1981, Davis-Besse experienced its first (and to date only) steam generator tube leak. Prior to this event, there had been no primary-to-secondary leakage, and the secondary side of the plant

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4/ Sludge by definition is a suspension of solids in water. The sludge discharged from the water treatment is about 1.5 percent solids. After settlement, the sludge accumulated at the bottom of the basin is about 20% solids. Tr. 618-20 (Bennett). See Lic. Testimony, Table 17-1 at 1.

had been uncontaminated. After the leak, the plant was shut down and the leak repaired. During the leak clean-up period, the secondary-side clean-up resins contained levels of radioactive material that required offsite disposal as a radioactive waste. Since then, very low levels of radioactive contaminants have continued to accumulate on the Condensate Demineralizer resins. Much of this radioactive material is residual radioactivity introduced into the secondary system during the tube leak. Id. at 13-14 (Briden).

14. The volume of resins injected into the Condensate Demineralizer system is small, and the resins are therefore replaced weekly. The resins are transferred from the Condensate Demineralizer vessel to the Condensate Demineralizer Backwash Receiving Tank. Id. at 14 (Briden). Each batch of secondary-side resin is dewatered, sampled, and analyzed by gamma spectroscopy for radioactive material prior to being discharged to the settling basin. The level of activity of each radionuclide detected is quantified. Id. at 15 (Briden); Tr. 619 (Briden). If the resins satisfy predetermined criteria (discussed in Findings 113-15 below), they are transferred as a slurry from the Condensate Demineralizer Backwash Receiving Tank to the same settling basin that receives sludge from the water treatment facility. Lic. Testimony at 14 (Briden); Tr. 156-57 (Briden). If the radionuclide concentrations are higher than acceptable, the resins are not sent to the settling basin, but

are treated as radioactive waste and processed for offsite disposal. Lic. Testimony at 15, 72 (Briden).

15. The sludge and resins that are discharged to the settling pond settle out immediately. Over time, this material has accumulated in the basin. Tr. at 157-59 (Briden). This accumulation of resins and sludge is the material to be disposed of at the Davis-Besse site.

B. The Presiding Officer's Questions.

1. Location of the Burial Site

16. The Presiding Officer's first question asked "What location on the Davis-Besse Site has been selected for waste burial?" The question was answered by Licensee's witness, Mr. Theo S. Swim, the Civil/Structural Engineering Manager for the Davis-Besse Nuclear Station. The State's witnesses offered no testimony on this question. Mr. Bimber, the witness for SOS/CLO, had testimony under the heading of question 1, but it was irrelevant. Testimony of R.M. Bimber ("Bimber"), ff. Tr. 459, at 2.5/

17. According to Licensee's uncontradicted testimony, the burial ground will be located in the south central portion of the

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5/ The gist of Mr. Bimber's testimony was that the level of radioactivity in the waste is too high for on-site disposal (and so presumably no location should be selected). As discussed below at Finding 120, Mr. Bimber's testimony provided no basis to dispute the dose estimates presented by Licensee's witnesses.

Davis-Besse site, approximately 2000 feet south of the switchyard and approximately 1200 feet east of State Route 2. The location is contingent on Licensee obtaining a Permit to Install (PTI) from the State of Ohio. Lic. Testimony at 16 (Swim).

18. The location of the burial ground was chosen as an area that is unlikely to be disturbed by any future construction on the Davis-Besse site. The burial site will be a minimum of 100 yards from any frequently occupied area. In accordance with Ohio requirements, the site will be over 1000 feet from any water well (not counting Licensee's observation and monitoring wells), and will be located at least 200 feet from any stream or lake (including the drainage ditch to the east of the burial site). The burial ground will not be within a floodway.6/ In addition, the burial ground is situated in an area with favorable geologic conditions. Id. at 16-17 (Swim).

2. Dimensions of the Burial Site

19. The Presiding Officer's second question asked "What will be the dimensions of the burial site in its final configuration (after 30 years)?" This question was also answered by Licensee's witness, Mr. Swim. No contradictory testimony was presented by the other parties.

6/ A floodway is the channel of the water-course and those portions of the adjoining flood plains which are required to convey the regional 100 year flood. Ohio Admin. Code § 3745-27-01(F).

20. Licensee intends to empty the settling basin six times over the life of the plant. There would therefore be six lots of waste buried at the burial site. Each lot will be buried in a separately constructed square cell so as not to disturb previously buried lots. Id. at 18 (Swim).

21. To provide flood protection and to maintain a suitable distance between the waste and groundwater in the underlying bedrock aquifer (discussed below at Finding 56), Licensee intends to partially elevate the cells. The walls of the cells will be constructed to serve as dikes and will be rip-rapped. Licensee also plans to equip each cell with a four-foot thick liner. From bottom to top, the liner will be composed of a 2-1/2 foot thick layer of compacted clay, a synthetic impervious membrane, a one foot layer of graded gravel for leachate collection, and a six inch layer of compacted clay. Each cell will be capped with a two to four foot thick lower compacted-clay layer, a sand or gravel filter layer above the compacted clay, and an uppermost layer of topsoil. Id. at 18-19 (Swim); Tr. 250 (Swim).

22. The inner base of a typical single cell is approximately 45 feet x 45 feet, and is about 3 feet below land surface. From the base, the inner sides of the cells slope upward and outward at a 3:1 grade to the top of the surrounding dikes. The top of the cell (not including the cover) is approximately 98 feet x 98 feet, and is about 5-3/4 feet above land surface. From the

top of the cell, the dikes slope downward and outward at a 3:1 grade to land surface. From toe of dike to toe of dike, each cell is 162 by 162 feet. Lic. Testimony at 20 (Swim).

23. Some cells will adjoin others. Where a new cell is constructed adjoining a pre-existing cell, the adjoining cells will share the dike between them. Id. at 19 (Swim).

24. The first three cells will be adjoining, and will be constructed in the center of the burial site. The next two cells will adjoin each other and will be constructed to the west of the first three cells. These two cells will not be connected to the first three because transmission lines pass between the two- and three-cell units. The last cell will be constructed next to the northeast corner of the first three cells. Id.

25. Because adjoining cells are constructed to share the dike between them, the dimensions of the multicell units are not simple multiples of the dimensions of a single cell. Taking this into ccnsideration, the dimensions of the 3-cell unit will be approximately 395 feet by 162 feet, and the dimensions of the 2-cell unit will be approximately 278 feet by 162 feet. Id. at 21-22 (Swim).

3. The Navarre Marsh

26. Question 3 asked, "Is the waste burial site located within the bounds of the Navarre Marsh? Provide a description of the burial site relative to the Marsh." Licensee presented two witnesses who addressed this issue: Ms. Jennifer Scott-Wasilk, the Environmental and Emergency Preparedness Manager for the Davis-Besse Nuclear Station, and Dr. Charles E. Herdendorf, a Professor of Zoology, Geology and Natural Resources at the Ohio State University and Director for the Center for Lake Erie Area Research. Mr. John H. Marshall, an Environmental Program Coordinator for the Ohio Department of Natural Resources, testified for the State. With respect to this issue, there was no dispute.

27. Originally, the Navarre Marsh referred to the marshland within the Navarre tract. The Navarre tract was 524 acres that was at one time a private hunt club and was subsequently acquired by the U.S. Fish and Wildlife Service. Id. at 23 (Scott-Wasilk).

28. In 1968, Toledo Edison acquired the Navarre tract from the U.S. Fish and Wildlife Service in exchange for the Darby Marsh (a marsh about eight miles to the southeast). As part of this transaction, Toledo Edison leased back to the U.S. Fish and Wildlife Service 447 acres of the Navarre tract, and also leased to the U.S. Fish and Wildlife Service 135 acres north of the site. Toledo Edison further agreed to allow the U.S. Fish and

Wildlife Service to operate and control an additional 33 acres of the Navarre tract. Under these leases and agreements, the U.S. Fish and Wildlife Service now manages all the marshland in the Navarre tract. This marshland, plus the 135 acres north of the site, are now called the Navarre Marsh unit of the Ottawa National Wildlife Refuge. The closest approach of the dike around the cell nearest to the Navarre Marsh unit will be approximately 400 feet west of the Navarre Marsh unit. Id. at 23-24 (Wasilk).

29. All marshes are wetlands. The burial site itself is not wetland under any definition. The site is above the mean high water mark which the U.S. Army Corps of Engineers uses to demarcate wetlands, and it does not contain the prevalent growth of hydrophytes which typically defines a wetland. Id. at 24-28 (Herdendorf). Confirming Licensee's testimony, Mr. Marshall (the State's witness) testified that the burial site will clearly be outside the wetland area and that wetland acreage will not be lost. Tr. 756 (Marshall).

30. There is a patch of wetland between the burial site and the Navarre Marsh. At the closest point, this patch is 25 feet from the dike around the last burial cell that might be constructed and about 100 feet from the next nearest cell. Lic. Testimony at 28 (Herdendorf); Tr. 579 (Swim). This patch of marsh is not contiguous with the Navarre Marsh; it is separated from the Navarre Marsh by a drainage ditch and dike. Tr. 175

(Scott-Wasilk). The patch is an ephemeral, short-term marsh in a small depression. As the result of completion of the new dike along the Toussaint River, this patch of marsh will revert to an upland type area over the next year or so. Tr. 578 (Herdendorf; Scott-Wasilk).

4. Flooding

31. The Presiding Officer's fourth question asked, "What is the observed flooding frequency at the waste burial site?" This question was addressed by Dr. Herdendorf for the Licensee and by Mr. Donald Guy for the State. For the most part, and except as discussed below, the testimony of the two witnesses was consistent.

32. The static water levels in the western basin of Lake Erie are affected by long term and annual cyclic variations in the mean monthly level from the mean low water level, and short period variations in the daily level from the monthly mean level. Lic. Testimony at 29 (Herdendorf). Water level records for Lake Erie have been gathered since 1860. Current lake levels are measured by the National Oceanic and Atmospheric Administration at a number of gauges positioned around the lake. Id. at 30 (Herdendorf).

33. The Davis-Besse site is located approximately midway between two lake level gauges -- one at Toledo (at the far

western end of the lake) and the other at Marblehead. Lake levels are not uniform across the Lake, but exhibit lengthwise and transverse variations. The maximum lake levels are observed at the ends of the Lake, while the center of the Lake is a wind tide node (a point in the lake were no wind tide change in lake level occurs). The Davis-Besse site is located about 80% of the way from the wind tide node to Toledo, and wind tide variations (storm surges) are therefore about 80% of those recorded at Toledo. Id. at 30-31 (Herdendorf).

34. The general area around the burial site has been observed flooded, but specific hydrological records of such events have not been maintained. The frequency of flooding, however, can be estimated from water level records for Toledo. It is conservatively estimated that over the last 50 years there have been 25 storms which potentially could have flooded the burial site. The total duration of these potential flooding events was probably less than the equivalent of 12 days, or about 2.4 days every ten years. Id. at 31-33 (Herdendorf).7/

35. During cross-examination of Dr. Herdendorf, counsel for the State observed that most of the potential flooding events occurred over the last 15 years and suggested that only this period

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7/ The analysis that was performed addressed lake flooding. River flooding is insignificant in comparison, and there is no evidence of river flooding at the burial site. Tr. 217-18, 587 (Herdendorf).

should be considered in determining flooding frequency. Tr. 223-24. As Dr. Herdendorf indicated in reply, such an approach would be inappropriate. The increase in frequency over the last 15 years reflects the abnormally high water levels, which statistically one would expect to return to normal. Tr. 224-25, 236-37 (Herdendorf). The U.S. Corps of Engineers is predicting lower lake levels over the next six months. Tr. 225 (Herdendorf). While the Corps declines to predict long term trends, the State's own witness, Mr. Guy, testified that a spectral analysis of lake levels by Cohn and Robinson suggests that high lake levels will not persist. Direct Testimony of Donald E. Guy, Jr. ("Guy"), ff. Tr. 638, at 2. Thus, statistically, the full 50 year data base utilized by Dr. Herdendorf provides the best prediction.8/

36. While the analysis discussed above indicates that the burial site area may be subject to occasional floods, the cells themselves would not be flooded. The waste burial cells will be surrounded by dikes constructed to elevation 579.75 feet IGLD. This elevation is 3.7 feet above the estimated flood level of the highest storm on record, which occurred on April 8, 1974. Dr.

8/ It bears repeating that Licensee's analysis is conservative. See Tr. 596 (Herdendorf). The analysis identifies seven events over the last three years that were calculated as having the potential to flood the burial site. See Lic. Testimony, Table 4.1. In actuality, flooding during this period has only been observed on a couple of occasions and has been inconsequential. Tr. 595 (Scott-Wasilk).

Herdendorf's analysis of water level records determined that the greatest storm surge at Locust Point was approximately 4.2 feet above still-water level. If this maximum historical surge took place at the record still-water levels observed in June 1986, the water level at the burial site would still be nearly two feet below the top of the dike.9/ Lic. Testimony at 36 (Herdendorf).

37. Mr. Guy testified that Robinson and Cohn's spectral analysis of lake levels predicts that lake levels will rise to higher levels in the mid-1990s. Guy at 2. On cross-examination, Mr. Guy admitted that the lake level predicted by Robinson and Cohn for the mid-1990s is about 572 IGLD, which is lower than current lake levels. Tr. 781-82 (Guy). Mr. Guy also testified that there had been a setup of "about seven to eight feet" at the eastern end of Lake Erie and the "it is conceivable" that such a setup could occur at the western end. Tr. 674 (Guy). But he also testified that surges of this magnitude have not been observed at the western end of the lake, and that surges at the eastern end of the lake are typically greater than those that occur at the western end. Id.; Tr. 788-89 (Guy). The eastern end of the lake is funnel-shaped and focuses the water coming from the west into a much smaller area, thereby increasing the

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9/ Under Ohio regulations, even a hazardous waste facility may be located in a one-hundred-year floodplain provided the facility is designed, constructed, operated and maintained to prevent washout of the waste by a one-hundred-year flood. Ohio Admin. Code § 3745-54-18(B). See Tr. 593 (Hendron).

surge height. One therefore expects higher surges at the eastern end of the lake. Tr. 789 (Guy). Mr. Guy's testimony therefore provides no basis to predict a surge of 7-8 feet at the western end of Lake Erie.10/ Such a surge far exceeds the highest surge on record and is very unlikely. Tr. 222 (Herdendorf).

38. Finally, Mr. Guy referred to a storm surge of 9.3 feet, which Licensee had calculated during Davis-Besse licensing as the probable maximum meteorological event. Tr. 886 (Guy); Tr. 895 (Guy). This event is a design basis event for reactor licensing -- an event with a zero probability of being exceeded. Tr. 934 (Scott-Wasilk); Tr. 938 (Hendron). The event postulates winds of 70 miles per hour sustained for six hours and gusts of 100 miles per hour. Tr. 934 (Scott-Wasilk). Such conditions far exceed those that have been actually observed. Id. Mr. Guy recognized the Davis-Besse design meteorological event as a worst conceivable event, and he could assign no probability to it. Tr. 895-96 (Guy). For these reasons, the maximum meteorological event calculated for reactor licensing has no probative value to a prediction of flooding that could reasonably be expected at the burial site. In contrast, the U.S. Corps of Engineers predicts that the maximum 500 year flood (i.e. a flood expected to occur

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10/ Mr. Guy's testimony also ignores the fact that Locust Point is not at the very end of the Lake, and that surges at Locust Point are generally about 20% lower than those that occur at the western end (at Toledo). Compare Lic. Testimony at 30-31 (Herdendorf).

only once every 500 years) at Locust Point is 576.7 IGLD, more than three feet below the elevation of the dikes that will surround the burial site. Lic. Testimony at 37 (Herdendorf); Guy at 2.11/

5. Erosion

39. In question 5, the Presiding Officer asked, "What soil erosion from storms has been actually observed at or near the disposal site?" This issue was addressed by Dr. Herdendorf and Mr. Swim for Licensee, and by Mr. Guy for the State.

40. Based on his inspections of the burial site, Dr. Herdendorf found the land surface well-vegetated and found no surficial evidence of erosion. Lic. Testimony at 39 (Herdendorf); Tr. 242-44 (Herdendorf). Nor would erosion be expected to occur. Both Dr. Herdendorf and Mr. Guy testified that erosion along the Lake Erie shore generally does not occur in the absence of wave attack. Lic. Testimony at 38 (Herdendorf); Guy at 4; Tr. 751 (Guy). Erosion has typically occurred at bluff areas, which are undercut by wave action, and not in still-water areas. The burial site is inland. In a storm that could create flooding of the burial site, waves would be coming towards the

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11/ Mr. Guy gives the elevation of a 500 year flood using the U.S.G.S. datum. To convert elevations using the U.S.G.S. datum to elevations using the IGLD, 1.5 feet must be subtracted. Thus 578.2 feet U.S.G.S. coincides with 576.7 feet IGLD.

site from the northeast, and the marsh area and the outer marsh dikes would absorb the brunt of storm's waves.12/ Wave heights near the burial site would also be limited by the physical properties of waves. Since the still-water depth near the burial site would be small, even in a flooding situation, the wave height would also be small. Lic. Testimony at 37-38 (Herdendorf). Mr. Guy, the State's witness, admitted: "I would not expect a great deal of erosion of the surface soils. I think we're going to be dealing primarily with standing water." Tr. 751 (Guy). See also Tr. 599 (Herdendorf).

41. Moreover, Licensee's design of the burial cells includes measures to protect the cells from erosion. The waste burial cells will be surrounded and protected by dikes. To prevent erosion of the dikes, the slopes of the dikes will be rip-rapped. Furthermore, there will be either a small graded stone layer or filter cloth under the rip-rap. Grasses will be planted on top of the burial structure. The U.S. Soil Conservation Service13/ has recommended that Licensee use a mixture of Kentucky blue grass and Lidino white clover, and is preparing a protective vegetation design plan which Licensee intends to

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12/ The outer marsh dikes are armored, except where a strong barrier beach exists. Licensee is committed to maintaining the dikes and barrier beach. Tr. 587-88 (Herdendorf, Scott-Wasilk).

13/ The legislative mission of the U.S. Soil Conservation Service is to control erosion and provide technical assistance on the subject. Tr. 599 (Herdendorf).

follow. These measures are well recognized and should be highly effective. Lic. Testimony at 40-41 (Swim, Herdendorf).

42. Mr. Guy's testimony suggested that dikes may be destroyed, but it was unclear whether his concern was for the dikes along the Lake shore or the dikes around the burial cells. In either event, his concern is unfounded. His accounts of dikes being destroyed referred primarily to unarmored, earthen dikes. Tr. 785-87 (Guy). The dikes around the burial cells will be armored with rip-rap. Mr. Guy's testimony also pertained to dikes that were subject to wave attack. He was unable to refer to any catastropic failures of dikes in slack water areas. Tr. 800 (Guy). As he admitted, even in the event of a flood, the burial site would be a still water area. Tr. 751 (Guy).

43. If Mr. Guy's concern is in fact with the dikes along the Lake shore, his concern is irrelevant. Irrespective of the integrity of these Lake shore dikes (which Licensee has committed to maintain), waves in the vicinity of the burial site would be limited by the depth of the water. Since the depth of water at the burial site in the event of a flood would be shallow, large waves could not propagate. Lic. Testimony at 38 (Herdendorf).

44. Mr. Guy also referred to the wave height chosen by Licensee in conjunction with the probable maximum meteorological event used as a design basis for reactor licensing. Tr. 887 (Guy). For the reasons previously stated, this design basis

event is an extremely conservative value, reflects meterological conditions far exceeding those that have been observed, and represents a condition that has a zero probability of being exceeded. The wave height used in this design basis analysis for reactor licensing is therefore irrelevant to flooding events that might reasonably be expected to occur.

6. Groundwater

45. Question 6 asked, "What is the direction of groundwater flow from the burial site relating to Lake Erie, Navarre Marsh, and the Toussaint River?" This issue was addressed by Mr. David M. Hendron for Licensee, and by Mr. Richard R. Pavey and John Voytek for the State.

46. Licensee's witness, Mr. Hendron, is a geotechnical engineer. He holds a graduate degree, has twenty years' experience, and has been involved in numerous waste management projects. Lic. Testimony at 6 (Hendron). He is a principal and vice president of Woodward-Clyde Consultants, a firm that specializes in geotechnical engineering. Id. at 2 (Hendron). Mr. Hendron's education has included a substantial amount of course work in geology and hydrology. As a practicing geotechnical engineer, he has been involved in groundwater development studies and regional and local groundwater studies. Geology and hydrology are important aspects of his profession. Mr. Hendron also has geologists and hydrologists on his staff under his supervision and control.

Tr. 599-601 (Hendron); Tr. 285 (Hendron). Mr. Hendron and his firm have been directly involved in geological and hydrological work at Davis-Besse since 1968, and Woodward-Clyde geologists, hydrologists, and engineers have spent hundreds of hours studying the Davis-Besse site. Tr. 304, 908 (Hendron). For these reasons, Mr. Hendron is extremely well qualified to testify on matters pertaining to the geology and hydrology of the Davis-Besse site.

47. The State's witnesses were considerably less experienced. See Resume of J. Voytek, ff. Tr. 638; Resume of R. Pavey, ff. Tr. 638. Furthermore, neither Mr. Pavey nor Mr. Voytek had any personal knowledge of or familiarity with the Davis-Besse site. Mr. Pavey admitted that it is very important to know specific site data before drawing conclusions pertaining to a site, but apparently did little to obtain such data. Tr. 805 (Pavey). Mr. Pavey has only visited the site once for a short time (a short tour). Tr. 793, 801 (Pavey). He has never requested further opportunity to study the site. He has never observed any of the excavations at the site, or examined any of the cores that were taken. Tr. 801-02 (Pavey). Of the hundreds of logged penetrations at Davis-Besse (see Tr. 909), he has only examined the logs of about a half dozen borings. He has not read the FSAR or USAR reports on site geology. Tr. 804 (Pavey). Similarly, Mr. Voytek had no data specific to the Davis-Besse site on which to base his conclusions. Tr. 845 (Voytek).

48. Mr. Hendron testified that the geologic and hydrologic characteristics of the glacial deposits and bedrock were determined through extensive investigations and studies of the Davis-Besse site for the siting and licensing of Units 1, 2, and 3. During these studies, hundreds of borings, test pits, probes, pump tests, and other direct field tests were made throughout the site area (including the area being considered for the waste disposal site), and tens of thousands of man hours were expended to evaluate the data obtained. The studies included discussions with State geologists and a thorough review of the already available information. Lic. Testimony at 45 (Hendron).

49. The large body of data from the soils, geological, and hydrological work performed at the Davis-Besse site since 1968 were reanalyzed by Mr. Hendron in conjunction with the waste burial project. Tr. 304-06 (Hendron). These data include several hundred logged penetrations of the subsurface materials and hundreds of observations of water flow conditions in these deposits at all seasons of the year. Tr. 909 (Hendron). While these data were originally obtained in conjunction with construction of the Davis-Besse station, the data remain valid and are appropriate for evaluating the waste burial site. Tr. 607-08 (Hendron).

50. In addition, a study was recently undertaken within the boundaries of the site being considered for the land disposal

site. The investigations included five borings through the soil deposits, physical property testing of drive samples taken from the boreholes, and laboratory permeability testing of tube samples taken from the boreholes. Lic. Testimony at 45-46 (Hendron); Tr. 291 (Hendron). Mr. Hendron also examined an extensive excavation nearby the burial site and made direct visual observations of the characteristics of the subsurface deposits. Tr. 310, 607 (Hendron).

51. These numerous studies show that the site is underlain from the ground surface by two primary glacial soil deposits. These glacial soil deposits are about fifteen feet thick in the area of the burial site, and they overlie a relatively flat-lying dolomite bedrock formation. Lic. Testimony at 42 (Hendron).

52. The upper glacial soil deposit is a glaciolacustrine clay. The deposit consists of a relatively homogeneous plastic silty clay that contains minor amounts of silts and fine sands within the clay matrix. The topmost foot contains organic material and is referred to as topsoil within the area being considered for the land disposal site. The glaciolacustrine deposit is only partially saturated (i.e. the voids between the individual clay particles are only partially filled with water). Id. at 42-43 (Hendron).

53. The lower glacial soil deposit is a glacial till deposit. The deposit consists of a relatively homogeneous mixture of

moderately plastic clay, silt, sands, and gravels. The overall matrix of the deposit is controlled by the high clay-silt content. Within the area being considered for the waste disposal site, the glacial till deposit is also only partially saturated. Id. at 43 (Hendron).

54 The upper 15 to 20 feet of the dolomite bedrock formation is a relatively pure massive dolomite. This upper layer is underlain to depths of several tens of feet by a laminated dolomite formation that contains lenses of gypsum and anhydrite in addition to the dolomite. Id.

55. In an attempt to suggest that Licensee's characterization of the site geology was inadequate, Mr. Pavey testified that there could be as many as six distinct till deposits. Direct Testimony of Richard R. Pavey ("Pavey"), ff. Tr. 638, at 2. He admitted, however, that multiple tills do not occur everywhere, and that one finds six distinctly different till deposits only where the glacial deposits are sufficiently thick. Tr. 810-11 (Pavey). Multiple till deposits occur where successive glacial advances did not erode previously deposited tills. Tr. 811 (Pavey). The nearest site that Mr. Pavey had examined did not contain six distinct till deposits. Id. Mr. Pavey further admitted that one might find only one till deposit at the Davis-Besse site. Id. Mr. Hendron testified that the glacial deposits at Davis-Besse are not particularly thick, and based on specific

investigation only one till unit is evident. Tr. 908-10 (Hendron). For these reasons and because Mr. Pavey has no personal knowledge of the geology of the Davis-Besse site, Mr. Pavey's suggestion that there might be multiple till deposits must be rejected.

56. With respect to the site hydrology, Mr. Hendron testified that measurable groundwater flow in the area being considered for land disposal occurs only in the bedrock formation. The dolomite bedrock formation contains several systems of joints, fissures, and vugs. Weathering and solution have opened some of these systems. The dolomite formation is fully saturated and is relatively permeable (i.e. the formation can convey fluids in response to application of either a natural or man-made gradient) because of the higher permeability of the system of joints, fissures, and vugs. The dolomite formation is the uppermost regional groundwater aquifer underlying the Davis-Besse site. Lic. Testimony at 44 (Hendron).

57. The gradient of groundwater in the bedrock is extremely small (1 to 2 ft/mile). As a result, the rate of flow of groundwater through the bedrock aquifer is so small that it is difficult to measure, and the precise direction of groundwater flow beneath the burial site cannot be determined reliably. However, groundwater flow can be determined on a larger scale. On a regional basis, groundwater most probably discharges very slowly

into Lake Erie several miles offshore where the bedrock outcrops in the lake and to a smaller extent into the Toussaint River where bedrock is probably intermittently exposed by erosion of the overlying soil deposits by the river. One would expect the same flow to occur beneath the burial site. Id. at 46-47 (Hendron).

58. Groundwater probably flows through the bedrock beneath the burial site toward the Navarre Marsh, in response to a very low gradient directed towards Lake Erie. The glacial clay deposits, however, separate the marsh from the bedrock and prevent communication. Id. at 48 (Hendron).

59. The glacial soil deposits are only partially saturated and are highly clay rich. Consequently, these soils are highly impermeable (i.e. have a low hydraulic conductivity). Id. at 44 (Hendron). The permeability of the glaciolacustrine deposit is measured at less than 10^{-9} cm/sec and the permeability of the glacial till is measured at less than 10^{-7} cm/sec. Id. at 49.14/

14/ Licensee's measurement of the permeability of the glacial deposits was based on laboratory tests. Mr. Voytek suggested that laboratory tests may underestimate permeability by one to three orders of magnitude, and he referred to studies of landfills in other states. Direct Testimony of John Voytek, Jr. ("Voytek"), ff. Tr. 638, at 11, 13, and Attachments C-E. He acknowledged that he had no proof that laboratory tests necessarily underestimate permeability. Tr. 873 (Voytek). Furthermore, he testified that the laboratory samples that were found to be too low in the studies mentioned were apparently mixed in accordance with the practice of the 1970's, mixing together layers of

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The geologic studies conducted at Davis-Besse indicate that the glaciolacustrine deposit and the till deposit contain no systematic open joints, fissures, sand strata, or other non-uniformities that could serve as groundwater flowpaths. There is no present measurable groundwater flow that occurs horizontally or vertically through the soil deposits that overlie the bedrock. Id. at 44, 46 (Hendron).

60. In contrast, Mr Pavey testified that till units may contain coarse sand and gravel lenses that are highly permeable and that can serve as groundwater flow paths. Returning to his multiple till theory, Mr. Pavey suggested that Lake and river sediments might separate each till. Pavey at 2-4. He suggested that the till may contain open joints. Id. at 2. Mr. Pavey testified that the glaciolacustrine deposits "vary from nearly-impermeable clay to cobble deposits with pores big enough

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sand with layers of clay and producing false readings. Id. at 11-12 (Voytek); Tr. 874 (Voytek). Licensee performed its tests on intact, Shelby tube samples. Tr. 604-05 (Hendron). Furthermore, the glacial deposits at the site are homogeneous and sand lenses are very infrequent. Tr. 309-10, 912 (Hendron). Under these circumstances, laboratory tests should accurately reflect the overall permeability of the glacial deposits. One would expect no more than one order of magnitude variation, which Licensee has considered. Tr. 931 (Hendron). Licensee's measurement of the permeability of glacial deposits is also corroborated by other observations. The degree of oxidation in the glacial deposits and the lack of groundwater flow in excavations in the glacial deposits are both indicative of permeabilities of less than 10^{-7} cm/sec. Tr. 305-06, 316, 911-12, 918-19 (Hendron).

to thread a garden hose through them," and that these deposits might also contain permeable layers. Id. at 3-4. Mr. Voytek then hypothesized an upper "till aquifer" consisting of groundwater in such a system of lenses. Voytek at 5-6. He posited that groundwater in this upper aquifer (and any contaminants therein) would flow downward into the bedrock aquifer and laterally into Lake Erie, the Navarre Marsh, and the Toussaint. Voytek at 9-10.

61. Neither Mr. Pavey nor Mr. Voytek could support or confirm their hypotheses. On cross-examination, Mr. Pavey admitted that one might not find sand or gravel lenses in a till deposit. Tr. 813, 818 (Pavey). He admitted that cobbles might not exist in glaciolacustrine deposits. Tr. 819 (Pavey). He admitted that permeable layers do not occur in all glaciolacustrine deposits. Tr. 813, 820-21 (Pavey). Neither Mr. Pavey nor Mr. Voytek had any direct evidence pertaining to the Davis-Besse site.

62. The speculative hypotheses advanced by Mr. Pavey and Mr. Voytek were squarely addressed and rebutted by Licensee's factual testimony, which was based on the site-specific data from Licensee's geologic and hydrologic investigations. The extensive site exploration conducted by Licensee (hundreds of logged penetrations coupled with direct observations in excavations) revealed no evidence of more than one till deposit and no evidence of lake or river sediments separating tills. Tr. 909-10 (Hendron). The till is homogeneous and does not certain

permeable paths. Tr. 912 (Hendron). Sand strata are very infrequent and not systematic (i.e. are not pathways). Tr. 314-15 (Hendron). See, e.g., Tr. 310 (Hendron). Fissures or joints in the till are closely shut and similarly do not constitute groundwater pathways. Tr. 316, 336, 610, 612-13 (Hendron). Open joints have not been observed. Tr. 910 (Hendron).15/

63. The glaciolacustrine deposit has been tested for gradation. The gradation tests have shown that the glaciolacustrine deposit is fine-grained, containing silt and clay-sized particles -- not coarse material such as cobbles. Tr. 912-13 (Hendron). Interconnected layers in the glaciolacustrine deposit have not been found. Tr. 913-14 (Hendron). Sand lenses have been observed at the Davis-Besse site, but they are thin, very infrequent, are not interconnected, and do provide groundwater pathways. Tr. 914 (Hendron). Fissures in the glaciolacustrine deposit have been examined. They have been found to be very

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15/ Mr. Pavey suggested that lineaments marked on State's Exhibits E and F might indicate areas where collapse of the bedrock has fractured the till above, resulting in saturated strips. Tr. 694-95 (Pavey). Note that Mr. Pavey's speculative hypothesis that the dark areas represent saturated strips implies that the till is generally unsaturated. Mr. Pavey further testified that he thought he could discern a lineament in the burial site area. As indicated by the dashed line he drew on the exhibit, he was uncertain. Lineaments are not apparent in the burial site area. See State Exh. E & F; Tr. 326-31, 614-15 (Hendron). Nor do lineaments necessarily reflect saturated soil. See Tr. 331 (Hendron). Furthermore, in contrast to Mr. Pavey's speculations, Licensee has sampled and tested the till under the burial site and has determined that it is unsaturated. Lic. Testimony at 52 (Hendron); Tr. 302-03, 617 (Hendron).

tight and impermeable, and there is no indication of interconnection. Tr. 914 (Hendron).

64. Mr. Pavey suggested that perhaps Licensee's sampling method masked the existence of sand layers. Referring to logs of borings B-125 and B-130, he suggested that Licensee's samples were taken with an auger which chewed up and blended different materials. Pavey at 6. This suggestion was inaccurate. Logs of borings B-125 and B-130, attached to Mr. Pavey's testimony, state and show that split spoon samples were taken. This technique is an ASTM (American Society of Testing Materials) standard method and produces an intact sample suitable for determining the stratographic characteristics of the material tested. Tr. 294-295 (Hendron). The outer surface of such a sample is cut away to expose a fresh, unsmeared surface. Tr. 921 (Hendron). Split spoon samples were also taken in the fire borings at the burial site area. Shelby tube samples were taken for permeability testing. Lic. Testimony at 46 (Hendron); Tr. 293, 604-05 (Hendron).

65. Mr. Voytek testified that the log of boring B-125 describes "traces of fine sand and gravel lenses." Voytek at 7, 15. This assertion was also inaccurate. The log for boring B-125 does not mention lenses. It merely notes the sand and gravel content within the matrix of the soil. Under standard practice, the presence of a lens would have been explicitly

noted.16/ Tr. 296-98, 927 (Hendron).

66. Mr. Voytek and Mr. Pavey also testified that instances where split spoon samplers did not recover a full length sample might indicate the presence of sand layers. Tr. 875-77. Mr. Hendron, who has considerably more experience, testified that a full sample is often not recovered because the clay material plugs up the sampler. Tr. 919-20 (Hendron). Mr. Hendron also testified that in his inspection of the 1000-foot long excavation near the site, only one sand lens was observed, about 2 to 3 centimeters thick and five to ten feet long. At Davis-Besse, sand lenses are discontinuous and very infrequent. Tr. 309-10 (Hendron).

67. Two additional points concerning sampling methodology were raised during cross-examination: (1) whether sampling was continuous and (2) whether borings were angled to detect vertical joints. See Tr. 294-95, 319. Continuous samples of the glacial deposits were taken in borings B-125 and B-130. Tr. 919 (Hendron). In the five recent borings in the burial site, the sampling percentage was over 50 percent. The wealth of data from other continuously sampled holes, the past and present observations of large cuts through the glacial deposits, and the high percentage of sampling at the burial site provide more than

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16/ These observations are also true for the logs of the five borings at the burial site. Tr. 296-98 (Hendron).

sufficient data to determine the absence of interconnected sand lenses or other non-uniformities. Tr. 603-04 (Hendron). For the Davis-Besse burial site, angled borings to detect vertical joints were unnecessary. The frequency and characteristics of joints were determined much better by direct observation in excavations. Tr. 612 (Hendron).17/ Joints were found to be tightly shut and provide no pathway for groundwater flow. Tr. 316, 336, 610, 612, 914 (Hendron). This characteristic has been confirmed over large areas. During site construction, the bedrock aquifer was dewatered. The level of water in ponds in the glacial deposits, however, remained constant, although the radius of influence of the dewatering operation extended to the bedrock aquifer below the ponds.18/ The ponds were several tens of acres in size. The lack of effect that dewatering had on these ponds belies the existence of open joints and fractures through the glacial deposits. Tr. 311-14 (Hendron).19/

17/ Mr. Pavey himself testified that borings and continuous sampling were unnecessary if one were able to properly inspect an exposed surface. Tr. 815 (Pavey).

18/ Mr. Voytek speculated that perhaps the water levels in the ponds were unaffected because the drawdown was shallow (i.e. a few inches of drawdown). Tr. 724-25 (Voytek). On the other hand, he indicated that if there had been a significant drawdown (ten feet to tens of feet), he would change his opinion. Tr. 884-85 (Voytek). The drawdown of the bedrock aquifer during dewatering was about 20 feet at a distance of 2000 feet, and about 10-12 feet at about 3000 feet. Tr. 924 (Hendron). The ponds were within these distances. Tr. 312 (Hendron). The levels of drawdown were not only theoretically calculated but were confirmed by field measurements. Tr. 923-24 (Hendron).

19/ These same observations apply to root systems in the glacial deposits. Hair roots have been observed in the glacial deposits

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68. Similarly, Licensee's testimony clearly refutes Mr. Voytek's hypothesis that a "till aquifer" exists. First, Mr. Voytek's hypothesis depends entirely on the existence of an interconnected network of sand layers and fissures. Tr. 854-55 (Pavey). As shown above, such a system does not exist. Moreover, an aquifer is defined as a saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients. R. Freeze & J. Cherry, Groundwater 47 (1979).20/ Licensee measured the water content in the glacial deposits and determined that those deposits were not saturated. Lic. Testimony at 52 (Hendron); Tr. 302-03, 617 (Hendron). Mr. Voytek admitted he had no data establishing that the glacial deposits are saturated. Tr. 861 (Voytek). The measurements of

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at the bottom of the excavation that Mr. Hendron examined near the site. These roots were very thin (described as between 1/32 to 1/64 of an inch in diameter) and in instances the organic material of the roots had been replaced by gypsum or calcite. Tr. 317, 611 (Hendron). Gypsum in the subsurface materials tends to seal off any roots or fissures that might exist. Tr. 613 (Hendron). No groundwater was observed coming up through these hair roots. Tr. 611 (Hendron). Again, if these roots represented significant groundwater pathways through the glacial deposits, one would have observed fluctuations in the water levels in ponds during dewatering of the bedrock aquifer. Such fluctuations were not observed. Tr. 311-14 (Hendron).

20/ Mr. Voytek testified that he does not know what the definition of an aquifer is, that there are no scientific definitions that accurately describe an aquifer, and that the term is very subjective. Tr. 846, 850 (Voytek). This testimony suggests that Mr. Voytek was not using any scientifically recognized definition.

the permeability of the glacial deposits indicate those deposits are highly impermeable. Lic. Testimony at 44, 49 (Hendron). There is no measurable groundwater flow through these deposits. Id. at 46 (Hendron). Over long periods of time, no flow was observed through either the glaciolacustrine deposit or the till deposit in any of the excavations around the site.21/ Tr. 306, 909 (Hendron). Similarly, in Mr. Hendron's examination of a 1000-foot long excavation near the site, no groundwater flow was observed upwards from the bedrock aquifer through joints in the till, although the glacial deposits had been excavated to within a few feet of the bedrock and a considerable hydraulic gradient existed across those few remaining feet. Tr. 607, 610 (Hendron). The glacial deposits thus do not fit the definition of an aquifer and cannot be properly categorized as such.

69. There are other infirmities with the State's hypothesis that a till aquifer might exist. The State's witnesses testified

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21/ Mr. Pavey and Mr. Voytek intimated that perhaps smearing of the excavated faces of glacial deposits and evaporation have disguised groundwater seeping out of the glacial deposits. Tr. 691-92, 852-53 (Pavey, Voytek). Mr. Hendron, however, testified that such smearing would be inconsequential to groundwater seepage over a long period of time, and further that the smeared surface in excavations was typically scraped off by the geologists so that the underlying material could be examined. Tr. 310, 920-21 (Hendron). Mr. Pavey admitted that less evaporation occurs in the winter, and that ice lenses would form and be visible in glacial deposits exposed by excavation if there were groundwater within cracks in the deposits. Tr. 828-29 (Pavey). Groundwater seepage out of excavated glacial deposits has not occurred at any season of the year, nor have ice lenses been observed. Tr. 909-10 (Hendron).

that if such an aquifer existed, it would be a source of recharge to the bedrock aquifer (i.e. groundwater would flow from the glacial deposits into the bedrock aquifer). Voytek at 8; Tr. 860-61 (Voytek). Yet analysis of the water in the bedrock aquifer reveals high levels of hydrogen sulfide, which indicates that the bedrock aquifer is not being recharged with fresh water. Furthermore, gypsum has been found at the base of the till unit, which is inconsistent with downward groundwater flow through the till. Tr. 915-16 (Hendron).

70. The State's speculation that a till aquifer exists must therefore be rejected as lacking any evidentiary basis and as being inconsistent with site specific data. Licensee's testimony and hydrogeologic investigation demonstrate that there is no measurable groundwater flow through the glacial deposits.

7. Depth of the Glacial Deposits

71. Question 7 asked, "What is the depth to bedrock of unconsolidated glacial deposits at the burial site?" Mr. Hendron addressed this issue, and his testimony was unchallenged.

72. In the area of the burial site, the glaciolacustrine deposit is five to eight feet thick. The thickness of the glacial till deposit in the area being considered for the burial site ranges from nine to twelve feet. The thicknesses were determined largely on the basis of the five most recent borings in

the burial site area. These ranges agree very well with results of numerous other borings conducted at the site during previous studies. Lic. Testimony at 50 (Hendron).

73. The presently proposed bottom of the waste disposal cells (that is, the bottom of the liner) is to be at elevation 567. The elevation of the top of bedrock is at elevation 560. The distance between the bottom of the waste disposal cells and the top of the bedrock will therefore be 7 feet. Id. at 50-51 (Hendron).

8. The Water Table

74. Question 8 asked, "What is the average depth and upper and lower range of the water table at the disposal site?" This issue was addressed by Mr. Hendron, and to some extent by Mr. Pavey and Mr. Voytek.

75. The simplest definition of water table is the point of contact between the saturated and unsaturated geologic zones in the subsurface.22/ This definition is consistent with that in Ohio's Solid Waste Disposal Regulations, Ohio Admin. Code § 3745-27-01(AA). Id. at 52 (Hendron).

76. As discussed above, both the glaciolacustrine and glacial till deposits beneath the burial site are unsaturated. The

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22/ See R. Freeze and J. Cherry, Groundwater 39 (1979).

bedrock deposit is saturated, and water in the bedrock formation is confined. Consequently, the water table within the area being considered for the disposal site is the contact point between the glacial soil deposits and the top of the weathered bedrock zone. This contact generally occurs at approximately elevation 560. Id.

77. The present elevation of the bottom of the waste cells is elevation 567 and the elevation of the top of the water table is elevation 560. The distance between the bottom of the waste cells and the water table is 7 feet. Id. at 53 (Hendron).

78. Mr. Pavey (who is not a groundwater hydrologist) stated that the top of the totally saturated zone in joints in the glacial deposits represents a water table. Pavey at 3. Since the evidence demonstrates both that the glacial deposits are unsaturated and that joints in the glacial deposits are tightly shut and impermeable, Mr. Pavey's statement has no factual basis and is irrelevant to the Davis-Besse site.23/

23/ Mr. Voytek questioned whether the "first water in hole" noted on boring log B-124 might reflect the top of a water table in a joint. Voytek at 5. Mr. Hendron responded to this query. The notation on log B-124 reflects a small amount of water that is sometimes found between the glacial till and glaciolacustrine deposits. Tr. 336 (Hendron). These accumulations are minor and isolated. They are not interconnected and are not a water table. Tr. 917-18 (Hendron).

79. Mr. Voytek stated that perhaps a better definition of a water table is the surface of water at which fluid pressure in an aquifer is at atmospheric pressure. Tr. 721 (Voytek). Observing that groundwater in the confined bedrock aquifer "would come up to about two to five feet below the natural land surface," Mr. Voytek suggested that the water table should be considered to be two to five feet below the land surface. Id. Mr. Voytek's written testimony, however, stated that the "water level" in the bedrock aquifer lies 10 to 20 feet below ground level. Voytek at 9. In using the term "water level," Mr. Voytek acknowledged that he was referring to the piezometric surface of the confined aquifer. Tr. 862.24/ The piezometric (or potentiometric) surface is the water level in wells tapping a confined aquifer and is a map of the hydraulic head in the aquifer. R. Freeze and J. Cherry, Groundwater 49 (1979). Water in a confined aquifer is under artesian pressure and will rise up in a well tapping such an aquifer. Id. at 48-49. Mr. Voytek indicated that he was equating the piezometric surface of the confined bedrock aquifer with a "water level" in the glacial deposits based on his

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24/ The same confusion resulted from Mr. Voytek's reference to Licensee's environmental report for the construction of Davis-Besse Unit 1. The environmental report referred to a groundwater table fluctuating with lake levels. Voytek, Attachment G. Mr. Hendron testified that this section of the environmental report was based on a section of the PSAR prepared by Woodward-Clyde -- a section that discussed variations in the potentiometric surface of the bedrock aquifer and not actual water levels in the glacial deposits. Tr. 926 (Hendron).

assumption that a saturated till aquifer exists and is interconnected with the bedrock. Tr. 862 (Voytek). He admitted that he had no evidence that this was the case, and that if the glacial deposits were unsaturated, pore pressure would be below atmospheric pressure. Id; Tr. 883 (Voytek). Given the determinations that the glacial deposits are not saturated, do not contain interconnected lenses and fissures, and do not constitute aquifers, Mr. Voytek's testimony once more lacks any factual basis.

80. Mr. Voytek also suggested that water which ponds in the topsoil during wet seasons is a water table. Voytek at 7.25/ Such water, which accumulates above an impermeable, unsaturated zone, is more correctly referred to as a perched water table. It is not considered a true water table. Tr. 615-16 (Hendron); R. Freeze & J. Cherry, Groundwater 45 (1979).

9. Endangered Species

81. The Presiding Officer's ninth question asked, "What species of plant or animal have been actually observed on the Davis-Besse site? What critical habitats for endangered species exist on the Davis-Besse site?" For Licensee, Dr. William B.

25/ The topsoil is also referred to as Toledo silty clay. See Tr. 394, 925 (Hendron). That water ponds in the topsoil indicates that the glacial deposits below are very tight and prevent groundwater flow downward. Tr. 928 (Hendron).

Jackson, Dr. Jeffrey M. Reutter, and Dr. John E. Till testified on this issue. Mr. John Marshall testified for the State.

82. Dr. Jackson is a Professor Emeritus of Biological Sciences at Bowling Green State University. He holds a bachelor of arts and a master of arts degree in zoology from the University of Wisconsin, and a doctorate of science from the Johns Hopkins University School of Hygiene and Public Health. He has over thirty years' experience in environmental research and studies. Lic. Testimony at 2, 7 (Jackson). He is a trained ornithologist. Tr. 339 (Jackson).

83. Dr. Reutter is the Associate Director of the Franz Theodore Stone Laboratory, Assistant Director of the Center for Lake Erie Area Research, and Adjunct Assistant Professor of Zoology and Natural Resources at the Ohio State University. He holds a bachelor of science and master of science degree in fisheries management, and a doctorate degree in biological limnology and fisheries biology from the Ohio State University. He has studied the aquatic ecology of Lake Erie for over a decade. Lic. Testimony at 3, 7 (Reutter).

84. From 1972 through 1980, Dr. Jackson, Dr. Herdendorf, and Dr. Reutter conducted environmental monitoring studies at the Davis-Besse site. Dr. Jackson and his associates studied terrestrial animal and plant communities at the site. Plant, mammal, and herpetile populations were examined. Bird populations were

censused each season, and bird strikes at the cooling tower were monitored during spring and fall migration periods. Lic. Testimony at 54 (Jackson). Dr. Jackson himself visited the site dozens of times. Tr. 339 (Jackson).

85. Complementing Dr. Jackson's studies, Dr. Reutter and Dr. Herdendorf conducted aquatic studies over the same nine-year period. The aquatic studies included a sampling program of fish and benthic organisms in Lake Erie near the site. A three-year sampling program was conducted in the Navarre Marsh. Lic. Testimony at 54-55 (Reutter). Dr. Jackson and Dr. Reutter were thus well qualified experts with direct knowledge of the species found at Davis-Besse.

86. Licensee's other witness, Dr. Till, is a health physicist. Dr. Till holds a bachelor of science degree in engineering from the U.S. Naval Academy, a master of science degree in health physics from Colorado State University, and a doctorate degree in nuclear engineering from the Georgia Institute of Technology. He is a member of the National Council on Radiation Protection and Measurements and a member of the Radiation Advisory Committee to the U.S. Environmental Protection Agency. Id. at 4, 8. With respect to Issue 9, Dr. Till discussed whether the low levels of radioactivity in the waste would have an impact on biota. Mr. Till, too, was a highly qualified witness.

87. The State's witness, Mr. Marshall, holds degrees in fisheries management and botany, with emphasis on wetland floristics. Witness Statement of John H. Marshall ("Marshall"), ff. Tr. 638, at 1. His written testimony, however, dealt almost exclusively with birds. He is not an ornithologist. Tr. 736 (Marshall). His resume lists no courses on ornithology, nor does Mr. Marshall have any publications in this field. Tr. 737 (Marshall). The information on birds in his testimony was second hand. Tr. 754 (Marshall).

88. No plants or animals on the Federal endangered species list have been observed on the Davis-Besse site. No aquatic species on the Federal endangered species list have been found in this part of Lake Erie. No aquatic species on the Federal or State lists were found in the Navarre Marsh. Id. at 55-56, 60 (Jackson, Reutter).

89. Dr. Jackson testified that the 1974 environmental monitoring program at the Davis-Besse site found evidence of Chenopodium leptophyllum (slender goosefoot) near the current location of the cooling tower. This plant is now on the endangered species list prepared by the Division of Natural Areas and Preserves of the Ohio Division of Natural Resources, but is not on the Federal endangered species list. Lic. Testimony at 55 (Jackson).

90. In June, 1986, a survey of the burial site was conducted by Dr. T. Richard Fisher, Botanist and Professor/Chairman Emeritus of the Department of Biological Sciences at Bowling Green State University. Dr. Fisher found no evidence of the slender goosefoot, or of any other species listed on the State or Federal endangered species lists. Id. at 55-56 (Jackson).

91. During the sampling program conducted in Lake Erie, four aquatic species on the State's endangered species list were found: silver chub, silver lamprey, Great Lakes muskellunge, and lake sturgeon. Only one muskellunge and one sturgeon were found in eleven years of sampling. Id. at 56 (Reutter).

92. Three benthic organisms listed by the State as "threatened" have also been found in Lake Erie near the plant site. These are the deer toe clam, the knob shell clam, and the eastern sand shell clam. Id.

93. Dr. Till testified that the levels of radioactivity in the waste would have no discernible impact on aquatic species. Even if all the waste were deposited in the Lake at once, the radionuclide concentrations would be well below the maximum permissible concentrations for water in Part 20 of the NRC's regulations.26/ At these levels, the impact on aquatic species would be negligible. Id. at 57 (Till). Dr. Till's testimony was undisputed.

26/ 10 C.F.R. Part 20, App. B, Table II, Column 2.

94. Mr. Marshall's written testimony stated that Licensee's disposal method "could" affect birds, fish, and wildlife. Marshall at 1. He testified that when he wrote this statement, he did not know licensee's disposal method or the composition of the waste. Tr. 738 (Marshall). He admitted that he did not know if there would be any effect. Id. Later in his written testimony, Mr. Marshall stated that chemical and/or radioactive contamination could migrate offsite, and that health effects on animals would depend on the exact composition and concentration of the waste. Marshall at 3. Again, Mr. Marshall admitted this statement was based on no analysis. Tr. 739. He did not know whether contaminants would leach out of the waste or whether they would have any effect on animals. Tr. 739-40 (Marshall).

95. After reviewing Licensee's testimony, Mr. Marshall did observe that the waste contained some heavy metals. He stated that some of these exhibit adverse effects on benthic organisms, and if there were a sufficient reduction in the diversity of benthic and macroinvertibrates, fish populations could be impacted. Tr. 655-56 (Marshall). Mr. Marshall admitted, however, that the heavy metals in the sludge were already in lake water (that is in fact the source of the metals in the sludge), and he had no knowledge of the concentrations of heavy metals that might exist in groundwater if that groundwater was somehow contaminated by the Davis-Besse waste disposal project and was able to reach Lake Erie. Tr. 746-48 (Marshall). He did not know whether there would be any effect. Tr. 740 (Marshall).

96. Dr. Reutter testified that there would be no impact on aquatic species. Lic. Testimony at 57 (Reutter); Tr. 602 (Reutter). The existing sediments in Lake Erie have higher metal concentrations than the waste. Tr. 603 (Reutter). Licensee's chemical analysis of the sludge shows it to be below EPA EP toxicity limits, and in fact any leachate would be below EPA water quality criteria, which are designed to protect aquatic life. Tr. 602 (Reutter). Furthermore, Licensee's waste disposal methods and the hydrogeologic characteristics of the site make it very unlikely that any waste or leachate would reach the lake. Tr. 602-03 (Reutter); Tr. 288-89, 914 (Hendron).

97. With respect to birds, bald eagles, which are on the Federal endangered species list, have been sighted over the Davis-Besse site on a few occasions. The nearest bald eagle nest is located approximately 1.5 miles south of the site. Two birds on the State's endangered species list, the sharp-shinned hawk and the common tern, have been seen twice and several times, respectively. Lic. Testimony at 58 (Jackson).

98. Mr. Marshall testified that the sharp-shinned hawk and common tern "can occur in the vicinity of the Navarre Marsh." Marshall at 3. When questioned, Mr. Marshall indicated that he knew only that these species had been seen several miles from the Davis-Besse site. Tr. 741 (Marshall). He admitted that the common tern does not nest in marshland, and that the sharp-shinned hawk is primarily a woodland bird. Id.

99. Mr. Marshall testified that two other birds on the State endangered species list -- the King rail and the upland sandpiper -- "can occur in the vicinity of the Navarre Marsh." Marshall at 3. Again, Mr. Marshall did not know whether either of these birds actually inhabits the Navarre Marsh, only that they had been seen several miles from the Davis-Besse site. Tr. 741 (Marshall). He admitted that the upland sandpiper is a grassland bird. Id. Dr. Jackson testified that during Licensee's nine-year monitoring program neither of these species were observed at or near the Davis-Besse site. While the King rail could use the Navarre Marsh, the open nature of the Navarre Marsh makes it unsuitable for the rail. The U.S. Fish and Wildlife Service drains the Navarre Marsh at certain seasons to seed weeds for food for duck and geese, and this action destroys dense emergent vegetation that the rail prefers. Tr. 761-62 (Jackson).

100. Mr. Marshall also testified that two other birds on the federal endangered species list -- the Kirtland's warbler and the American peregrine falcon -- are "known to occur on or about the Davis-Besse site." Mr. Marshall further testified that the Navarre Marsh provides "critical habitat" to these two birds. Marshall at 4. Neither the Kirtland's warbler nor the American peregrine falcon nest or have been observed at the Navarre Marsh or Davis-Besse site. Lic. Testimony at 58-59 (Jackson). Accord, Marshall at 4. These two species merely migrate through the

northern Ohio area. Tr. 343-44 (Jackson); Marshall at 4. The term habitat does not generally encompass migratory paths. Tr. 762-63 (Jackson). Moreover, the Navarre Marsh is not particularly important to either of these birds during migration. The Kirtland's warbler does not prefer marsh. Tr. 741 (Marshall). The peregrine falcon is unlikely to rest in the marsh. Tr. 763 (Jackson); Tr. 742-43 (Marshall). While the peregrine falcon may feed on waterfowl, it has many other food sources. Tr. 742 (Marshall).

101. Finally, Mr. Marshall testified that the Navarre Marsh provides "critical habitat" for the bald eagle. Marshall at 4. Mr. Marshall explained that he was not using the term "critical habitat" as it is defined in the Endangered Species Act, but instead as a synonym for important habitat. Tr. 654-55, 745 (Marshall). Dr. Jackson testified and Mr. Marshall agreed, that the Navarre Marsh has not been designated as critical habitat for the bald eagle or for any other species. Lic. Testimony at 61-62 (Jackson); Tr. 654-55, 745 (Marshall).

102. Mr. Marshall testified that the Navarre Marsh contains potential nesting sites for the bald eagle. Tr. 654 (Marshall). On cross-examination, he indicated he was referring to the creation of artificial nesting structures, and that other marshes also contain such potential nesting sites. Tr. 743 (Marshall). There are no actual bald eagle nests in the Navarre Marsh. Id.

The nesting preference of the eagle is for very tall, isolated trees. Tr. 764 (Jackson). Mr. Marshall testified that the eagle may forage in the Navarre Marsh, but he also indicated other marshes along Lake Erie also provide foraging ground. Marshall at 5.

103. In summary, as the testimony discussed above shows, no endangered species of bird have been found to inhabit the Davis-Besse site (including the Navarre Marsh), although occasional foraging is possible. The Navarre Marsh is not critical habitat in its proper sense of the term. Nor would the construction of the burial site remove or disturb potential habitat for species that have been observed in the vicinity on occasion. Lic. Testimony at 59 (Jackson); Tr. 765 (Jackson). As the State's own witness Mr. Marshall admitted, the burial site will not result in loss of wetland. Tr. 756 (Marshall).

104. Operation of the burial site should similarly have no impact on bird species. The disposal methods that Licensee intends to use should prevent the waste from becoming biologically available (that is, it will remain immobile and unable to enter the food chain). If the waste were somehow mobilized, there would still be no effect. The radionuclide concentrations are too low to present any significant hazard to plant, or animal. Even if this waste were completely mobilized, the very low levels of radioactivity would have no observable environmental

impact. Lic. Testimony at 60 (Jackson, Till). Similarly, Licensee's chemical analysis has demonstrated the waste to be below toxicity limits. Id. at 96-98 (Bennett); Tr. 602-03 (Reutter).

10. Expected Radionuclide Inventory

105. The Presiding Officer's tenth question asked, "What will be the total radiological inventory of the burial site after 30 years of operation under expected levels of resin contamination? Mr. J. Stewart Bland, a health physicist, testified on behalf of Licensee. Mr. Bland holds a bachelor of science degree in physics, a master of science degree in nuclear science, and has worked as a health physicist for a dozen years. Lic. Testimony at 1, 7 (Bland). No other party presented testimony on question 10. Mr. Bland's testimony was uncontradicted.27/

106. The inventory of radionuclides in each batch of waste has been measured prior to discharge to the settling pond. To date, 0.0044 Curies has been sent to the settling pond, and as a result of decay, 0.0031 Ci. remains. Id. at 63 (Bland).

107. To estimate the inventory in the burial site at the expiration of the Davis-Besse operating license, Mr. Bland

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27/ SOS/CLO's witness Mr. Bimber, who provided testimony on other radiological issues, acknowledged that he had no reason to challenge the activity estimates in Licensee's testimony. Tr. 481-82 (Bimber).

conservatively assumed that levels of activity in future resin batches will continue at previously measured levels (which were the result of a tube leak which is now repaired).28/ He therefore took the present inventories in the settling basin as the inventories that would be produced and buried every five years. The expected radionuclide activities for each buried lot were decayed from the respective estimated burial date of each lot to the year 2011 (when the Davis-Besse operating license expires). The decayed activities of the lots were then summed. Id. at 64 (Bland).

108. Based on this calculation, the total expected activity in the burial site at termination of the Davis-Besse operating license (in 2011) will be 0.013 Ci. This activity is essentially all cesium-137. Id.

11. Estimated Exposure Dose

109. Question 11 asked, "What is the estimated dose to an individual standing on covered basin dredgings after 30 years of operation under expected levels of resin contamination?" This issue was addressed by Mr. Bland on behalf of Licensee. No other party presented testimony on this issue,29/ and Mr. Bland's

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28/ By assuming for his estimate that previously measured levels of activity, which are the result of a tube leak, will persist, Mr. Bland took account of the possibility of future tube leaks. Tr. 401 (Bland).

29/ Mr. Bimber, stating that only maximum values have radiological significance, addressed his radiological testimony to

(Continued Next Page)

testimony was uncontradicted.

110. The dose an individual would receive if he stood directly on top of the last constructed burial cell at the expiration of the Davis-Besse operating license 24 hours per day for an entire year is estimated to be 0.007 mrem. If the individual stood on top of earlier constructed cells, the dose received would be less, since the inventory of those cells would have decayed more. Id. at 67 (Bland).

111. To calculate this dose, it was assumed that the burial cells will have a two-foot thick soil cover, which coincides with the minimum thickness specified in Licensee's design of the burial ground. The soil density value measured in borings at the burial site (2 gm/cm^3) was used. The radionuclides concentrations recently measured in the settling basin30/ were used as the concentrations in the last-constructed burial cell. Id. at 68-69 (Bland). The radiation shielding and dose calculational methods of ISOSHLD were then applied. The methodology employed in the calculations is point kernel integration. This technique is used throughout the industry and government for calculating radiation shielding attenuation and doses. Id. at 67-68 (Bland).

(Continued)

question 14. Bimber at 3. The points Mr. Bimber raised are discussed in the findings on that issue.

30/ Licensee took approximately 30 core bore samples all the way through the material accumulated in the settling basin. Tr. 162, 166 (Briden).

112. Counsel for TCSE questioned Mr. Bland during cross-examination concerning whether the 0.007 mrem per year dose calculated by Mr. Bland for continuous exposure was consistent with the 0.007 rem hourly dose calculated by the NRC Staff in its environmental assessment. Mr. Bland explained that the NRC Staff's dose calculation was for an individual standing on uncovered waste, whereas the issue designated for hearing by the Presiding Officer asked for the dose an individual would receive standing on a covered cell. The cover reduces exposure and dose. Tr. 404-05 (Bland).

12. Limiting Concentrations

113. The Presiding Officer's twelfth question asked, "What criteria will be used to decide whether resins will be buried on site or transported to a licensed burial site in the event that resins become contaminated at higher than expected levels (from steam generator tube leaks or ruptures, for example)?" This issue was addressed by Mr. Bland and Mr. David Briden, the Chemistry and Health Physics Superintendent for the Davis-Besse Nuclear Station. Their testimony was uncontradicted.

114. Licensee has set limits on radionuclide concentrations in resin batches discharged to the settling basin. These limits were based on an evaluation of feasible release scenarios and environmental transport and exposure pathways. The concentration limits were chosen so that, under the feasible release scenarios

and environmental transport and exposure pathways evaluated, the dose to any member of the public would be negligible (less than 1 mrem). Lic. Testimony at 72 (Bland).

115. As previously discussed, each batch of spent resin is analyzed before it can be discharged to the settling basin. If radionuclide concentrations exceed the established limits, the spent resins are not discharged to the basin, but are instead treated as radioactive waste and processed for offsite disposal. The maximum concentrations allowed in resin batches to be discharged to the settling basin apply to the resin batches before they are mixed with the water treatment sludge. Id. at 71-72 (Bland, Briden).

13. Maximum Radionuclide Inventory

116. The Presiding Officer's thirteenth question asked, "What is the estimated upper limit of radionuclide inventory that could exist after 30 years under the above criteria?" Mr. Bland addressed this issue on behalf of Licensee. His testimony was again unchallenged.

117. The total maximum activity that could exist in the burial ground at the termination of the Davis-Besse operating license is 0.036 Ci. This activity is almost entirely attributable to cesium-137. This value is based on the maximum activities that would result if all resin discharges contained the

limiting (i.e. maximum allowable) radionuclide concentrations. Id. at 73 (Bland).

14. Maximum Exposure Dose

118. The Presiding Officer's fourteenth question asked, "What is the estimated upper limit of dose to the whole body for an individual standing on the burial site that could exist after 30 years under the above criteria?" Mr. Bland responded to this question on behalf of Licensee. In addition, Mr. Russell Bimber provided testimony on behalf of SOC/CLO. Mr. Bimber's testimony, however, consisted mainly of questions and contained few factual assertions. See generally Bimber at 4-5. Mr. Bimber acknowledged he is not a health physicist. Tr. 468 (Bimber).

119. The maximum whole body dose due to direct exposure that an individual would receive if, after expiration of the Davis-Besse operating license, he stood directly on top of the burial site 24 hours per day, 365 days per year, would be 0.02 mrem per year. To calculate this maximum dose, the previously described ISOSHLD methodology and assumptions were used. It was assumed that the individual stood continuously over the last constructed burial cell, and that this cell contained the maximum radionuclide concentrations. Lic. Testimony at 75-76 (Bland).

120. Mr. Bimber's testimony on question 14 did not challenge Licensee's calculation, but instead questioned the NRC Staff's

environmental assessment. See Bimber at 4-5. Mr. Bimber acknowledged that he had no reason to challenge the activity estimates in Licensee's testimony. Tr. 481-82 (Bimber). Mr. Bimber performed no dose calculations of his own. Tr. 488 (Bimber). Mr. Bimber's testimony did not relate to Licensee's plans for the burial site. For example, he testified that fertilizer applied to the burial site may elute radioisotopes from the resins in the waste. Bimber at 5. Under Licensee's plan, fertilizers will not be applied to the burial site. Lic. Testimony at 40 n.12 (Swim). Mr. Bimber suggested that combined doses due to various exposure pathways -- for example drinking water and consuming fish -- should be considered. Bimber at 4. Licensee's testimony addressed such pathways. See Lic. Testimony at 80-82 (Bland). Mr. Bimber suggested that dose calculations should assume continuous exposure. Bimber at 5. Licensee's analysis and the calculations discussed above did so.

15. Strontium-90

121. The Presiding Officer's fifteenth question asked, "Why has Sr-90 not been included in Licensee's assessments?" Mr. Bland responded to this question on behalf of Licensee, and his testimony was unchallenged.

122. Mr. Bland testified that Sr-90 was considered in the ingestion and inhalations dose calculations in Licensee's testimony. The radioactive decay of Sr-90 is not accompanied by any

gamma radiation or x-rays, and therefore does not contribute to the direct exposure doses. Lic. Testimony at 77 (Bland).

123. Strontium-90 was not included in Licensee's previous assessments because of its negligible contribution to both the total activity and the doses. Licensee has examined the Sr-90 levels in this particular waste stream, and Sr-90 comprises only 0.04 percent (0.0004) of the total activity. Its abundance and dose contribution are negligible compared with that of Cs-137. Id. at 77-78 (Bland).

16. Ingestion Pathways

124. Question 16 asked, "What would be the total estimated whole body dose equivalent for an individual through the food ingestion pathway that could result from the final 30-year inventory of radionuclides including Sr-90? Provide estimates for expected levels and upper limits of radionuclide inventory after 30 years." Mr. Bland responded to this question on behalf of Licensee. No other parties submitted testimony on the issue.

125. Assuming that resin discharges to the settling basin contain expected levels of radionuclides, the total estimated whole body dose rate for the food ingestion pathway would be 0.31 mrem/year. This dose was calculated using the environmental transport modeling of U.S. Nuclear Regulatory Commission Regulatory Guide 1.109 coupled with effective total body dose

conversion factors derived from Publication 30 of the International Commission on Radiological Protection. For the analysis, it was assumed that an individual grew all his fresh vegetables in soil contaminated with waste from the last burial cell. It was further assumed that the vegetables are grown in a mixture of contaminated waste and soil in equal proportions. This assumption follows the guidance in NUREG/CR-3585, "De Minimis Waste Impacts Methodology" (Feb. 1984). The soil-to-plant transfer factors specified in NRC Regulatory Guide 1.109 were then used. Lic. Testimony at 79-80 (Bland).

126. The doses attributable to the ingestion of geese that might graze on the burial site were also evaluated. For this analysis, it was assumed that the geese graze on grass grown directly on waste from the last cell. For simplicity and conservatism, it was assumed that the flesh of the geese would accumulate radionuclide concentrations equal to the concentration in the vegetation. It was then postulated that an individual would consume 14 kilograms (30 pounds) of such goose flesh per year. The total whole body dose equivalent from this scenario is 0.025 mrem. Id. at 80-81 (Bland).

127. Finally, the whole body dose to an individual who drank contaminated lake water and consumed fish from the Lake was evaluated. For this analysis, it was postulated that some catastrophic mechanism transferred the entire burial site inventory

to the Lake at one time and that all the sludge dissolved. The total body dose to an individual was then calculated using the Davis-Besse Off-Site Dose Calculation Manual (ODCM), which the NRC has reviewed and approved. The ODCM is based on the NRC's Regulatory Guide 1.109 methods adapted to the specific features of the Davis-Besse site. In accordance with this methodology, a 10:1 near field dilution factor was applied to address the immediate dispersion in the lake environment. An additional dilution of 5.7:1 was applied to determine the resultant radionuclide material concentration at an assumed beach well, conservatively postulated to be located at the southeast boundary of the Davis-Besse site. An individual consumption rate of 21 kg/year of fish and 730 liters/year of water was used. The resultant total body dose (assuming expected levels of resin contamination) would be 0.1 mrem. Due to dissipation of the release, this dose would be received only in the first year after the postulated release. Doses in subsequent years would be orders of magnitude smaller. Id. at 81-82 (Bland).

128. One cannot add up the ingestion pathway doses for vegetables, fowl, fish, and water to arrive at a total dose. One could add the food ingestion pathway doses for vegetable and fowl consumption. One could not, however, receive the total body dose equivalent for vegetable and fowl consumption and the total body dose due to ingestion of fish and drinking water. Both scenarios could not occur simultaneously. Either the waste remains in the

burial ground, in which case the dose due to vegetable ingestion applies, or the waste is released to the Lake, in which case the dose due to ingestion of fish and water applies. Id. at 82 (Bland).

129. If one assumes that the radioactivity in the waste is at the maximum possible level, the maximum total body dose equivalent for food ingestion (vegetables) would be 0.85 mrem per year. The maximum total body dose equivalent due to ingestion of goose flesh would be 0.07 mrem per year. The alternative maximum total body dose due to ingestion of fish and drinking water would be 0.3 mrem. The 0.3 mrem total body dose due to ingestion of fish and drinking water would be received only in the first year and due to dissipation would not recur. Id. at 83 (Bland).

130. Dr. John Till, whose qualifications are discussed above at Finding 86, conducted a peer review of Mr. Bland's analysis. Dr. Till confirmed that Mr. Bland had used well accepted methodologies, and that Mr. Bland's assumptions were generally conservative (i.e would tend to overestimate actual doses). Id. at 84-85 (Till). Dr. Till's own independent calculations agreed with those of Mr. Bland. Id. at 84 (Till).

131. Licensee also presented the testimony of Dr. Roger E. Linnemann to put in perspective the significance of the doses calculated by Mr. Bland. Dr. Linnemann is Vice Chairman and Chief Medical Officer of Radiation Management Corporation and is

also an Associate Clinical Professor of Radiology at the University of Pennsylvania School of Medicine. Dr. Linnemann holds a medical degree and has been involved in the fields of radiology and health physics for over twenty years. Id. at 3, 8-9 (Linnemann).

132. Dr. Linnemann testified that he would not expect any adverse health effects. Statistically, the probability of an adverse health effect from these doses is vanishingly small, about one in ten million. Id. at 85 (Linnemann).

133. Dr. Linnemann based this opinion on the risk estimators published in the 1980 report of the Committee on Biological Effects of Ionizing Radiation, National Academy of Sciences, entitled, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation" (the BEIR III Report). These are the most current risk estimators, and are the basis for the U.S. EPA's estimates of risk. These risk estimators conservatively assume a linear relationship between dose and response, with no threshold. Id. at 85-89, 91 (Linnemann).

134. Dr. Linnemann applied the BEIR III risk estimators to the doses that Mr. Bland calculated to place a statistical upper bound on resulting health effects. For simplicity, he rounded off to one mrem/year the dose rate a maximally exposed individual might receive from the burial ground. The risk to an individual of a fatal cancer from a continuous one mrem dose would be 1.58

in ten million per year. In contrast, the risk of a spontaneous cancer death would be about 10,000 times greater. The risk of a genetic abnormality would be about one-half of the cancer risk or about one chance in ten million that a parent so exposed would experience a live birth with a genetic abnormality. The normal genetic abnormality risk is about one in ten. Even if the entire population residing within 10 miles of the Davis-Besse plant were to receive this dose (one mrem/year), one would not expect a single fatal cancer or genetic abnormality to occur. Id. at 89-90 (Linnemann).

135. As a further illustration, Dr. Linnemann compared a one mrem dose with doses an individual would receive from other sources. This comparison revealed that the maximum dose attributable to the burial ground would be only one percent of the dose an individual would receive from natural background radiation, is less than the additional dose a person would receive from living in a brick building, and is about the same as the annual dose a person receives from watching television. Id. at 90-91 (Linnemann).

136. SOS/CLO presented Dr. David Gitlin to discuss radiation. In a few brief sentences devoid of fact, Dr. Gitlin testified "all ionizing radiation of whatever source inevitably results in an aliquot cost in increased cancer and birth defects," and that "there is only the inevitable toll in death and

disease that will needlessly result." Testimony of David Gitlin, ff. Tr. 439, at 2. This testimony is vague, lacks factual support, and is entitled to no weight. Dr. Gitlin is an allergist. Id. at 1. He has no particular expertise in the field of radiation-induced health effects. See Tr. 440-41 (Gitlin). He had done no calculations to determine doses that one might receive from the burial site. Tr. 450 (Gitlin). He had not bothered to read Licensee's testimony. Tr. 442 (Gitlin). Furthermore, his responses to questions during cross-examination indicate that Dr. Gitlin is in fact not concerned about doses as low as a millirem. See Tr. 445-450 (Gitlin).

17. Chemical Constituents of the Sludge

137. Question 17 asked, "What are the principal chemical components of the nonradioactive sludge that are mixed with radioactively contaminated resins?" Dr. Gary F. Bennett addressed this issue on behalf of Licensee.

138. Dr. Bennett is a Professor of Biochemical Engineering at the University of Toledo. Dr. Bennett holds a bachelor of science degree in chemical engineering from Queen's University in Kingston, Ontario, and master of science and doctor of philosophy degrees, also in chemical engineering, from the University of Michigan. He has taught chemical and biochemical engineering for approximately 20 years. He has also been involved in numerous studies on water pollution control and hazardous wastes. Lic. Testimony at 1, 9 (Bennett).

139. Dr. Bennett testified that the sludge that is discharged to the settling basin consists of impurities removed from the raw lake water together with chemicals used in and produced by the water treatment process (calcium hydroxide, sodium aluminate, and calcium carbonate). The sludge is mainly a suspension of inorganic solids in water. Id. at 94 (Bennett).

140. To determine the precise content of the sludge, the contents of the settling basin bottoms was sampled.31/ Standard analytical procedures were used to determine the chemical and physical characteristics of the sample. Id. at 96 (Bennett).

141. During cross-examination of Dr. Bennett, counsel for the State questioned whether more samples were needed. Dr. Bennett testified that the sludge produced by the water treatment process has little variation. Tr. 413 (Bennett). Moreover, the sample that was taken was composed of several dips of a dip-type sampler over the range of the settling basin bottoms where they had accumulated in the west end of the basin. Tr. 413-14 (Briden). The sample was therefore sufficiently representative. Tr. 619 (Bennett).

31/ In the sampling, excess water was decanted off the sludge that was collected. Tr. 414 (Briden). The sludge that was tested therefore had only its natural water content. See note 4 supra.

142. The chemical analysis shows that other than containing the water treatment chemicals themselves, the sludge consists of the impurities found in Lake Erie water in a concentrated form. Metals are present in a concentration that mirror the concentration in the Lake water. The settling basin bottom sample has a pH of 9. At this pH level, the metals would exhibit close to their minimum solubility and maximum resistence to dissolution and leaching. Lic. Testimony at 96-97 (Bennett). The Davis-Besse sludge is in fact fairly typical of that produced in municipal water treatment facilities. Its principal solid constituent is calcium carbonate. The concentrations of heavy metals in the Davis-Besse sludge are smaller than that in sludge produced by the water treatment facility of the town of Oregon or the City of Toledo. Id. at 95-96 (Bennett).

143. The settling pond bottoms were also tested in accordance with the extraction procedure (EP) toxicity tests called for in the U.S. Environmental Protection Agency's regulations implementing the Resource Conservation and Recovery Act (RCRA), 40 C.F.R. Part 261, App. II. Comparing the results of the tests with the RCRA standards (40 CFR § 261.24) shows that the settling basin bottoms were well below the EP toxicity limits. Given the characteristics of the sludge and resins, the bottoms do not exhibit the characteristics of reactivity, corrosivity or ignitibility as defined in the U.S. EPA regulations (40 CFR §§ 261.21, .22 and .23). Furthermore, water treatment sludge is

not listed as a hazardous waste in 40 C.F.R. Part 261, Subpart D. Therefore, the bottoms would not be considered as hazardous under U.S. EPA regulations. Id. at 97-98 (Bennett).

144. None of the intervenors presented any testimony contradicting or challenging Dr. Bennett's testimony. During cross-examination of Dr. Bennett, the State inquired whether some of the trace metals and organics in the waste were "hazardous waste constituents." Dr. Bennett responded that some of these constituents were listed by the EPA and subject to limits. See Tr. 414-17 (Bennett). The waste met the applicable limits. Lic. Testimony at 97-98 (Bennett). The mere presence of those constituents does not make the waste a hazardous material. The sludge is not hazardous. Tr. 620 (Bennett).

18/19. Resin Chemistry

145. The Presiding Officer's eighteenth question asked, "What is the rate of biological or chemical degradation of resins?" Question nineteen asked, "What biological hazards are there from resin degradation that have been published in the scientific literature or are known from manufacturers' tests?"

146. Mr. Richard Hetherington addressed these issues on behalf of Licensee. Mr. Hetherington holds a bachelor of science degree in chemistry from Temple University. He has been active in ion-exchange and water treatment fields for over forty years.

He has authored numerous papers on ion-exchange technology and holds a humber of patents relating to the application of ion-exchange resins. He is currently employed by Epicor, which provides the ion-exchange resins used at Davis-Besse. Lic. Testimony at 9 (Hetherington). Mr. Bimber provided some testimony on behalf of SOS/CLO.

147. Mr. Hetherington testified that he would not expect resins to be subject to biological degradation. In his substantial experience with ion-exchange resins, he has never seen any instance where biological degradation of resin has occurred, even when resins have been placed in soil for twenty years. Lic. Testimony at 100-101 (Hetherington). Mr. Bimber confirmed that the polymeric structure of resins is very resistant to degradation. Tr. 462-63 (Bimber).

148. The resins are similarly resistant to chemical degradation. They are extremely insoluble in water. Even in solvents and solutions used in the laboratory, the resins are essentially insoluble. Decomposition can occur, but requires extremely powerful oxidizing solutions, such as boiling nitric acid or chromic-nitric acid. Lic. Testimony at 101 (Hetherington).

149. One would therefore not expect any chemical reaction between the resins and the environment which might cause the release of radioactivity from the resins. Impurities which have been exchanged onto a resin may be deliberately eluted (i.e.

removed) from the resin by a regeneration process. This process requires the use of relatively strong acids or bases. Id. at 102-03 (Hetherington). It is highly unlikely that acids or bases of sufficient strength exist in the natural environment. Moreover, the manner in which the burial cells are constructed, as well as the packing characteristics of the resins, would prevent water containing ionizable salts and acids from percolating through the resins. Also, the resins are mixed with a very large volume of lime sludge. Even if water were able to percolate through the resin/sludge mixture, the alkalinity of this material would neutralize any strong acid. Id. at 103-04 (Hetherington).

150. Mr. Bimber suggested that perhaps fertilizer might elute radionuclides from resins. Bimber at 5. Fertilizer will not be applied to the burial site. Lic. Testimony at 40 n.12 (Swim). Second, the resins have a greater affinity for cesium (the principal radionuclide on the resins) than for potassium in fertilizer. Tr. 384 (Hetherington). Third, elution will not occur if the eluting ions are not in solution and if the resins are encrusted. Tr. 376, 378, 380, 385 (Hetherington). Elution therefore would not occur in solidified waste. Tr. 384-85 (Hetherington). Finally, the residual ion exchange capacity that remains on the resins even after they are discharged provides further protection against elution of the radioactive ions. Typically, spent resins when they are discharged still retain about 40% of their ion exchange capabilities. Thus, the presence in

the environment of ions with a greater affinity for the resins than the ions presently held on them would not be expected to cause leakage of ions from the resins. Lic. Testimony at 104 (Hetherington).

151. Mr. Hetherington also testified that resins are not only inert but also nontoxic. Several drugs listed in the United States Pharmacopeia and the Physicians Desk Reference are based on the same type of resins. These drugs are taken orally and contain large quantities of the resins. Lic. Testimony at 102 (Hetherington). The resins have been used in drugs and cough medicines on the market for years. Tr. 364, 374 (Hetherington).

152. Counsel for TCSE (apparently acting on behalf of SOS/CLO) questioned Dr. Hetherington on the Physicians' Desk Reference discussion of Questran (SOS Exhibit 1), which Counsel suggested indicates that the resins might be carcinogenic. See Tr. 373-75. The exhibit does not support this claim. It states:

> In studies conducted in rats in which cholestyramine resin was used as a tool to investigate the role of various intestinal factors, such as fat, bile, salts, and microbial flora, in the development of intestinal tumors induced by potent carcinogens, the incidence of such tumors was observed to be greater in cholestyramine resin treated rats than in control rats. The relevance of this laboratory observation from studies in rats to the clinical use of Questran is not known. In the LRC-CPPT study referred to above, the total incidence of fatal and non-fatal neoplasms was similar in both treatment groups. When the many different categories of tumors were examined, various alimentary system

> cancers were somewhat more prevalent in the cholestyramine group. The small numbers and the multiple categories prevent conclusions from being drawn.

SOS Exh. 1 at 1 (emphasis added). This discussion clearly indicates that the rats developing cancers were being exposed to potent carcinogens, and that conclusions that the resin is carcinogenic cannot be drawn. That large quantities of resins are contained in drugs that are taken orally and have been prescribed for years is a good indication that these resins do not pose a significant health hazard.

153. Mr. Hetherington was also asked why some data safety sheets advise inducing vomiting if resins are ingested. Mr. Hetherington responded that old data sheets from Rohm and Haas (a resin manufacturer) contain this advice, but that other data sheets from Rohm and Haas and Dow Chemical (another resin manufacturer) do not. Tr. 363-64, 383 (Hetherington). Mr. Hetherington further testified that he had spoken to the head of Rohm and Haas' pharmaceutical and special applications group, and they could not understand why the data sheet contained such advice. Tr. 383 (Hetherington).

154. Last, Mr. Bimber questioned whether the resins were flammable and could constitute a fire hazard. Bimber at 6. The resins are not combustible until moisture is removed. When moisture is removed, the resins will burn in flame at 230°C. It is

estimated that auto ignition of pure resins will occur at 427°C (800°F). At Davis-Besse, however, the resins will not be buried in pure form, but rather are already mixed with tens of thousands of cubic feet of water treatment sludge (which is predominantly calcium carbonate) and will be solidified by cement kiln dust. Such a solidified mixture will not be combustible. Lic. Testimony at 105 (Hetherington).

20. Burial Site Management

155. The Presiding Officer's last issue stated, "Describe the Licensee's plans for site management during operation, for marking the burial site, and for record keeping at the burial site." This issue was addressed by Mr. David M. Wallace, a construction engineer and Lead Nuclear Projects Manager for the Davis-Besse Nuclear Station, and by Ms. Scott-Wasilk. During cross-examination of Licensee's witnesses, Mr. Hendron and Mr. Swim also provided pertinent information. The intervenors presented no witnesses to testify on issue 20, though some remarks by Mr. Bimber and Mr. Voytek touched on the issue.

156. Each time it becomes necessary to remove and bury settling basin bottoms, a project manager will be appointed. The project manager will be responsible for construction of the burial cell to be used, for removal of the bottoms from the settling basin and transportation of the bottoms to the constructed cell, and for the subsequent closure of the cell. After the cell is

sealed and the burial project completed, Licensee's Environmental Monitoring Section will assume responsibility for monitoring the burial site and maintaining the cell. Lic. Testimony at 106 (Wallace).

157. The burial project will be conducted in accordance with the Davis-Besse Project Management procedure. The project team will be composed of members of the various divisions with responsibility over aspects of the project. The procedure brings all these divisions together under one project management and ensures an integrated, interdisciplinary approach to the project. Id. at 107 (Wallace).

158. The project manager will develop a detailed project plan. The project plan will define the scope of the work to be done, the project goals and objectives, the project team organization, the method of implementation, schedule, and functional assignments. The project team will perform any further engineering work that might be necessary (for example, to satisfy any additional design features that might be required by the Ohio Permit to Install). The team will develop the final specifications for the project (including the specifications for the synthetic membrane liner). Lic. Testimony at 107-08 (Wallace). The ability to withstand puncture will be taken into account in the selection of the synthetic membrane, as will be the compatability between the waste and liner. A compatability test will be

performed. Tr. 191 (Swim); Tr. 582 (Hendron). The liner will be tested for compatability with the waste (sludge), not leachate, since the sludge would have higher concentrations of the chemicals present and would represent worst case conditions. Tr. 582 (Hendron).32/

159. The actual construction of the cells and transportation of the waste will most likely be performed by contractors. In this case, the project team would prepare purchase order requests governing cell construction and waste transportation. The contractual documents will provide the specifications for the work to be performed and will include quality controls. The project team will oversee the work to ensure it meets the specifications. Lic. Testimony at 107-08 (Wallace).

160. Construction of the cells should be completed in less than 90 days. Tr. 195 (Wallace). The construction will be conducted so as not to disturb previously constructed cells. No machinery will traverse previously constructed cells. Tr. 193-94 (Swim). If a new cell is going to be built adjoining a previously constructed cell, the sides of the new dike will be

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32/ The State's witness, Mr. Voytek, referred to a study suggesting that some chemicals could cause clay liners to leak. Voytek at 14. The chemicals referred to were hazardous organic solvents -- acetone, xylene, and heptane. See Voytek, Attachment F at 2; Tr. 933 (Hendron). These hazardous organic solvents are not present in the waste to be buried at Davis-Besse. Tr. 872 (Voytek); Lic. Testimony at Table 17-1.

constructed before rip-rap is removed from the wall separating the two cells. Tr. 195 (Swim). The removal of the rip-rap will cause no damage. Tr. 194 (Swim). If it rains during construction of the cells, the rainwater will be pumped out and will not affect the materials being worked. Tr. 196-97 (Wallace).

161. After the cell is constructed, the waste will be removed from the settling basin and transported to the cell. Licensee's present concept of operations is as follows: The settling basin will first be dewatered, but not to an extent where the bottoms would dry out. A number of representative samples of the bottoms will be taken to define the content of the bottoms. Then, vacuum trucks will be used to draw the bottoms out of the settling basin. These vacuum trucks are equipped with a suction pump which draws material into closed tanks on the trucks. This operation will be performed by a contractor licensed by the State of Ohio to haul waste. The vacuum trucks will transport the waste to the burial site. Lic. Testimony at 108-09 (Wallace).

162. At the burial site, the waste will be mixed with a solidifying agent (cement kiln dust). Lic. Testimony at 109 (Wallace). This process will be performed in accordance with formal specifications to assure uniformity of the product. Tr. 425 (Wallace). Typically, a backhoe bucket would be used to mix the waste and solidifying agent in the cell. Tr. 425-26 (Wallace); Tr. 433 (Hendron). The same wide-tired equipment

would be used to mix the material as was used to place and compact the liner; hence there will be no unusual loads placed on the liner. Tr. 433 (Wallace). Licensee also anticipates placing a pad or concrete mat in the area of the cell where mixing will start to provide further protection to the liner during the mixing operation. Tr. 425, 434 (Wallace). The solidifying agent will cause the waste to set up. Lic. Testimony at 109 (Wallace).

163. After the waste has solidified, the cell will be capped and the cover seeded. Id. (Wallace). This process should be completed in about a week. Tr. 434 (Wallace). The volume of the cell is sufficient to encompass the waste and kiln dust with about a one foot freeboard. The waste therefore will not overtop the cell, even if rain occurs during the capping process. Tr. 203-04, 583 (Swim); Tr. 435-36, 623 (Hendron).33/

164. Licensee's Environmental Monitoring Section intends to monitor groundwater and to conduct periodic inspections of the cells. Lic. Testimony at 109 (Scott-Wasilk). Final procedures have not yet been prepared, since they will depend on the terms of the Permit to Install issued by the State. Tr. 426-27 (Scott-Wasilk).

33/ The time Licensee estimates for closure is well within the period allowed by Ohio's regulations. Tr. 623 (Wallace).

165. The Environmental Monitoring Section's current plan is to monitor groundwater in four wells. One of the wells will provide background data, and the other three will be located in directions of possible groundwater flow. Water in these wells will be sampled semi-annually for priority pollutants, pH, and radioactivity. Lic. Testimony at 109-10 (Scott-Wasilk). Licensee will also remove and test leachate in the cells. Tr. 193 (Swim). The disposition of the leachate will of course depend on the results of the test. Id. Licensee expects some leachate in the cells initially after they are completed. After a short while, however, leachate should no longer occur. Tr. 192, 423-24 (Hendron).

166. The Environmental Monitoring Section intends to conduct formal inspections of the cells and dikes semi-annually to ensure that cracking of the cover or erosion does not occur. The cells and dikes will also be inspected after any significant flooding event. Lic. Testimony at 110 (Scott-Wasilk). In addition to these formal inspections, the Environmental Monitoring Section conducts site surveys several times a week. The survey teams pass by the burial site area and will be able to observe the condition of the cells. Tr. 245-46 (Scott-Wasilk).

167. If any significant deterioration of a cell is detected, it will be repaired. Lic. Testimony at 110 (Scott-Wasilk); Tr. 200 (Scott-Wasilk). If the vegetative cover on the cell

dies, new grass will be planted. Tr. 247 (Scott-Wasilk). The grass will be watered to the extent necessary. Tr. 248.34/ The Environmental Monitoring Section will also deal with any deep-rooted plants that might seed themselves on the cells and compromise the intergrity of the cells. Tr. 248-49 (Scott-Wasilk). Plant roots are, however, unlikely to penetrate the gravel layer separating the topsoil and compacted clay, since the gravel layer is xeric. Tr. 596-97 (Jackson). The gravel layer also impedes insects from burrowing into the compacted clay below.35/ Tr. 254-56, 597 (Jackson). Groundhogs could perhaps tunnel into a cell, although the gravel layer would again present a barrier. Tr. 256-57 (Jackson). Licensee, however, conducts a vigorous groundhog eradication program under the direction of the U.S. Fish and Wildlife Service in consultation with the Ohio Department of Natural Resources. Tr. 593 (Scott-Wasilk).36/

34/ Watering the grass on the cells should not result in water percolating through the waste. Licensee's cell design calls for a gravel drainage layer between the topsoil and 2-4 feet of compacted clay. Lic. Testimony at 18-19 (Swim); Tr. 250 (Swim). Watering the grass on the topsoil would be no different than rain. Tr. 248 (Scott-Wasilk).

35/ Insects are also unlikely to burrow into the clay layer because the clay lacks nutrients. Tr. 256 (Jackson).

36/ If a groundhog did tunnel into the clay cover of a waste burial cell, there would be little impact. Very little, if any, water would run off into the burrow during the time intervals between Licensee's surveys and repair. Tr. 598 (Hendron).

168. The Environmental Monitoring Section will maintain a description of the waste in each cell, identified by type, volume, content, and date of burial. The location of each cell will be surveyed and recorded on a plat. In addition, all settling basin sampling data, all groundwater monitoring data and reports, all burial site inspection reports, and all maintenance reports will be retained. These documents will be kept available for inspection and will be treated as NRC permanent records. Project records pertaining to the design and construction of the cells will also be retained as NRC permanent records under the Davis-Besse Nuclear Records Program. Lic. Testimony at 110-11 (Wallace, Scott-Wasilk).

169. Since the burial cells will be surveyed and recorded on a plat, and since the cells are raised, diked structures, there is no need to erect monuments or markers to define the bounds of the cells. Licensee will post signs to alert any person in the area and to prohibit unauthorized access. Id. at 111 (Scott-Wasilk).

C. Conclusion

170. The petitions of the intervening parties, particularly the State, raised a number of issues which the questions above address. Those issues are: (1) does the radioactivity of the waste to be buried pose an undue risk to the public health and safety; (2) does section 102(2)(C) of the National Environmental

Policy Act (NEPA) require the preparation of an environmental impact statement; (3) does section 102(2)(E) of NEPA require a study of alternatives, and (4) have the consultation provisions of the Endangered Species Act been complied with. Inherent in each of these issues is the more general question whether sufficient information exists for their determination (i.e. to the extent necessary to resolve the issues above, are the characteristics of the waste and the site sufficiently well known). Based on the findings above, each of these questions is resolved and decided in Licensee's favor.

171. Licensee has clearly developed sufficient information to resolve the pertinent issues. The levels of radioactivity in the waste are known and unchallenged. The chemical nature of the waste has been ascertained and evaluated against EPA criteria. The location of the site has been specified, and the design characteristics of the cells are sufficiently developed to permit determinations as to the radiological and environmental impact of the project. See, e.g., Tr. 624-25, 953 (Hendron).37/ The geology and hydrology of the site, including the potential for flooding, have been extensively explored. The effect of the project on wildlife and endangered species has also been evaluated.

37/ Further details on site design and operation may need to be developed by Licensee to obtain a permit to install from the State, but that process and the State's requirements belong to the State, are beyond the province of the Commission.

172. The record in this proceeding establishes unequivocally that the waste in question at the Davis-Besse site presents no radiological hazard. Licensee's testimony was essentially unchallenged and uncontradicted. Accordingly, the waste burial project presents no radiological risk to the public health and safety.

173. The record in this proceeding also establishes that the burial of the waste at the Davis-Besse site will have no significant environmental impact. There will be no radiological impact. Nor will there be any significant effect from the chemical constituents of the waste, which are harmless. The burial site is not being built in and will have no impact on a wetland. No endangered species will be affected. Licensee's design of the burial cells and the geologic characteristics of the site ensure that groundwater will not become contaminated, but even if leachate did reach the water table, the levels of contaminants would pose no hazard. The burial site will be adequately protected against flooding. Moreover, even if floods did damage the site, no adverse effect would be anticipated because of the innocuous nature of the waste. Since there will be no significant environmental impact, section 102(2)(C) of the National Environmental Policy Act (NEPA) does not require the preparation of an environmental impact statement. 42 U.S.C. § 4332(2)(C) (1982); 10 C.F.R. § 51.20

174. Section 102(2)(E) of NEPA, 42 U.S.C. § 4332(2)(E) (1982), which requires an agency to study, develop and describe appropriate alternatives to any action in any proposal which involves "unresolved conflicts concerning alternative uses of available resources," is distinct from NEPA's EIS requirement. Consumers Power Co. (Big Rock Point Nuclear Plant), ALAB-636, 13 N.R.C. 312, 332 n.41 (1981). The burial of waste at Davis-Besse, however, does not involve an unresolved conflict concerning alternative uses of available resources. The Davis-Besse site, including the burial ground, is already dedicated to use for a nuclear facility. There is no significant environmental impact associated with the burial project. These determinations obviate any further evaluation of alternatives. "[N]either section 102(2)(C) nor section 102(2)(E) of NEPA obligates the federal agency 'to search out possible alternatives to a course which itself will not either harm the environment or bring into serious question the manner in which this country's resources are being expended.'" Duke Power Co. (Amendment to Materials License SNM-1773 -- Transportation of Spent Fuel From Oconee Nuclear Station for Storate at McGuire Nuclear Station), ALAB-651, 14 N.R.C. 307, 321-22 (1981); Portland General Electric Co. (Trojan Nuclear Plant), ALAB-531, 9 N.R.C. 263, 266 (1979). See also Virginia Electric and Power Co. (North Anna Nuclear Power Station, Units 1 and 2), ALAB-584, 11 N.R.C. 451, 457 (1980).

175. Furthermore, even if section 102(2)(E) were invoked, its mandate would be satisfied by the evaluation which has been conducted of the only alternative to burial, i.e., off-site disposal, which as discussed below the NRC has studied and developed in depth. The authorization granted by the NRC to Licensee to bury very low level waste is directly attributable to that study.

176. The Commission's efforts to study and develop licensing criteria for low level radioactive waste disposal sites commenced in 1978 and culminated with the publication of 10 C.F.R. Part 61 in December, 1982. See 47 Fed. Reg. 57,446 (1982). The NRC's environmental evaluation for low-level radioactive waste disposal sites is contained in NUREG-0782, the Draft Environmental Impact Statement on 10 C.F.R. Part 61: "Licensing Requirements for Land Disposal of Radioactive Waste" (Sept. 1981), and NUREG-0945, the Final Environmental Impact Statement on 10 C.F.R. Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste" (Nov. 1982). NUREG-0945 is a three-volume, 1000 page report.

177. Stemming from this effort was the realization that the volume of low-level waste shipped to commercial disposal sites had to be minimized. The Comission therefore issued a policy statement to that effect. Policy Statement on Low Level Waste Volume Reduction, 46 Fed. Reg. 51,100 (1981). This policy is intended to extend the operational lifetime of the existing low-level disposal sites, alleviate concern for adequate storage

capacity if there are delays in establishing additional regional sites, and reduce the number of waste shipments. Id.

178. In the same vein, the Commission recognized the need for a de minimis classification of wastes, to be exempted on a case by case basis from Part 61 and considered of no regulatory concern. 46 Fed. Reg. 38,081, 38,085 (1981). In the statement accompanying the final Part 61 rule, the Commission stated

> The Commission agrees with the importance of setting timely standards for disposal of certain wastes by less restrictive means. The Commission agrees with the commenters that establishment of such de minimis levels would reduce costs of disposal for many licensees and would also conserve space in disposal facilities which are otherwise designed for wastes having much higher activities. The Commission also believes that establishment of de minimis levels is important in enhancing overall stability of a disposal facility, and therefore in reducing potential long-term site maintenance and corresponding costs, since de minimis levels would reduce the volume of Class A waste. This would also tend to reduce ground water migration impacts, since subsidence and water infiltration would be reduced.

47 Fed. Reg. 57,446, 57,453 (1982). The Commission invited licensees to continue to request amendments for alternative disposal methods for the licensee's own waste pursuant to 10 C.F.R. § 20.302. Id. Thereafter, the NRC issued IE Information Notice No. 83-05, "Obtaining Approval for Disposing of Very-Low-Level Radioactive Waste -- 10 C.F.R. Section 20.302" (Feb. 24, 1983), pursuant to which Licensee sought the approval that was the

subject of this proceeding. The Commission's policy to minimize the volume of low-level waste delivered to disposal sites has now been made a Congressional mandate. Low Level Radioactive Waste Policy Amendments Act of 1985, Pub. L. No. 99-240, §§ 6(i), 10, 99 Stat. 1842, 1857, 1859 (1986).

179. Thus, it is evident that the authorization to bury very low level waste at Davis-Besse was granted by the NRC only after and as a result of its studying the developing provisions governing off-site disposal. The NRC's action reflects an informed and a reasonable choice among alternatives.

180. Finally, the Presiding Officer concludes that the consultation provisions of the Endangered Species Act have not been violated. The Endangered Species Act states, ". . . a Federal agency shall consult with the Secretary on any prospective agency action at the request of, and in cooperation with, the prospective permit or license applicant if the applicant has reason to believe that an endangered species or threatened species may be present in the area affected by his project and that implementation of such action will likely affect such species." 16 U.S.C. § 1536(a)(3) (1982) (emphasis added).

181. Here, there has been a determination that there will be no significant environmental impact. The levels of radioactivity in the waste are de minimis, the chemical content of the material is innocuous, and the minor change in on-site land usage is

insignificant. In addition, studies of the bird populations at the Davis-Besse site have been conducted over a nine year period. At no time was any endangered species found inhabiting the site. The particular burial site is not part of a marsh habitat and is not a principal nesting, feeding, or roosting site for any birds. Nor is it important to any mammalian or reptile species. There is therefore no indication that the burial of the waste "will likely affect such species," and the consultation provision of Section 7 of the Endangered Species Act is not invoked.

III. CONCLUSIONS OF LAW

1. There is reasonable assurance that the secondary system demineralizer resins and water treatment sludge can be buried at the Davis-Besse Nuclear Station without endangering the health and safety of the public.

2. The issuance of a materials license authorizing burial of this waste is not inimical to the public health and safety or the common defense and security.

3. The burial will have no significant environmental impact, and the National Environmental Policy Act therefore does not require that an environmental impact statement be prepared. 42 U.S.C. § 4332 (1982).

4. There are no unresolved conflicts concerning alternative uses of available resources, and the National Environmental Policy Act therefore does not require further studies. 42 U.S.C. § 4332.

5. There is no reason to believe that any endangered species will be affected by the waste burial, and the consultation provisions of the Endangered Species Act are therefore not invoked. 16 U.S.C. § 1536(a)(3).

6. The NRC's environmental assessment, 50 Fed. Reg. 41,266 (1985), is amended pro tanto to include these findings and conclusions. 10 C.F.R. § 51.103(b); Allied Central Nuclear Services (Barnwell Nuclear Fuel Plant Separations Facility), ALAB-296, 2 N.R.C. 671 (1975).

IV. ORDER

The authority previously granted by the Nuclear Regulatory Commission to The Toledo Edison Company to bury water treatment sludge and secondary side demineralizer resins on the site of the Davis-Besse Nuclear Station is hereby affirmed. In accordance with the Commission's Order of February 21, 1986, this Decision

will become final agency action thirty days after the date of issuance, unless the Commission on its own motion undertakes a review of the Decision. No petition for review of this Decision will be entertained.

IT IS SO ORDERED.

Helen F. Hoyt
Administrative Judge

Dated at Bethesda, Maryland
this __ day of _____, 1986

September 8, 1986

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Administrative Judge

In the Matter of	)	
	)	
TOLEDO EDISON COMPANY, et al.	)	Docket No. 50-346-ML
	)	
(Davis-Besse Nuclear Power Station, Unit No. 1)	)	
	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Licensee's Proposed Findings of Fact and Conclusions of Law in the Form of an Initial Decision," dated September 8, 1986, were served upon those persons on the attached Service List by deposit in the United States mail, postage prepaid, or where indicated by an asterisk (*), by hand delivery, this 8th day of September, 1986.

Respectfully submitted,

David R. Lewis

Dated: September 8, 1986

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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(Davis-Besse Nuclear Power Station, Unit No. 1)	)	

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