Appendix B. Figures

Figure B-1. Location of ISFSI

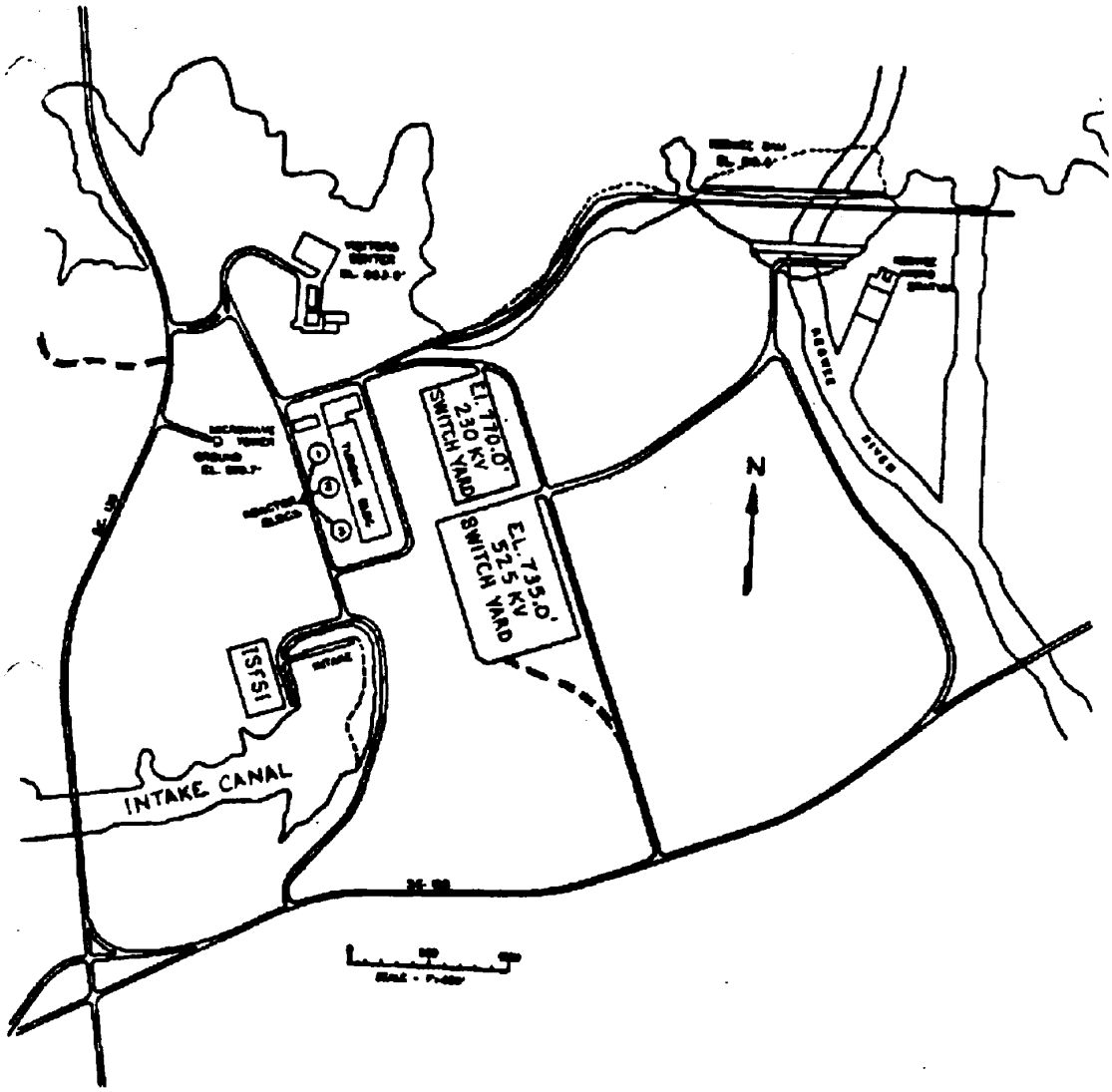


Figure B-2. General Location

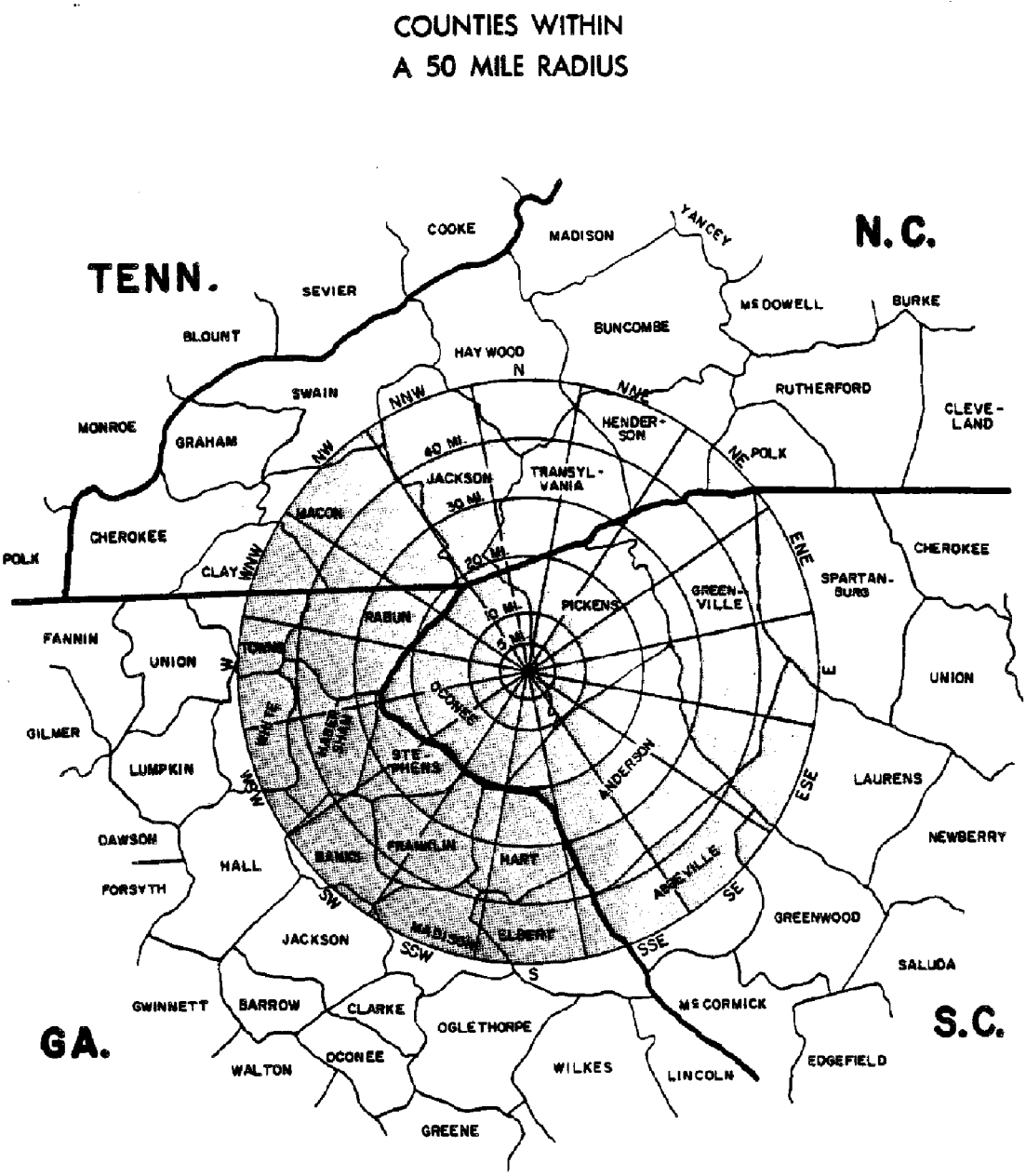


Figure B-3. Site Plan

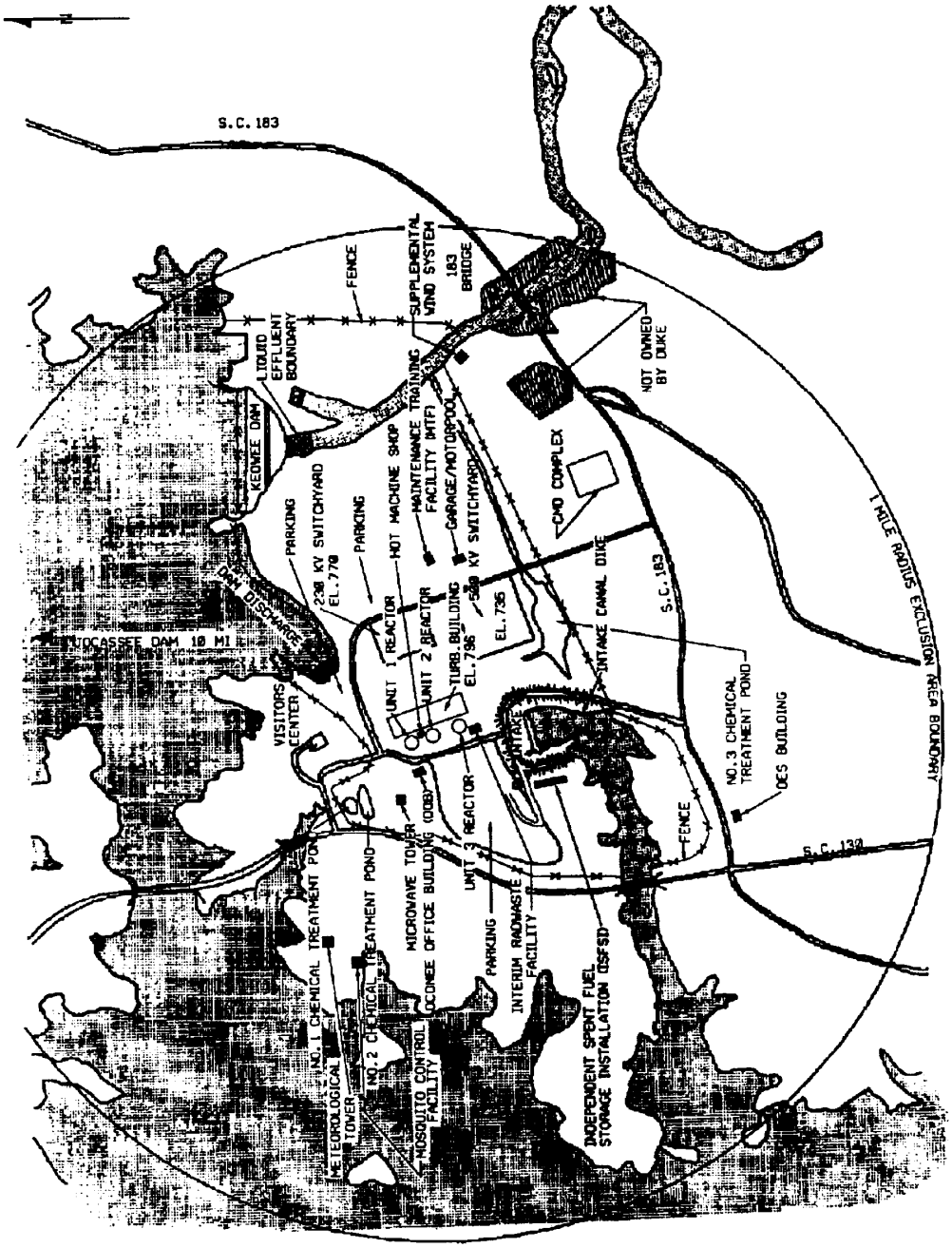


Figure B-4. ISFSI Layout

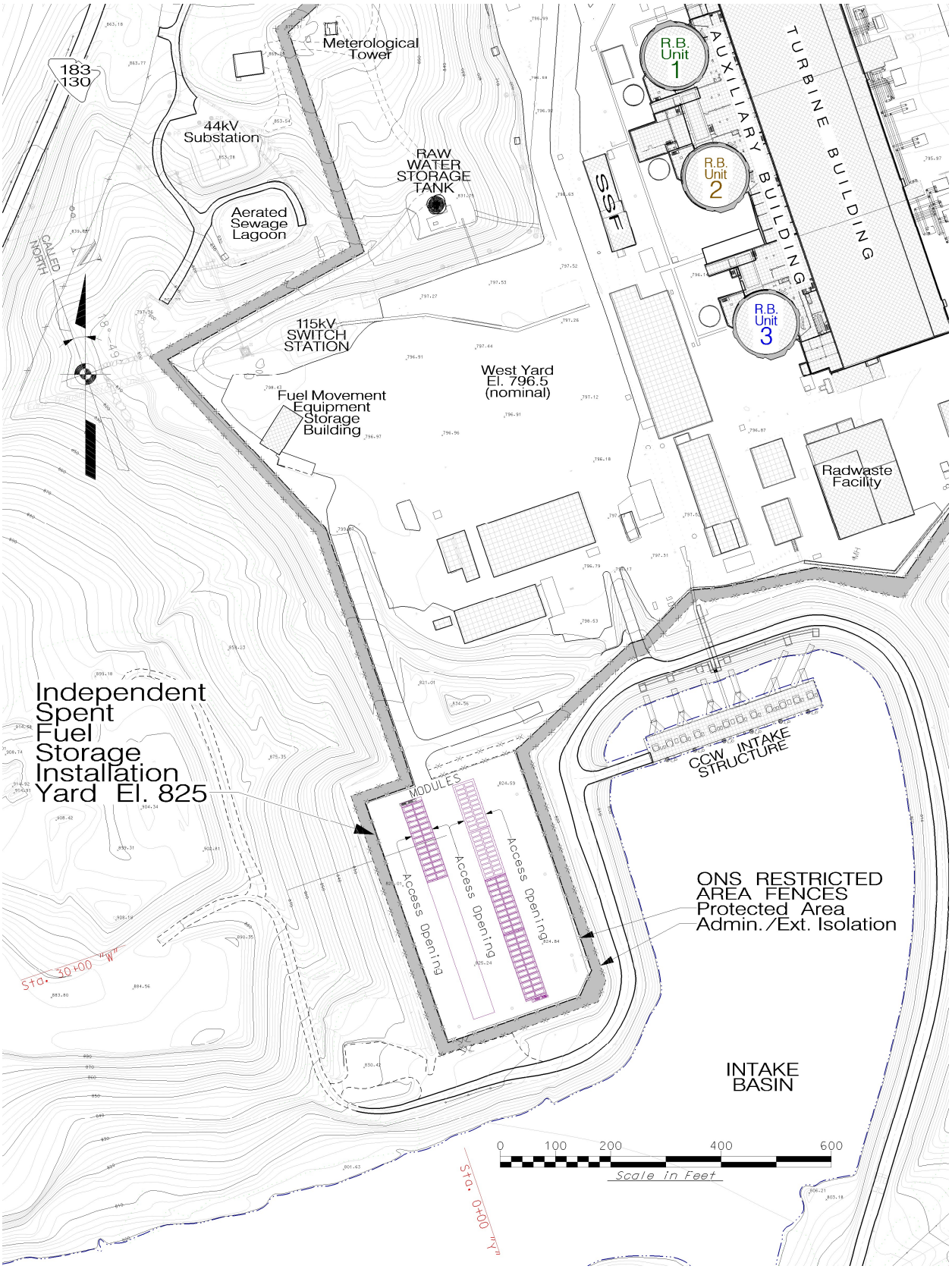


Figure B-5. Topography Within 5 Miles

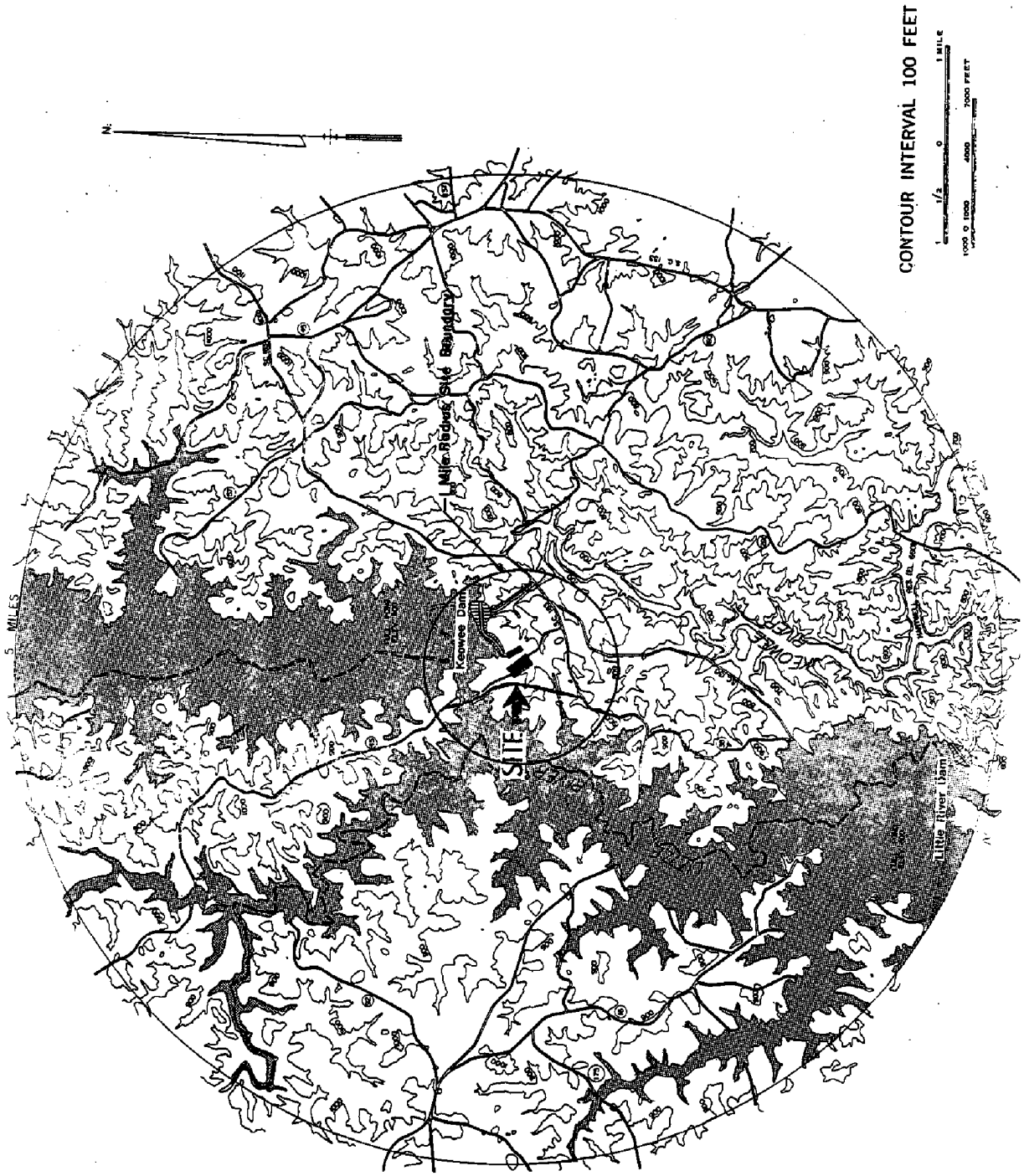


Figure B-6. Relative Positions of Meteorological Instruments

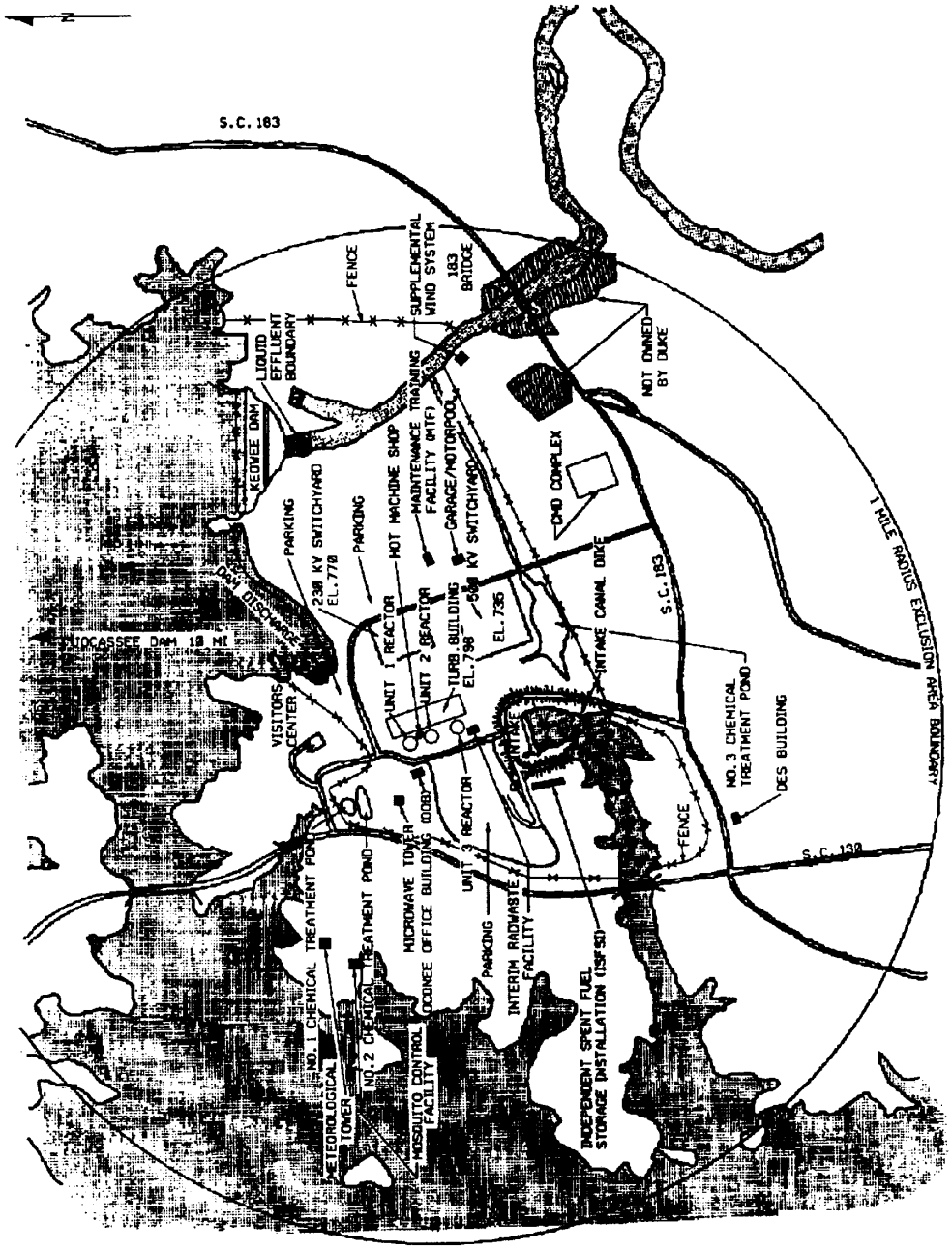


Figure B-7. Relative Elevations of Meteorological Instruments

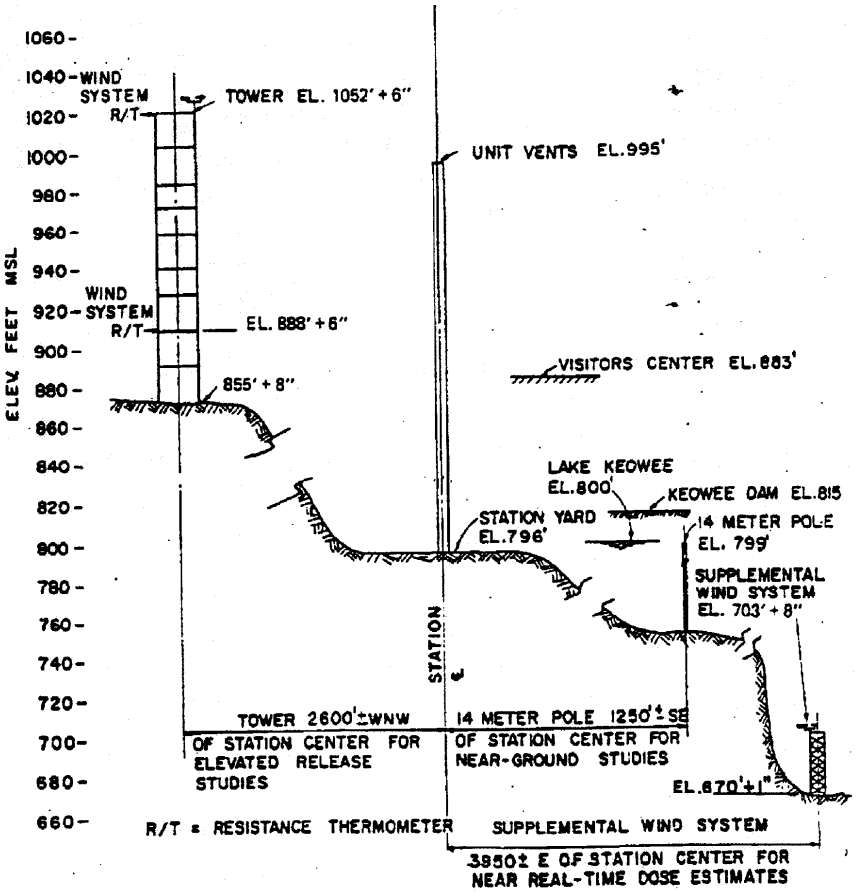


Figure B-8. Areal Groundwater Survey

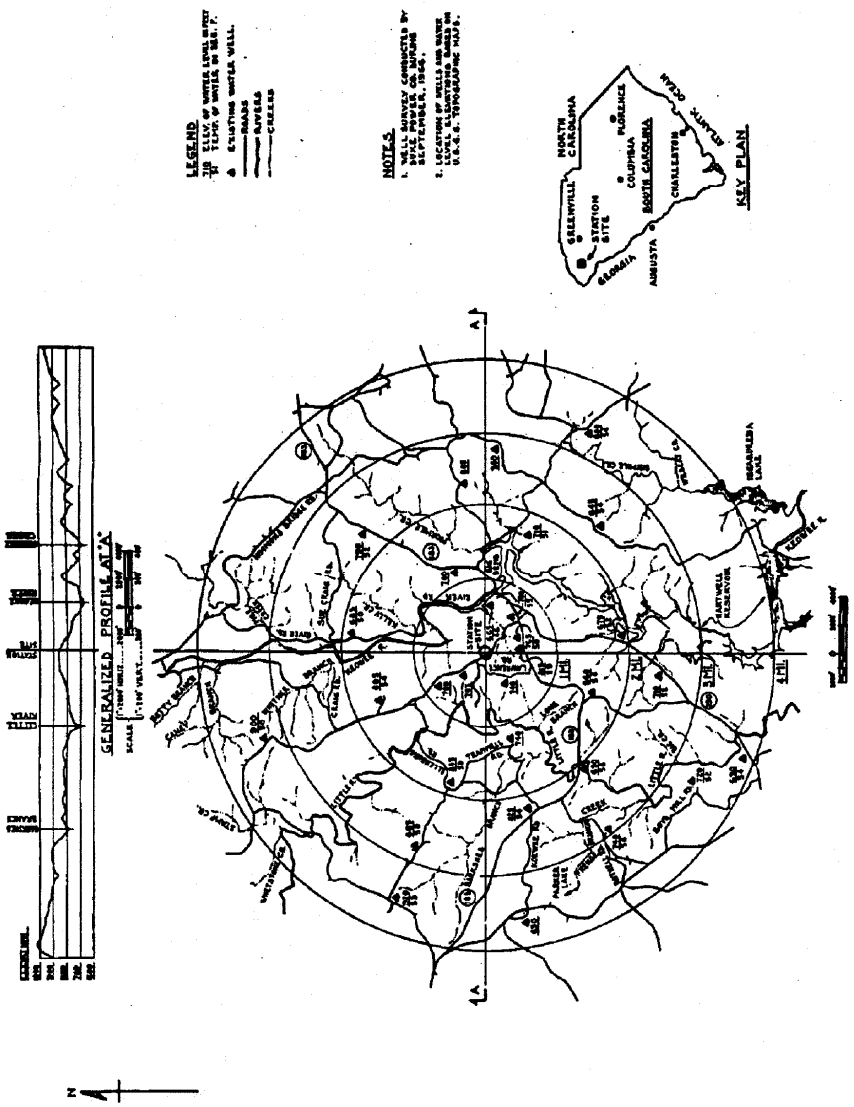


Figure B-9. Groundwater Survey at Station Site

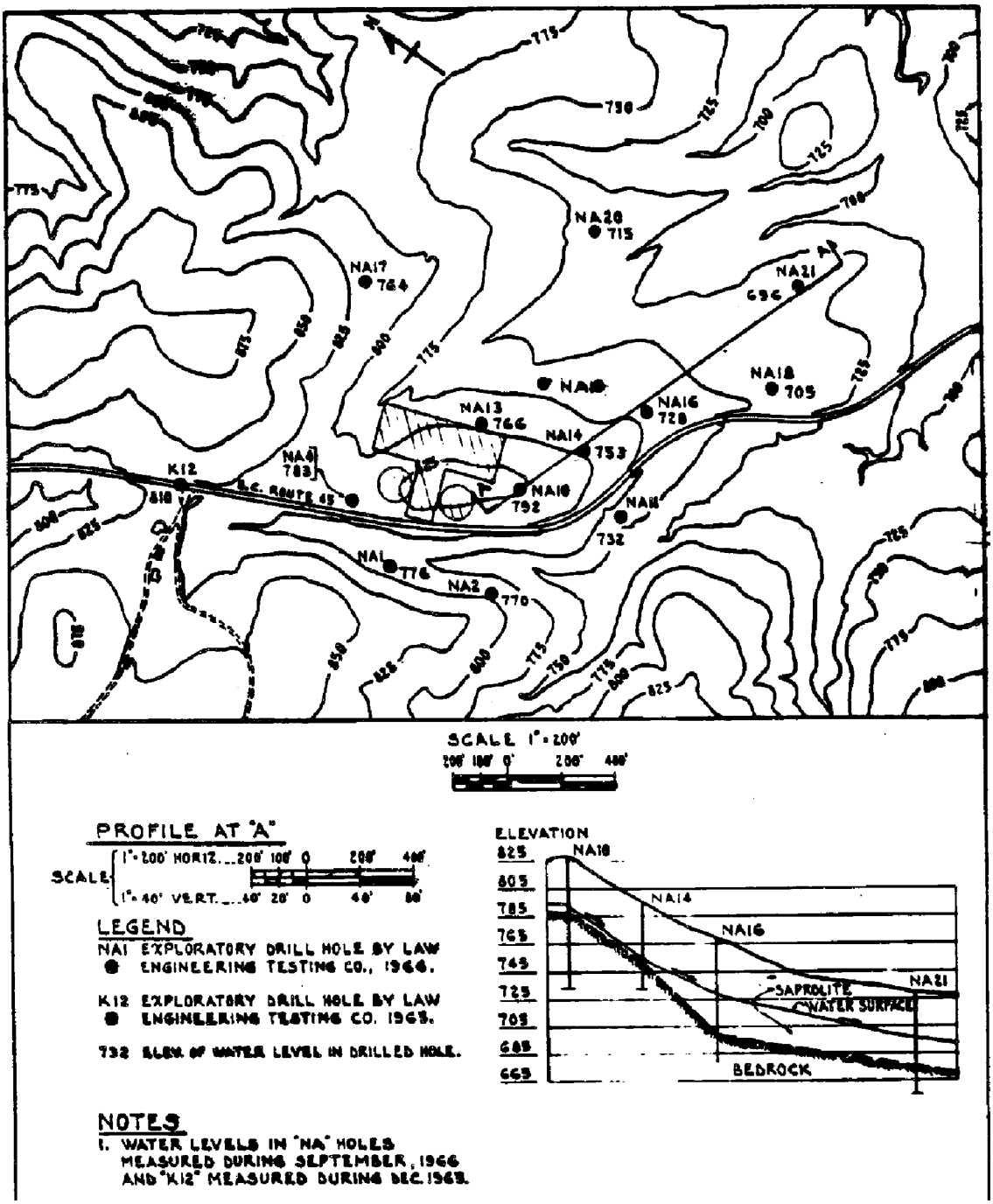
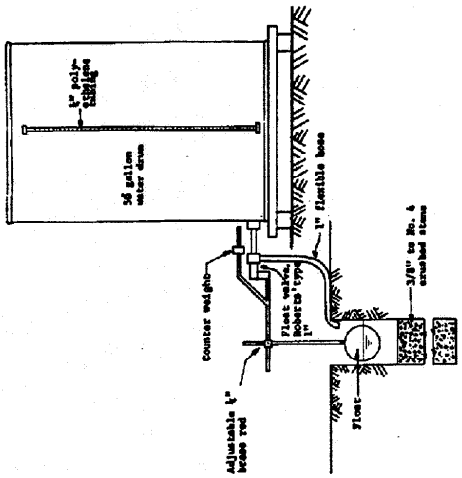


Figure B-10. Well Permeameter Test Apparatus



FIELD PERMEABILITY TESTING

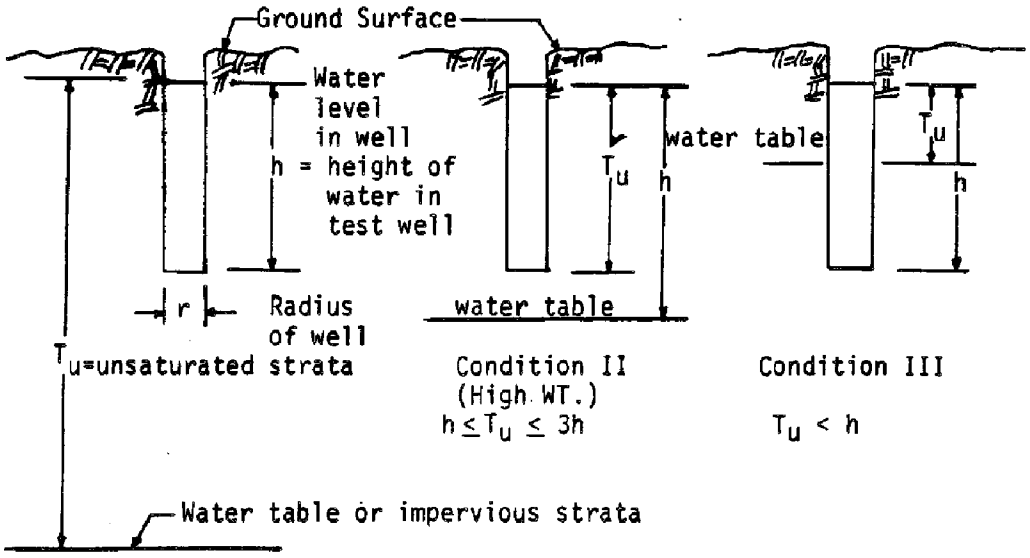
The tests were run according to the Bureau of Reclamation's Field Permeability Test, Earth Manual, E-18. Three suitable vicinity of each of the exploratory borings were selected as the locations for the wells: BA-9, BA-11, BA-13, and BA-15 (Figure 2.6.13-2). Two 8 in. diameter holes were drilled at each location, to the refusal of the auger used. The BA-9 test wells were drilled with a 27 in. auger. Generally, the test wells were within 20 ft. of the exploratory borings.

The wells were prepared with care in order to cause as little disturbance to the surrounding soil as possible. No water was encountered in any of the wells. After the wells were cleaned, the sides and bottoms were lightly scraped where necessary, and the loose soil was removed from the bottom.

After cleaning, all wells were backfilled with 3/8 in. to Number 4 size crushed stone and covered with plastic sheets until time of testing. The settlement was checked periodically by measuring to the top of the stone. Each 20 inch drop was calibrated in increments of 1/16 of an inch change in water level which corresponds to 0.0162 cubic feet of water.

For each test the permeability equipment, as shown, was set up. The crushed stone was removed to a depth of approximately 1 ft. below the ground surface and the Roberts type valve float bob was adjusted so that a water level would be maintained constant at about 6 in. depth. All depths from the ground surface were measured from a baseline string stretched across the hole at ground level. The drum was filled with water and the test started. Water readings of water level (to the nearest 1/16 of an inch) and time (to the nearest minute) were taken throughout the test. Plots of cumulative water volume versus time were prepared during each test. In general, the dry soil at the start of the test absorbed water at a comparatively high rate, but as the soil became saturated the rate decreased to a point where it became practically constant. When this occurred, as evidenced by the plotted points on the curve falling on practically a straight line for several hours, the tests were discontinued. This data is available but has not been included on the test summary. The slope of the straight line portion of the curve is measured to determine the coefficient of permeability, k. Figure 2.6.13-4 shows the formulae used for determining the coefficient of permeability, k and Table 2.6.13-1 summarizes the results of the test.

Figure B-11. Formulae For Determining Permeability



Condition I
(Low Wt.)
$T_u > 3h$

Condition I: $$k_{20} = 525{,}600 \frac{\left[\sinh^{-1} \frac{h}{r} - 1\right] \frac{Q}{2\pi}}{h^2} \left(\frac{\mu_T}{\mu_{20}}\right)$$

Condition II: $$k_{20} = \frac{525{,}600 \log_e \frac{h}{r} \frac{Q}{2\pi}}{h^2 \left[\frac{1}{6} + \frac{1}{3}\left(\frac{h}{T_u}\right)^{-1}\right]} \left(\frac{\mu_T}{\mu_{20}}\right)$$

k_{20} = coefficient of permeability, feet per year

h = height of water in the well, feet

r = radius of well, feet

Q = discharge rate of water from the well for steady state condition, $ft^3/min.$

μ_T = viscosity of water at temperature T

μ_{20} = viscosity of water at 20°-C

T_u = unsaturated distance between the water surface in the well and the water table, feet

Figure B-12. General Site Area

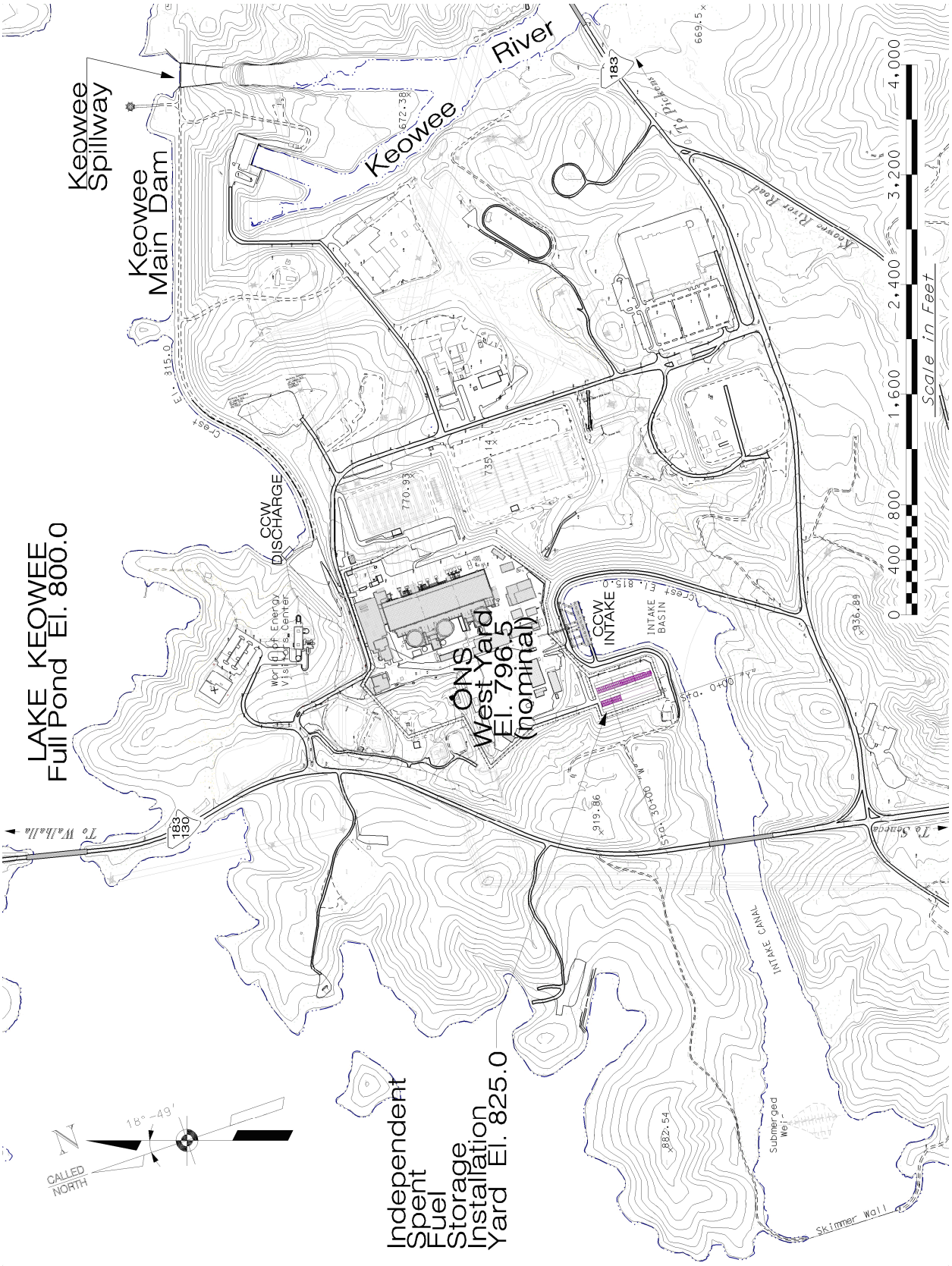


Figure B-13. Site Boring Plan

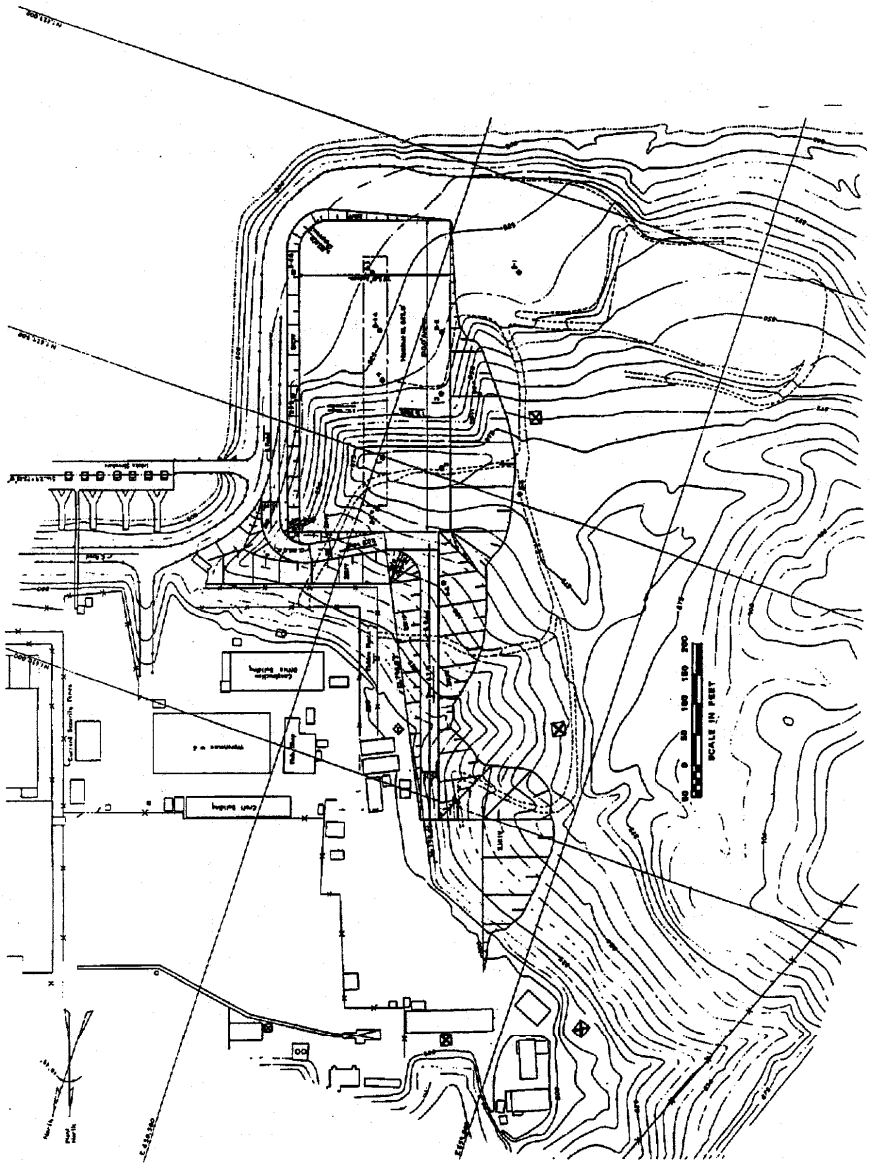


Figure B-14. Core Boring Record

BORING DESIGNATION 1

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Red micaceous silty fine to medium sand			881.80	N = 13
5.0	Strong brown micaceous fine to medium sandy silt			876.80	N = 6
10.0	Gray/brown micaceous silty fine/coarse sand			871.80	N = 11
15.0				866.80	Undisturbed Sample 17.6′ – 19.5′
20.0	Black/gray micaceous slightly silty fine/coarse sand w/gravel			861.80	N = 12
22.6	Brown micaceous silty fine/coarse sand Black/reddish brown very micaceous fine to medium sandy silt			859.20	N = 6
25.0	Brown/white micaceous silty fine to coarse sand			856.8	N = 10
30.0	Black/gray micaceous silty fine to coarse sand			851.8	N = 100

BORING DESIGNATION 1

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0	Black light gray micaceous slightly silty fine to coarse sand			846.80	N = 100 Undisturbed Sample 37.6′ – 37.8′
40.0	Light brown/light gray micaceous slightly silty fine to coarse sand			841.80	N = 49
45.0	Top: Reddish brown micaceous fine sandy silt. Bottom: Light brown to gray (light) micaceous slightly silty fine to coarse sand			836.80	N = 100
50.7	Carbide fishtail refusal			831.10	
55.0		42.9	NX		
60.0		84.5	NX	821.80	
60.2	Water Table			821.60	
70.0		98.0	NX	811.80	
79.4	Coring Terminated			802.40	

Figure B-15. Core Boring Record

BORING DESIGNATION 2

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Bownish red micaceous silty fine to coarse sand			881.62	N = 29
5.0	Brownish red micaceous fine to medium sandy silt, Black/light gray silty sand at bottom of sample			876.62	N =100
10.0	Black strong brown micaceous silty fine to coarse sand			871.62	N = 100
14.5	Carbide fishtail refusal			867.12	
15.0		0.0	NX	866.62	
20.0				861.62	
25.0		0.0	NX	856.62	
30.6	Re-enter Hole w/fishtail Light brown to gray micaceous silty fine to medium sand			851.02	N = 17
35.0				846.62	Undisturbed sample 38.1′ – 39.9′
40.0	Brown to light gray micaceous silty fine to coarse sand			841.62	N = 100

BORING DESIGNATION 2

Depth Ft	**Description**	**ROD %**	**BIT Size**	**Elev**	**Remarks**
45.0	Brown to light gray micaceous silty fine to coarse sand			836.62	N = 100
53.7	Carbide fishtail refusal			827.92	
55.0				826.62	
60.0		97.0	NX	821.62	
60.3	Water Table			821.32	
70.0		100.0	NX	811.62	
78.8	Coring Terminated			802.82	

Figure B-16. Core Boring Record

BORING DESIGNATION 3

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0				834.41	
5.0	Light brown/light gray micaceous silty fine to medium sand, strong brown/black micaceous silty fine to medium sand			829.41	N = 100
10.4	Carbide fishtail refusal			824.01	
15.0		43.6	NX	819.41	
18.9	Water Table			815.51	
19.9	Boring Terminated			814.51	

Figure B-17. Core Boring Record

BORING DESIGNATION 4

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0				828.37	
5.0	Yellowish brown/light gray micaceous silty fine to coarse sand			823.37	N = 37
10.0	Brown/light gray micaceous silty fine to coarse sand			818.37	N = 100
13.1	Carbide fishtail refusal			815.27	
15.0		59.4	NX	813.37	
18.1	Water Table			810.27	
20.0	Coring Terminated			808.37	

Figure B-18. Core Boring Record

BORING DESIGNATION B-1

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Reddish brown, mica, silty, fine to coarse sand (some ground)			828.32	N = 45
5.0				823.32	Undisturbed Sample 7.4′ – 9.9′
10.0	Olive brown, mica, silty, fine to medium sand			818.32	N = 10
15.0	Reddish yellow, mica, silty, fine to medium sand			813.32	Undisturbed Sample 17.4′ – 19.9′ N = 51
20.0	Reddish yellow, mica, silty, fine to medium sand			808.32	N = 44
25.0	Light olive brown/white, mica, silty, fine to medium sand			803.32	Undisturbed Sample 27.4′ – 28.6′ N = 49
30.0	Light olive brown/white, mica silty, fine to medium sand			798.32	Undisturbed Sample 32.4′ – 33.5′ N = 100
32.5	Water Table			795.82	

BORING DESIGNATION B-1

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0	Light olive brown, mica, silty fine to coarse sand			793.32	N = 100
40.0	Light olive brown/white, mica, silty fine to medium sand			788.32	N = 100
46.7	Carbide fishtail refusal			781.62	
50.0		55.4	NQ	778.32	
55.0				773.32	
60.0		90.5	NQ	768.32	
64.5	Coring Terminated			763.82	

Figure B-19. Core Boring Record

BORING DESIGNATION B-2

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0				831.01	Undisturbed Sample 2.5′ – 5.0′
5.0	Strong brown, mica, silty fine to medium sand			826.01	N = 8 Undisturbed Sample 7.5′ – 10.0′
10.0	Light pole brown, mica, silty, fine to medium sand			821.01	N = 15 Undisturbed Sample 12.5′ – 15.0′
15.0	Yellowish brown, mica, silty, fine to medium sand			816.01	Undisturbed Sample 15.0′ – 16.7′ N = 23
20.0	Strong brown, mica, silty, fine to medium sand			811.01	N = 100
25.0	No Description			806.01	N = 100
30.0	Very pale brown/yellowish brown mica, silty, fine to coarse sand			801.01	N = 30
32.2	Water Table			798.81	

BORING DESIGNATION B-2

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
37.4	Carbide fishtail refusal			793.61	
40.0		40.8	NQ	791.01	
45.0		61	NQ	786.01	
50.0		100	NQ	781.01	
59.0	Coring Terminated			772.01	

Figure B-20. Core Boring Record

BORING DESIGNATION B-3

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0				820.98	Undisturbed Sample 2.0′ – 4.5′
5.0	Light yellowish brown/reddish brown, mica, silty, fine to medium sand			815.98	Undisturbed Sample 4.5′ – 7.0′ N = 12
10.0	Light yellowish brown/strong brown, mica, fine to medium sandy silt			810.98	Undisturbed Sample 12.0′ – 14.5′ N = 11
15.0				805.98	Undisturbed Sample 17.0′ – 19.5′
20.0	Light yellowish brown/strong brown mica, fine to medium sandy silt			800.98	Undisturbed Sample 19.5′ – 22.0′ N = 13
23.9	Water Table			797.08	
25.0				795.98	Undisturbed Sample 27.0′ – 29.5′
30.0	White/pinkish gray, mica, silty, fine to coarse sand			790.98	N = 65 Undisturbed Sample 32.0′ – 33.6′

BORING DESIGNATION B-3

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0	White/pinkish gray, mica, silty, fine to medium sand			785.98	N = 100
37.0	White/pinkish gray, mica, silty, fine to medium sand			783.98	N = 27
40.1	Carbide fishtail refusal			780.88	
45.0		99	NQ	775.98	
50.1	Coring Terminated			770.88	

Figure B-21. Core Boring Record

BORING DESIGNATION B-4

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0				878.53	Undisturbed Sample 2.4′ – 4.9′
5.0	Reddish brown/red, mica, silty, fine to medium very sandy clay			873.53	N = 19 Undisturbed Sample 7.4′ – 9.9′
10.0	Reddish brown/red, mica, silty, fine to medium very sandy clay			868.53	N = 100
	Light brown yellow/yellowish brown, mica, silty, fine to coarse sand (with gravel)				N = 49
15.0	Light brownish yellow/yellowish brown, silty, fine to coarse sand			863.53	N = 100
20.2	Carbide fishtail refusal			858.33	
25.0		12.1	NQ	853.53	
30.0		0	NQ	848.53	
35.0				843.53	
40.0	Yellow/brownish yellow, mica, silty fine to medium sand			838.53	N = 100

BORING DESIGNATION B-4

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
	Pale brown/light yellow brown, mica, silty, fine to medium sand				N = 100
43.9	Water Table			834.63	
45.0	No Description			833.53	N = 100
49.9	Carbide fishtail refusal			828.63	
50.0				828.53	
55.0		91	NQ	823.53	
59.9	Coring Terminated			818.63	

Figure B-22. Core Boring Record

BORING DESIGNATION B-5

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0				853.63	Undisturbed Sample 2.2′ – 4.7′
5.0	Red/Reddish brown, mica, silty, fine/medium sand			848.63	N = 12 Undisturbed Sample 7.2′ – 8.2′
	Red/yellowish red, mica, silty, clay, fine to medium sand				N = 12
10.0				843.63	Undisturbed Sample 12.2′ – 14.7′
15.0	Light yellow brown/brownish yellow, mica, silty, fine to coarse sand (with gravel)			838.63	Undisturbed Sample 14.7′ – 17.2′ N = 11
20.0				833.63	Undisturbed Sample 22.2′ – 24.7′
25.0	White yellowish brown, mica, silty fine to coarse sand			828.63	Undisturbed Sample 24.7′ – 26.7′ N = 100
27.8	Carbide fishtail refusal			825.38	
30.0		0	NQ	823.68	

BORING DESIGNATION B-5

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0	White/dark red mica, silty fine to coarse sand			818.63	
36.5	Carbide fishtail refusal			817.13	
40.0		50	NQ	813.63	
44.9	Water Table			808.73	
45.0		48	NQ	808.63	
50.0				803.63	
55.0		96	NQ	798.63	
64.3	Coring Terminated			789.33	

Figure B-23. Core Boring Record

BORING DESIGNATION B-1*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Strong brown/reddish brown mica, silty, fine to coarse sand			824.59	N = 12
5.0				819.59	Undisturbed Sample 7.0′ – 9.5′
10.0	Reddish brown/brownish yellow, mica. silty fine/coarse sand			814.59	N = 17 Undisturbed Sample 9.5′ – 12.0′
15.0				809.59	Undisturbed Sample 17.0′ – 19.5′
20.0	White/brown mica, silty fine/coarse sand w/gravels			804.59	N = 59 Undisturbed Sample
25.0	White/brown mica, silty fine to coarse sand			799.59	N = 100
26.2	Water Table			798.39	
30.4	Carbide Refusal Boring Terminated			794.19	

Figure B-24. Core Boring Record

BORING DESIGNATION B-2*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Red mica, silty, clayey, fine/medium sand			869.38	N = 20
5.0				864.38	Undisturbed Sample 6.9’ – 9.4’
10.0	Strong brown/white, mica, silty fine/medium sand			859.38	N = 8 Undisturbed Sample 9.4’ – 11.4’
15.0	Strong brown/dark brown, silty, mica, fine/medium sand			854.38	N = 9 Undisturbed Sample 16.9’ – 18.9’ Undisturbed Sample 18.9’ – 20.9’
20.0	White, brown mica, silty fine to medium sand			849.38	Undisturbed Sample 20.9’ – 22.9’ N = 100
25.0				844.38	
30.0	Yellowish red/strong brown mica, silty fine/medium sand			839.38	N = 16

BORING DESIGNATION B-2*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0				834.38	Undisturbed Sample 36.9′ – 38.9′ Undisturbed Sample 38.9′ – 40.9′
40.0	White/brown, mica, silty, fine/medium sand			829.38	N = 17
45.0	White/strong brown mica, silty, fine/medium sand			824.38	N = 21
50.0	Brown/yellowish red, mica, silty, fine medium sand			819.38	Undisturbed Sample 51.9′ – 54.1′ N = 29
55.0	Yellowish red/brown, mica, silty, fine/coarse sand			814.38	N = 27
60.0	White/brown mica, silty fine/ medium sand			809.38	N = 100 Undisturbed Sample 61.9′ – 62.65′
67.0	Carbide refusal Boring Terminated			802.38	

Figure B-25. Core Boring Record

BORING DESIGNATION B-3*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Red, mica, silty, clayey, fine/medium sand			861.54	N = 16
5.0				856.54	Undisturbed Sample 7.0′ – 9.5′
	Dark brown/strong brown, mica, silty fine/coarse sand with gravels				N = 20
10.0	Brown/strong brown, mica, silty, fine/medium sand			851.54	N = 12
15.0				846.54	
20.0				841.54	Undisturbed Sample 20.0′ – 22.5′
					Undisturbed Sample 22.5′ – 24.4′
25.0	White/light brown mica, silty, fine/medium sand			836.54	N = 25 Undisturbed Sample 26.9′ – 28.8′
	White/light brown, mica, silty, fine/medium sand				N = 48
30.0	White/strong brown, mica, silty, fine/coarse sand			831.54	N = 46

BORING DESIGNATION B-3*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0	Brown/dark brown, mica, silty, fine/medium sand			826.54	N = 21
40.0				821.54	N = 100
45.0				816.54	N = 100
50.9	Carbide refusal Boring Terminated			810.64	

Figure B-26. Core Boring Record

BORING DESIGNATION B-4*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Light gray/yellowish brown, mica, silty, fine/coarse sand			814.66	N = 18
5.0				809.66	Undisturbed Sample 7.1′ – 9.6′
10.0	Red mica, silty, fine/medium very sandy clay			804.66	Undisturbed Sample 9.6′ – 12.1′ N = 19
15.0				799.66	Undisturbed Sample 17.1′ – 19.6′
18.3	Water Table			796.36	
20.0	Red/Yellowish red, mica, fine/medium sandy silt			794.66	Undisturbed Sample 19.6′ – 22.1′ N = 12
25.0				789.66	Undisturbed Sample 27.1′ – 29.6′ Undisturbed Sample 29.6′ – 30.1′
30.0	White/brown, mica, silty, fine to medium sand			784.66	N = 52 Undisturbed Sample 32.1′ – 33.5′

BORING DESIGNATION B-4*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
35.0	Gray/white, mica, silty fine/medium sand			779.66	N = 55
	White/brown, mica, silty, fine/coarse sand				N = 37
40.0	Pinkish gray, mica, silty, fine/coarse sand			774.66	N = 52
45.0	Light brown/reddish yellow, mica silty, fine/coarse sand			769.66	N = 100
50.0	Dark brown/yellowish brown, mica, silty, fine/coarse sand			764.66	N = 100
57.4	Carbide fishtail refusal Boring Terminated			757.26	

Figure B-27. Core Boring Record

BORING DESIGNATION B-5*

Depth Ft	Description	ROD %	BIT Size	Elev	Remarks
0.0	Dark brown/white, mica, silty, fine/medium sand			817.17	N = 25
5.0				812.17	Undisturbed Sample 6.5′ – 8.0′
10.0	White/brown, mica, silty, fine/coarse sand			807.17	N = 100
12.6	Carbide fishtail refusal Boring Terminated			804.57	

Figure B-28. ISFSI Foundation Profile

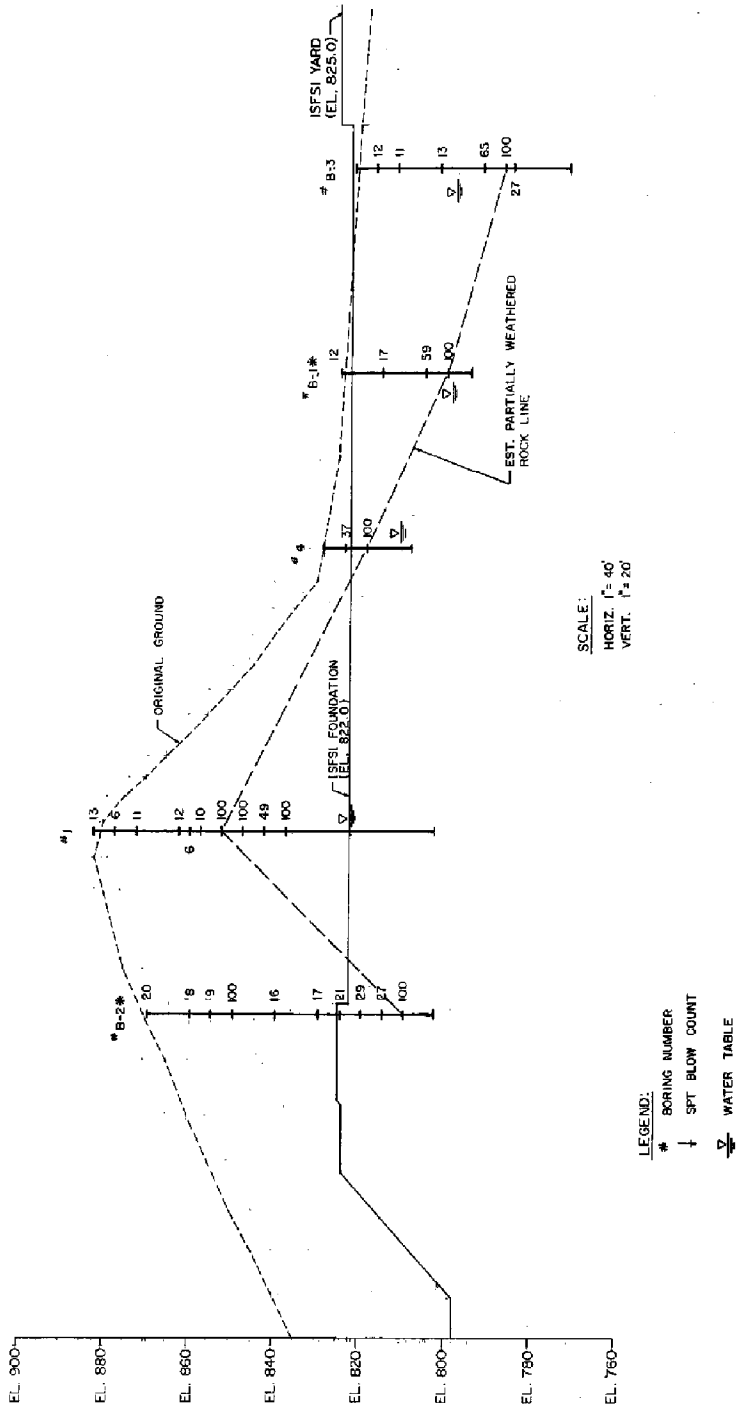


Figure B-29. Site Layout and Route

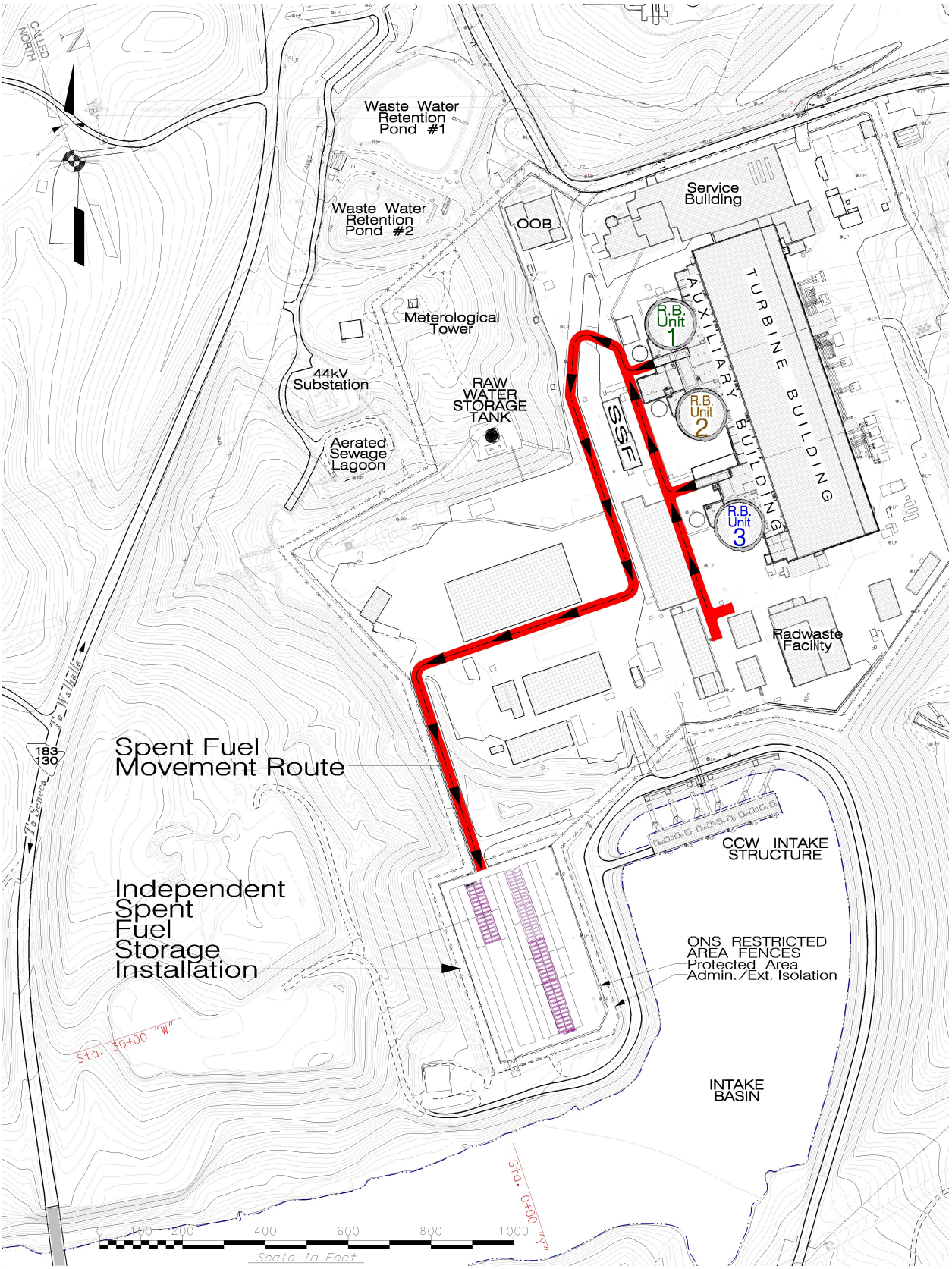


Figure B-30. Site Plan

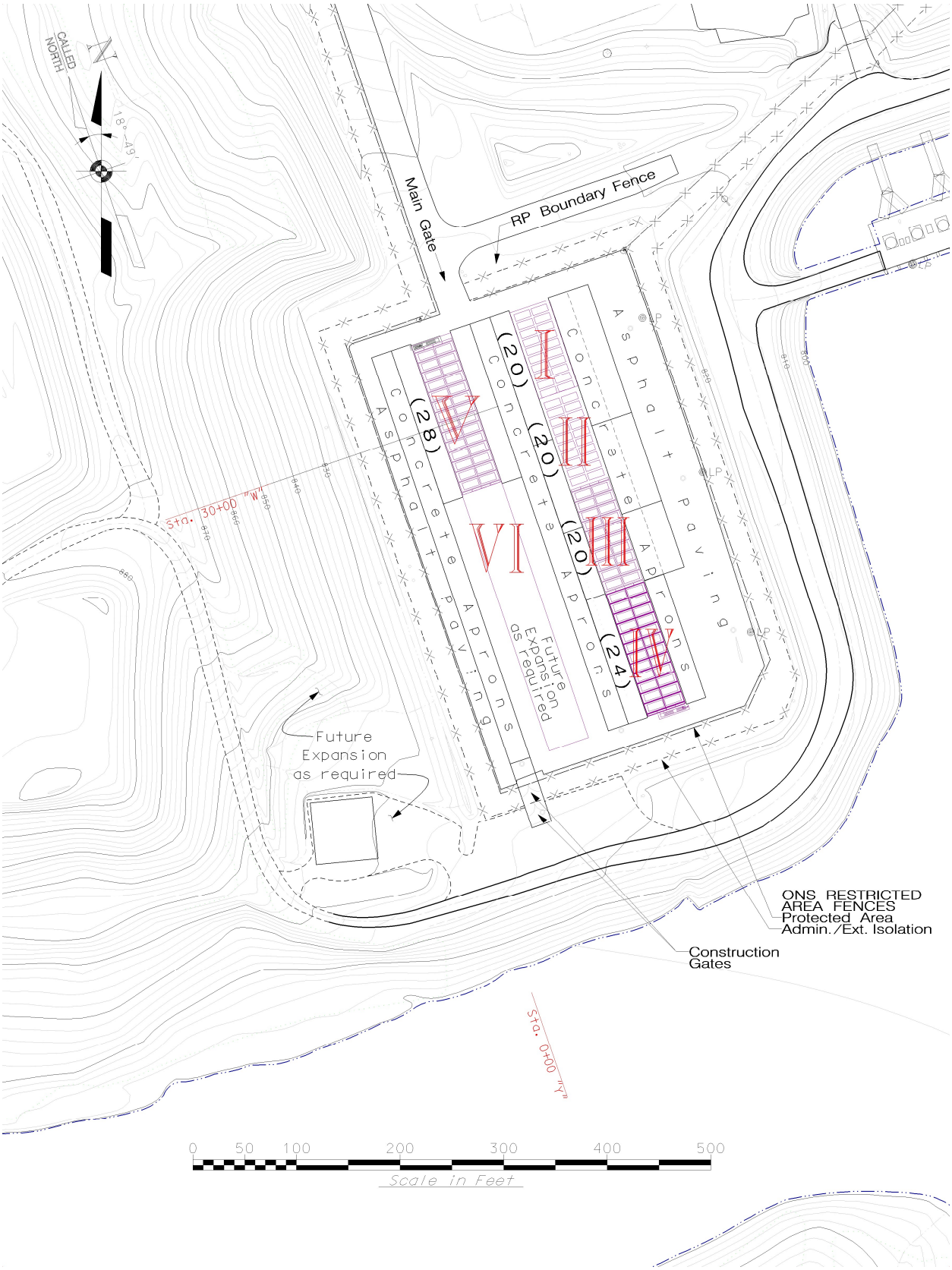


Figure B-31. Transfer Cask Lifting Yoke

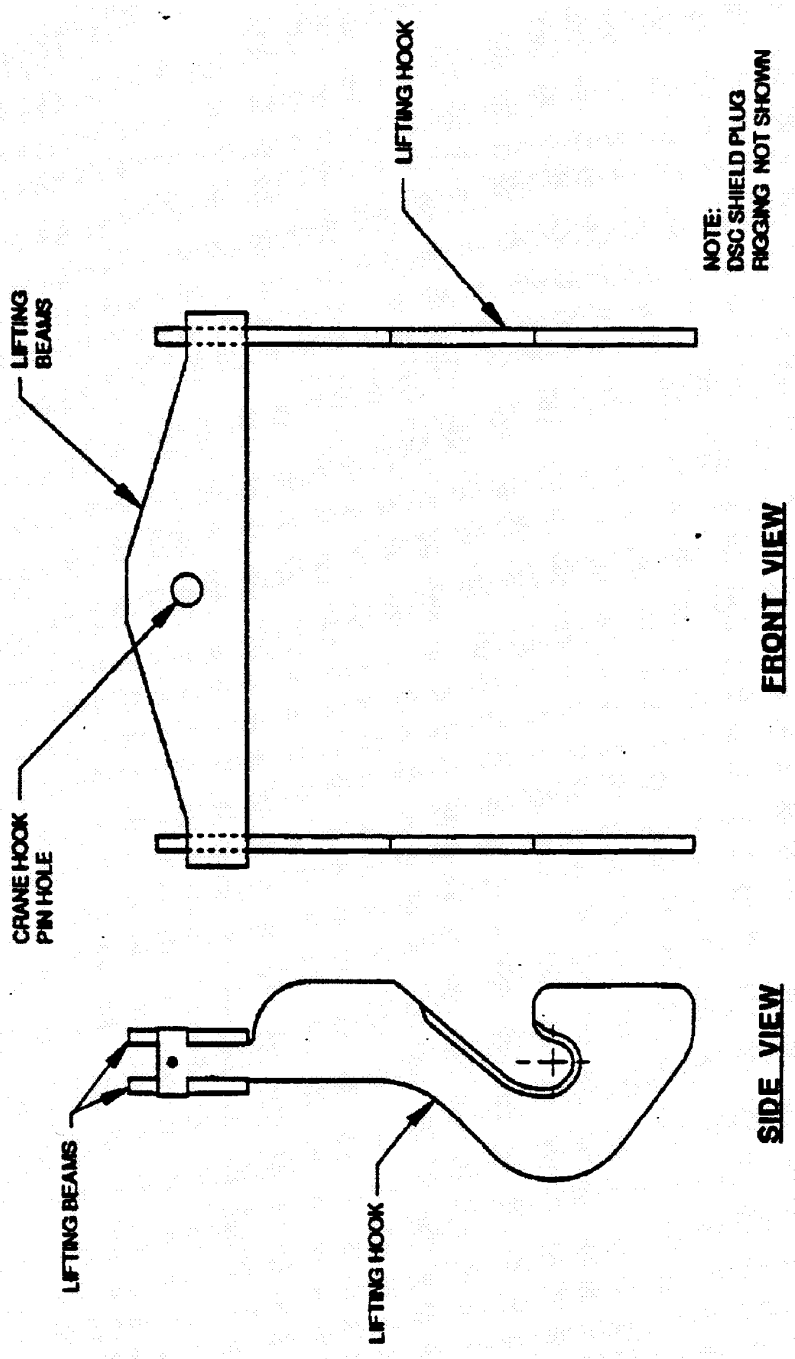


Figure B-32. Transfer Cask Lift Extension

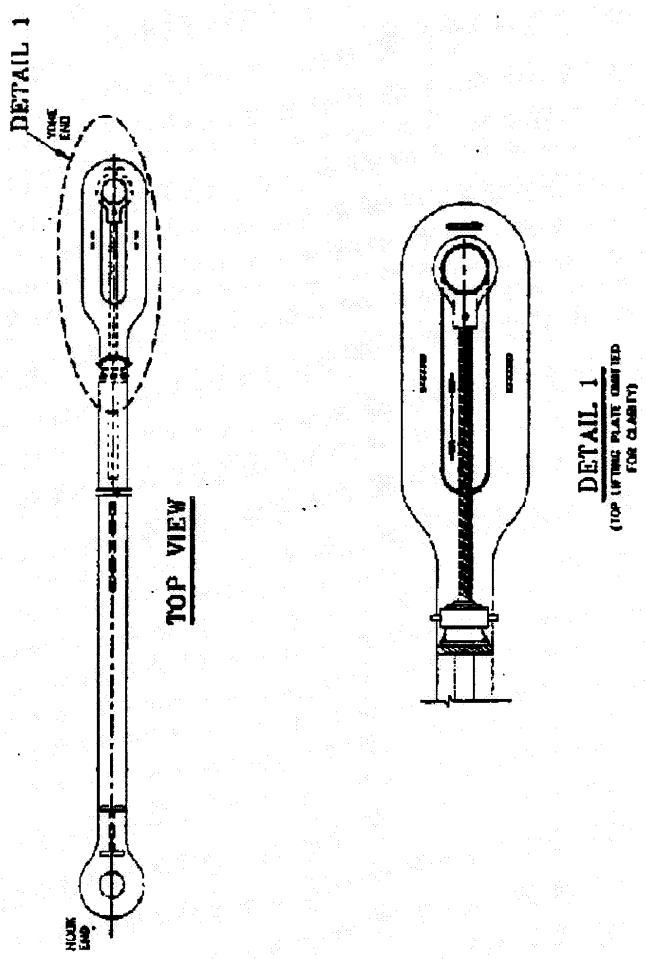


Figure B-33. Spent Fuel Pool Area

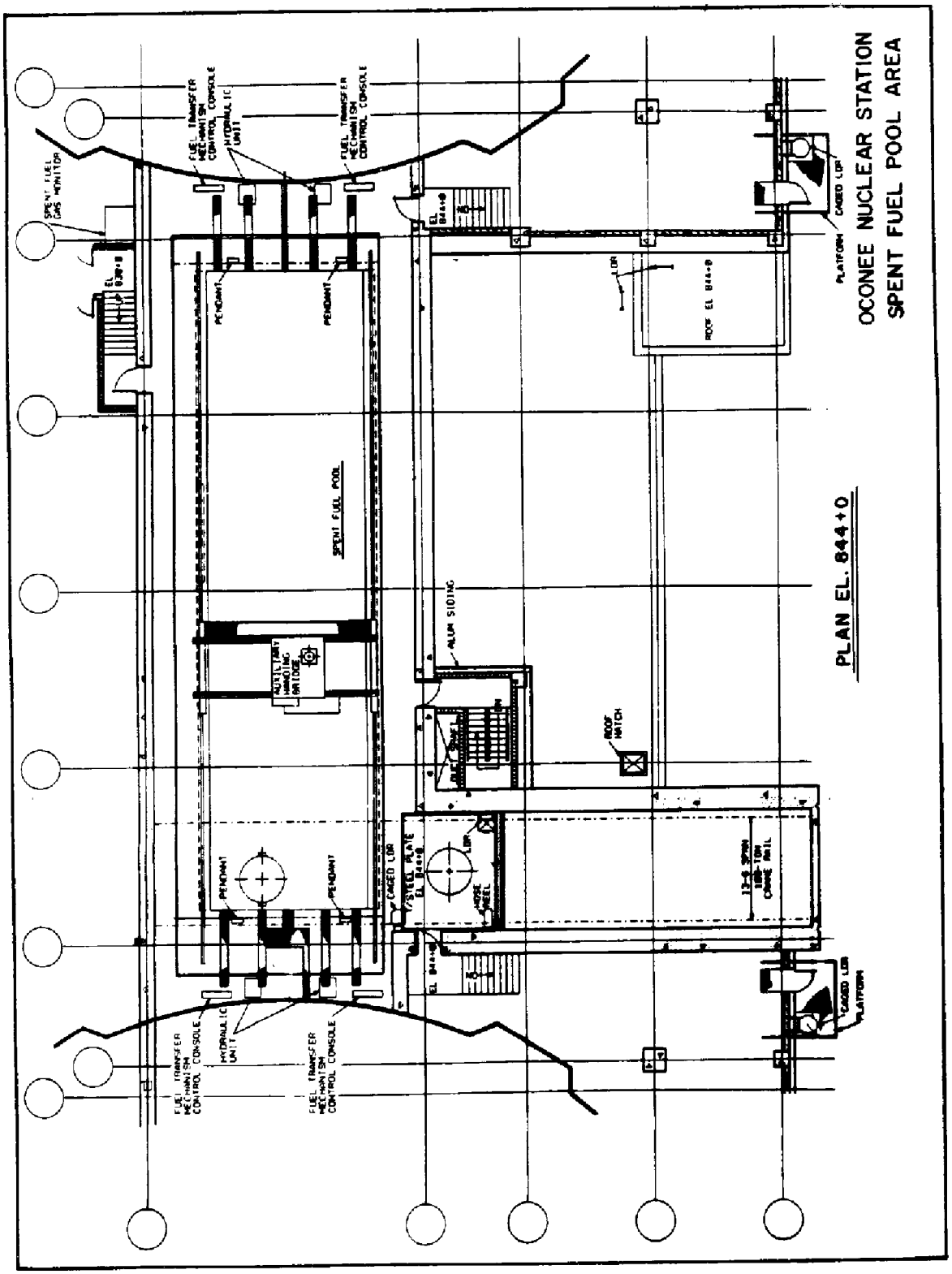


Figure B-34. Spent Fuel Pool Area

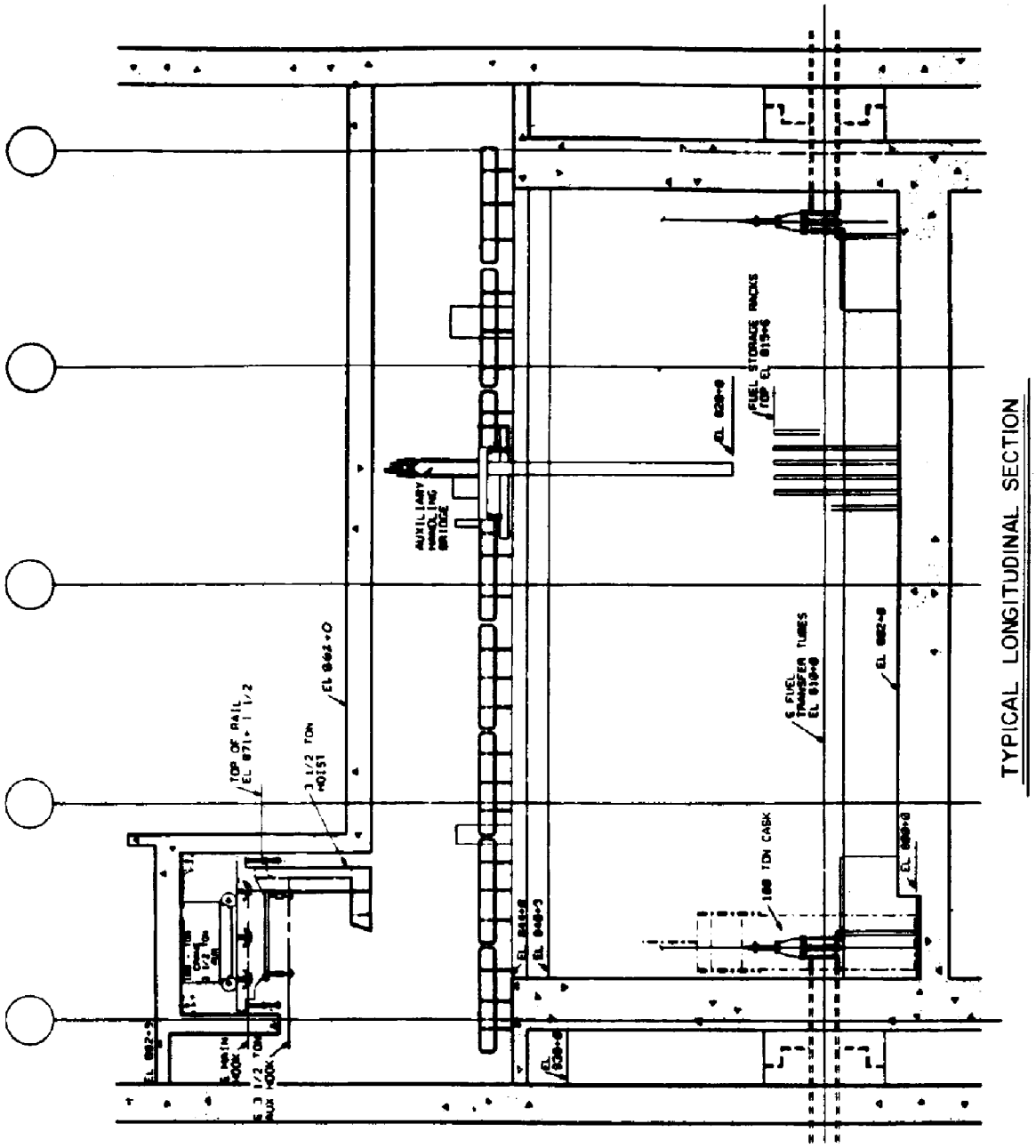


Figure B-35. Spent Fuel Pool Area

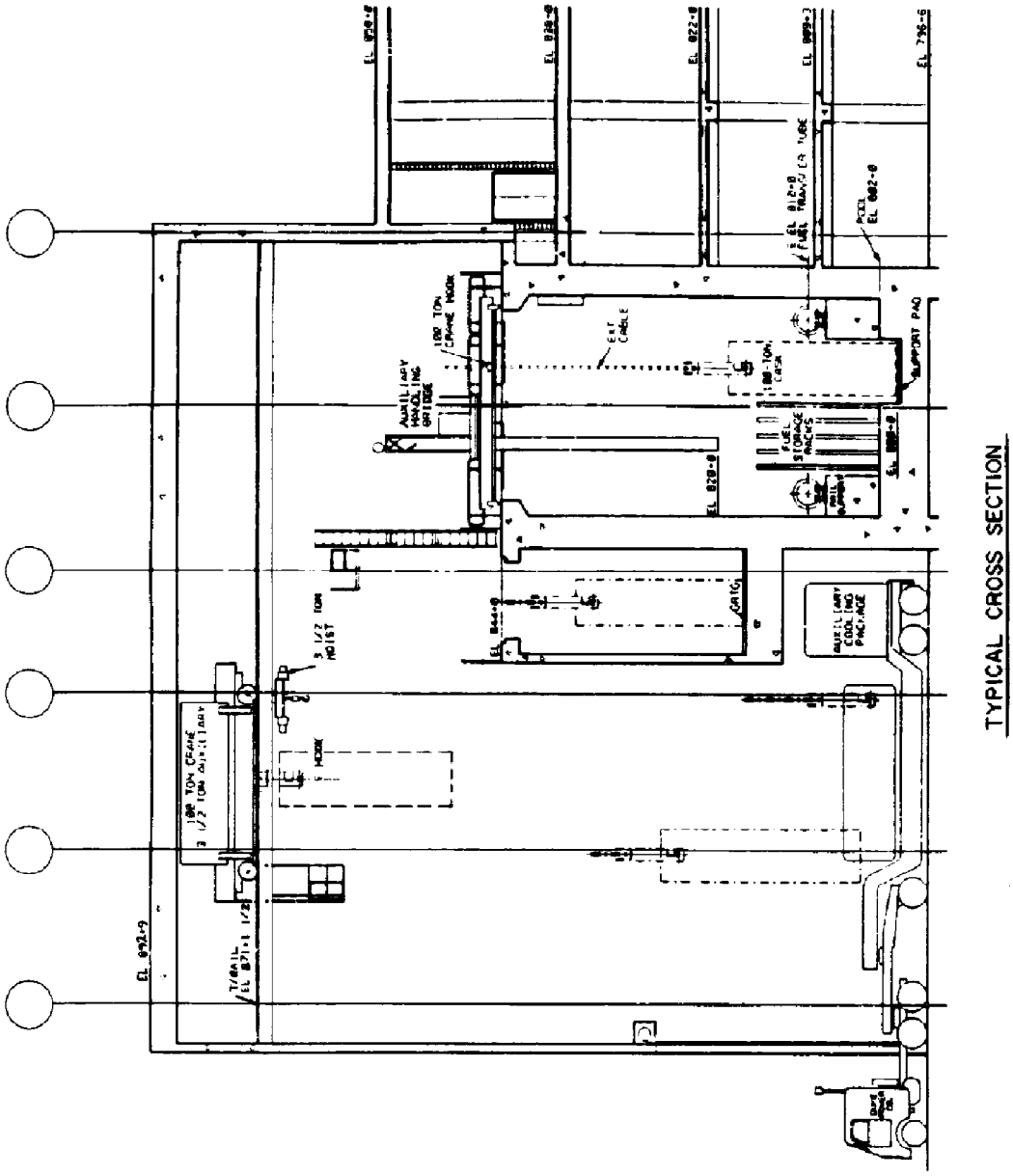


Figure B-36. NUHOMS® System Loading Operations Flowchart.

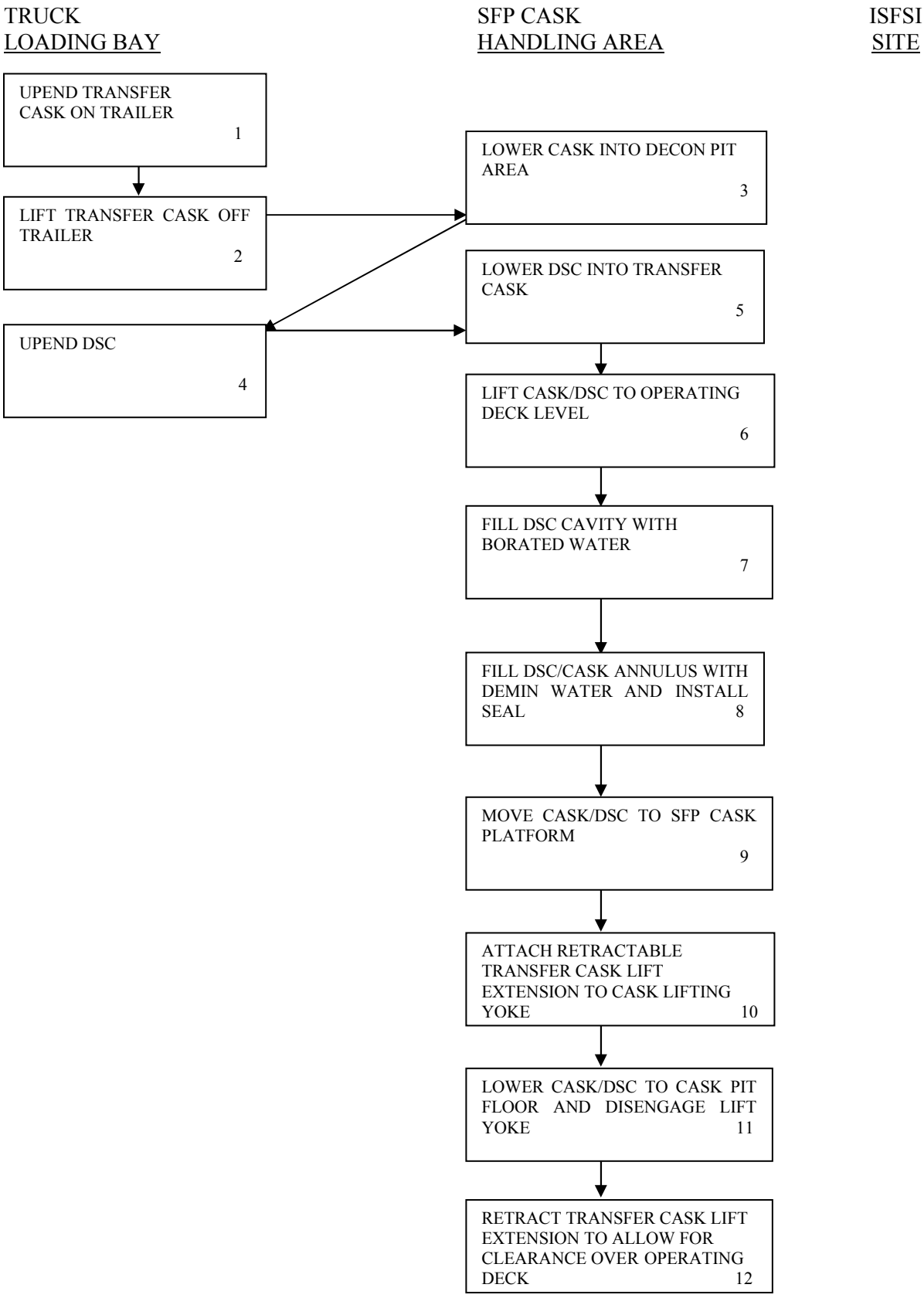


Figure B-37. NUHOMS® System Loading Operations Flowchart.

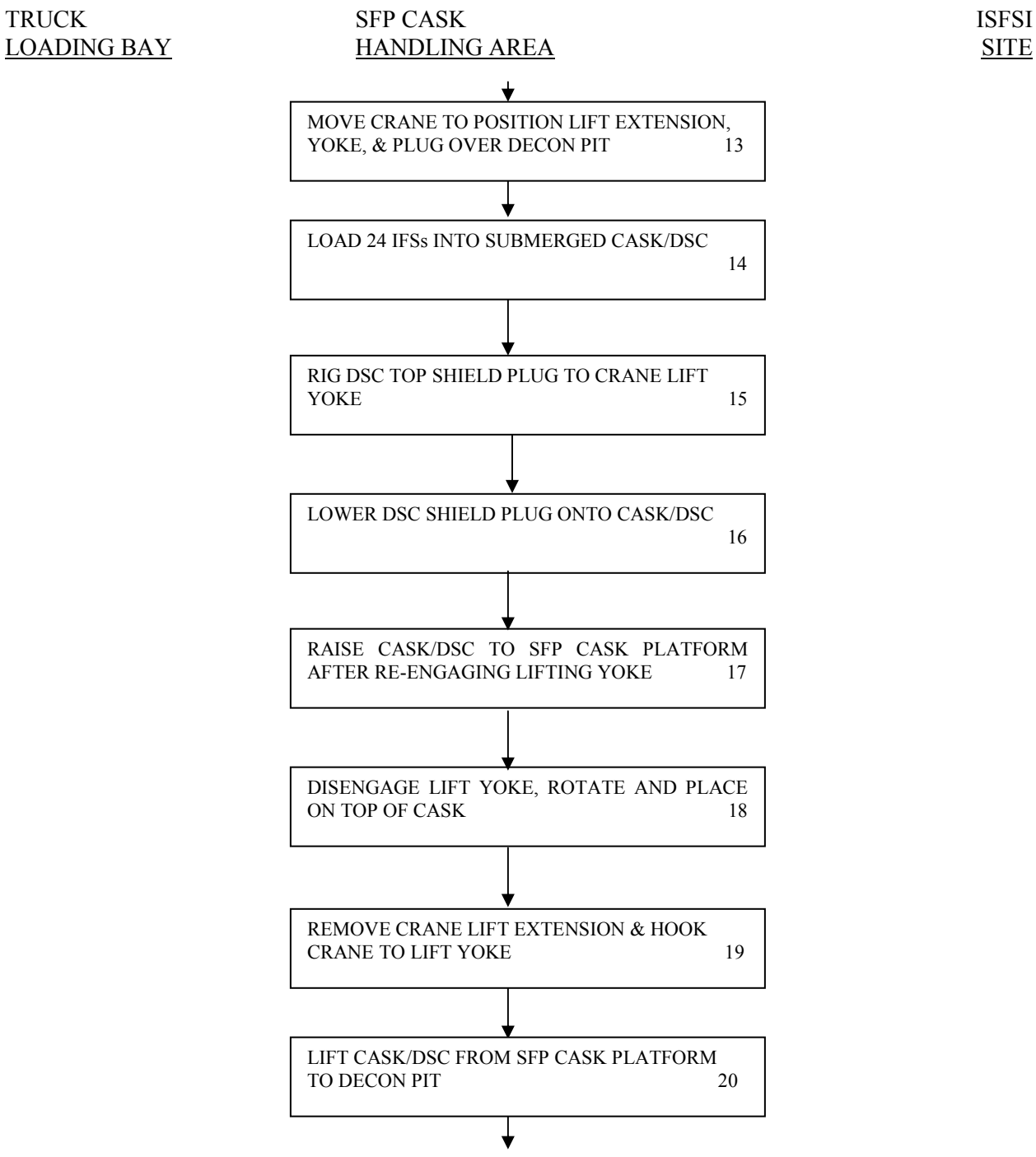


Figure B-38. NUHOMS® System Loading Operations Flowchart.

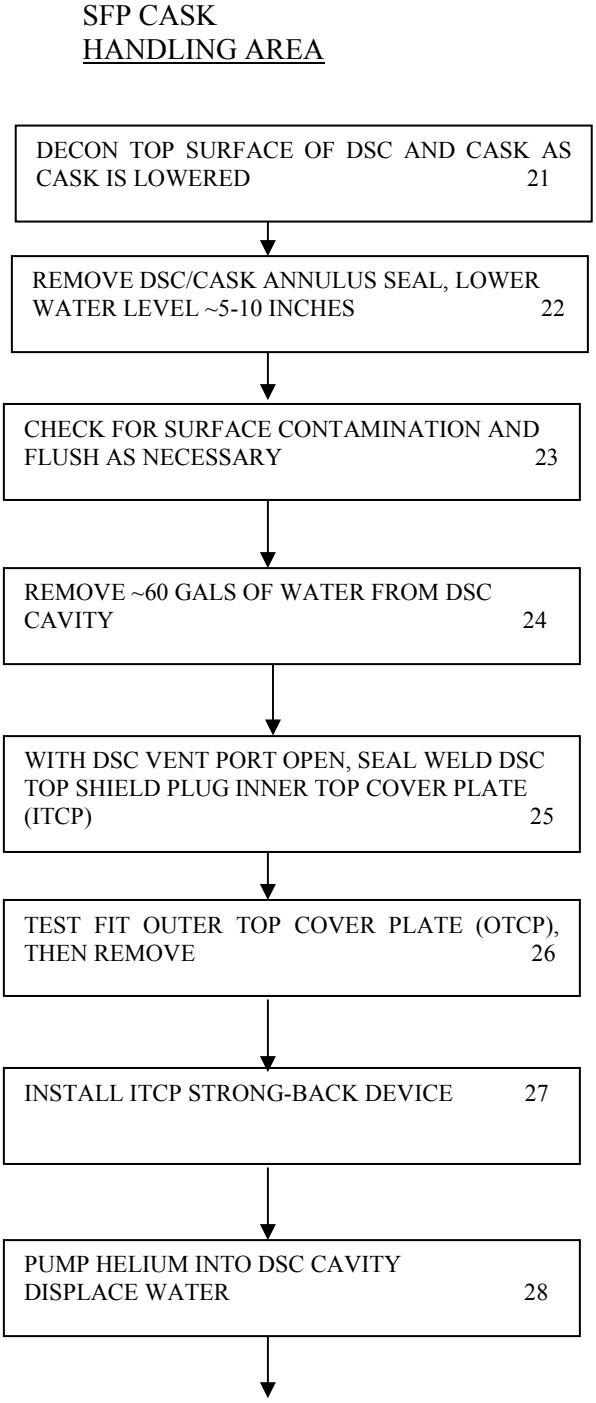


Figure B-39. NUHOMS® System Loading Operations Flowchart.

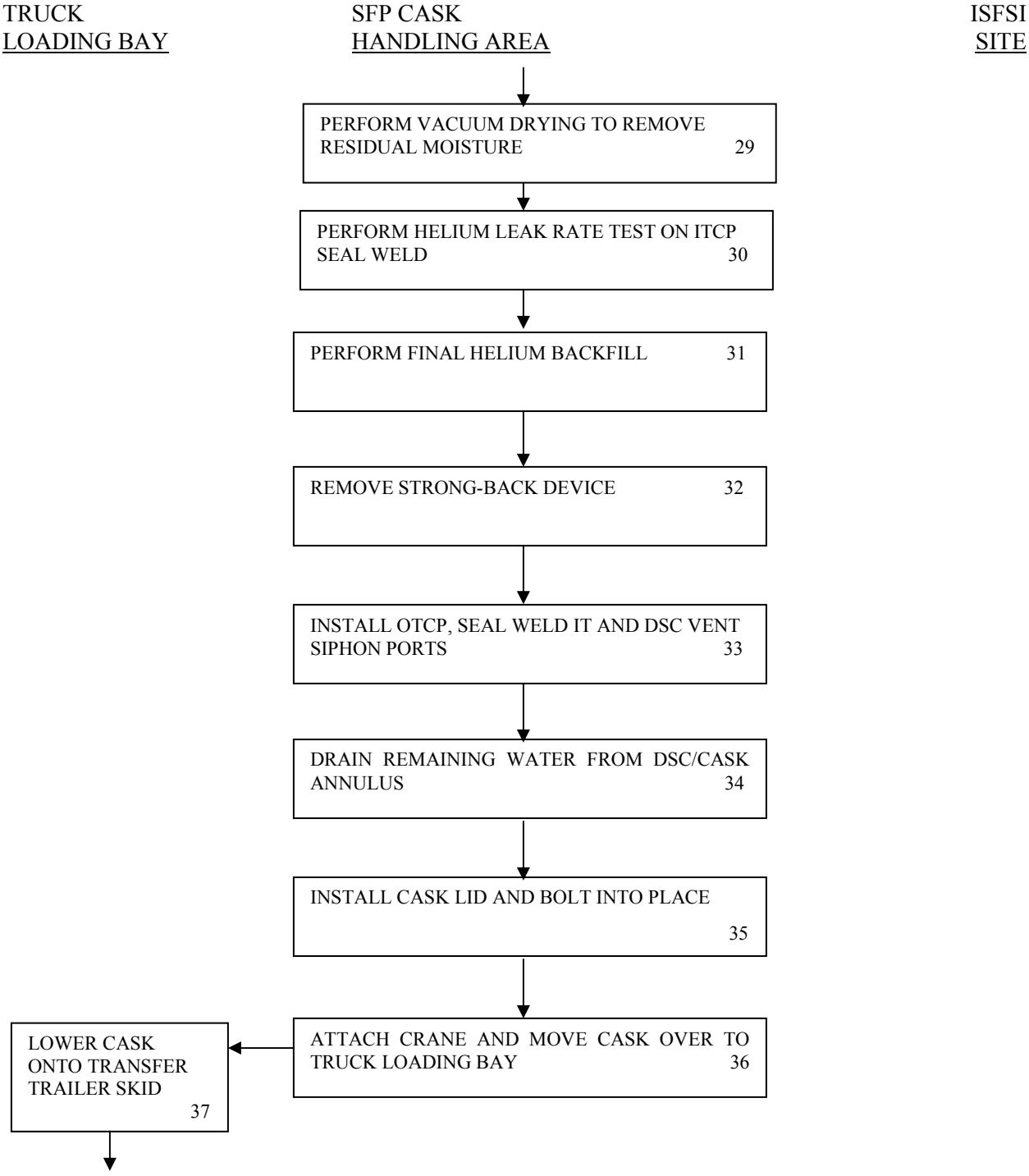


Figure B-40. NUHOMS® System Loading Operations Flowchart

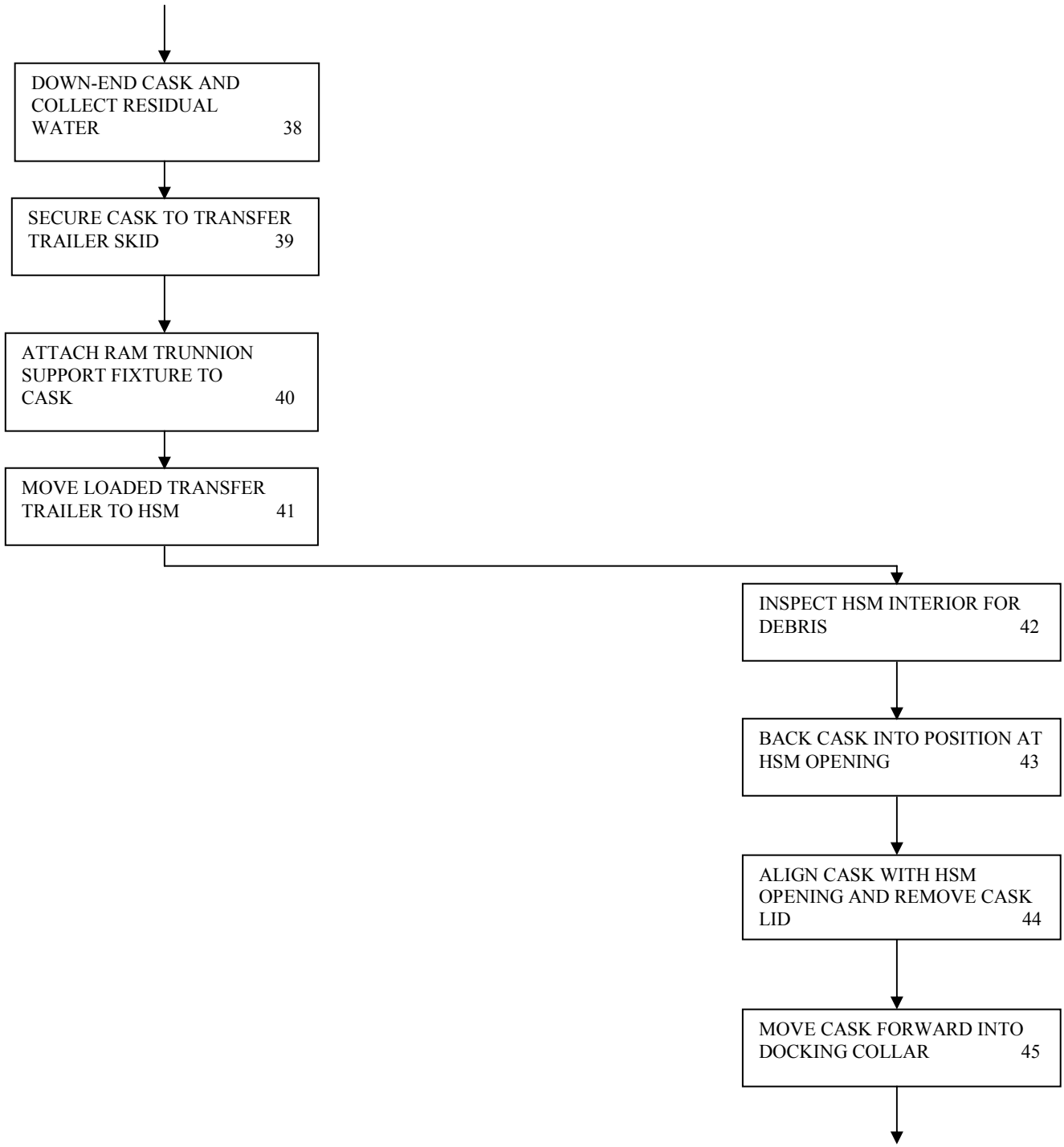
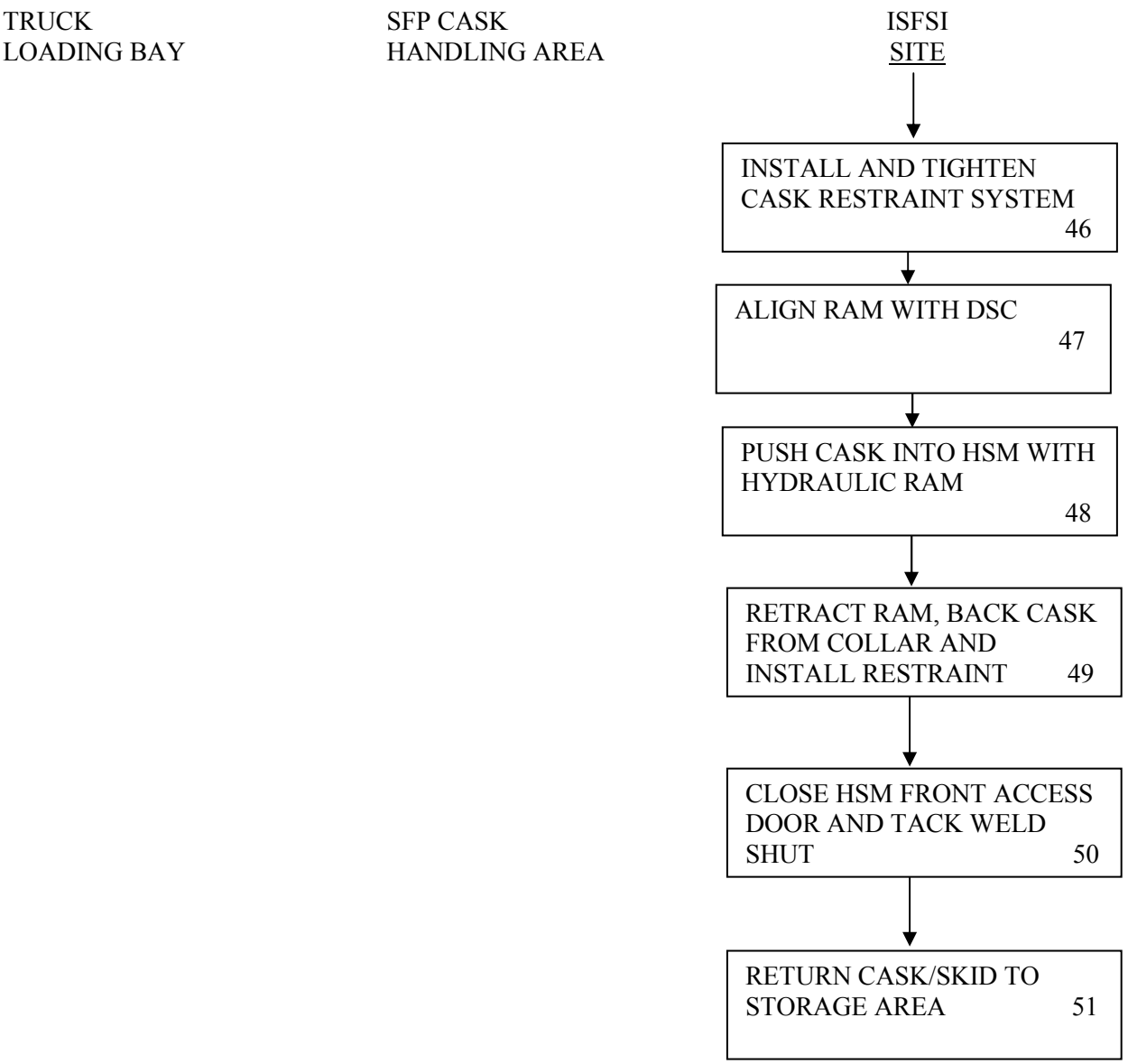


Figure B-41. NUHOMS® System Loading Operations Flowchart



NOTE: NUHOMS® SYSTEM RETRIEVAL OPERATIONS FLOW CHART IS SHOWN IN FIGURE 5.1-4 OF REFERENCE 5.1

Figure B-42. Location of Dose Rates. Reported in Table A-18

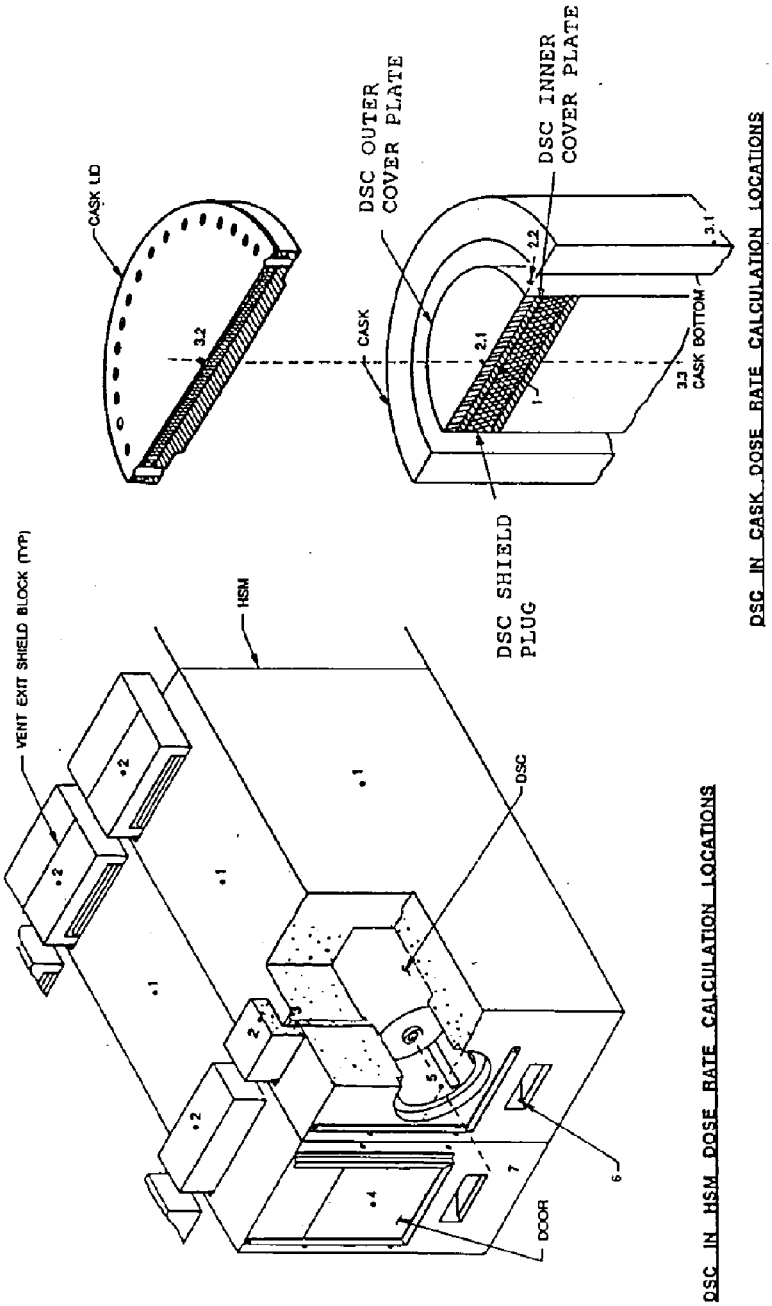


Figure B-43. Dose Rate Versus Distance From Surface of HSM

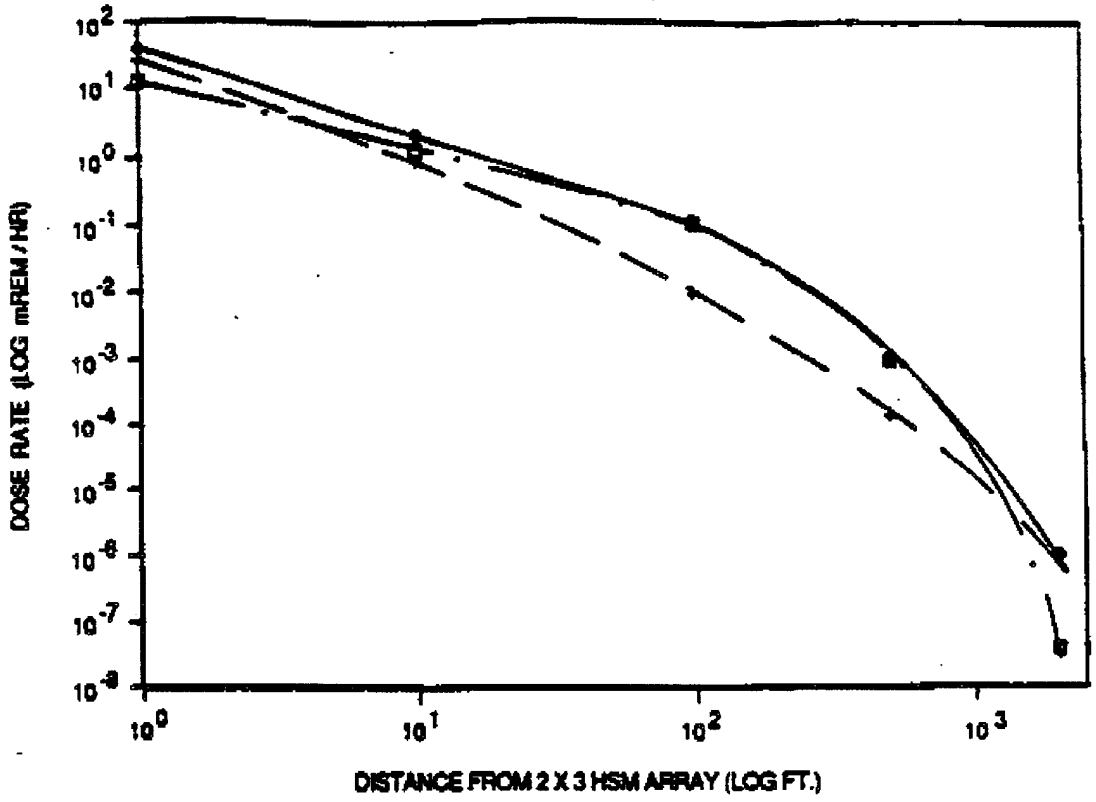


Figure B-44. Dose From Filled HSM Array

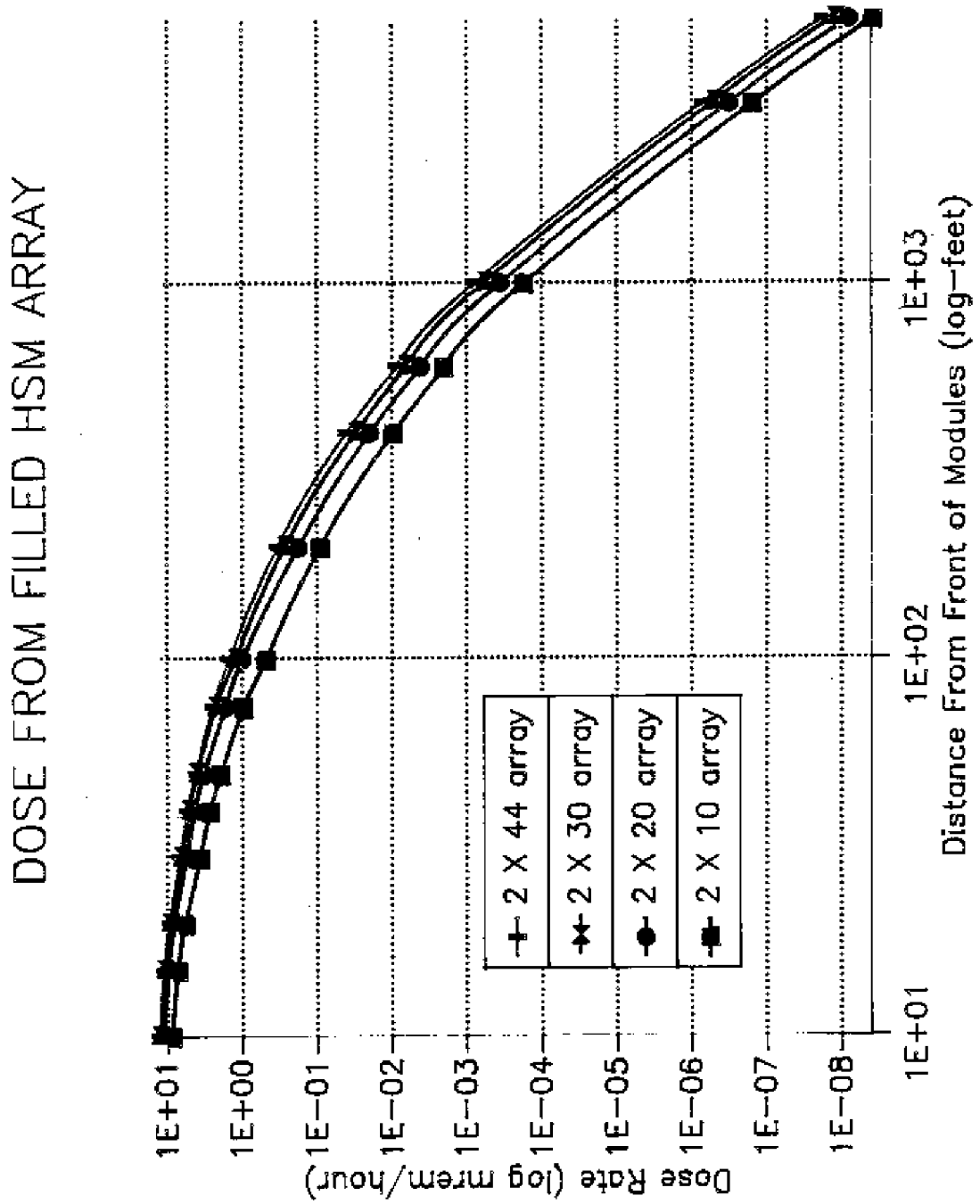


Figure B-45. Dose From Filled HSM Array

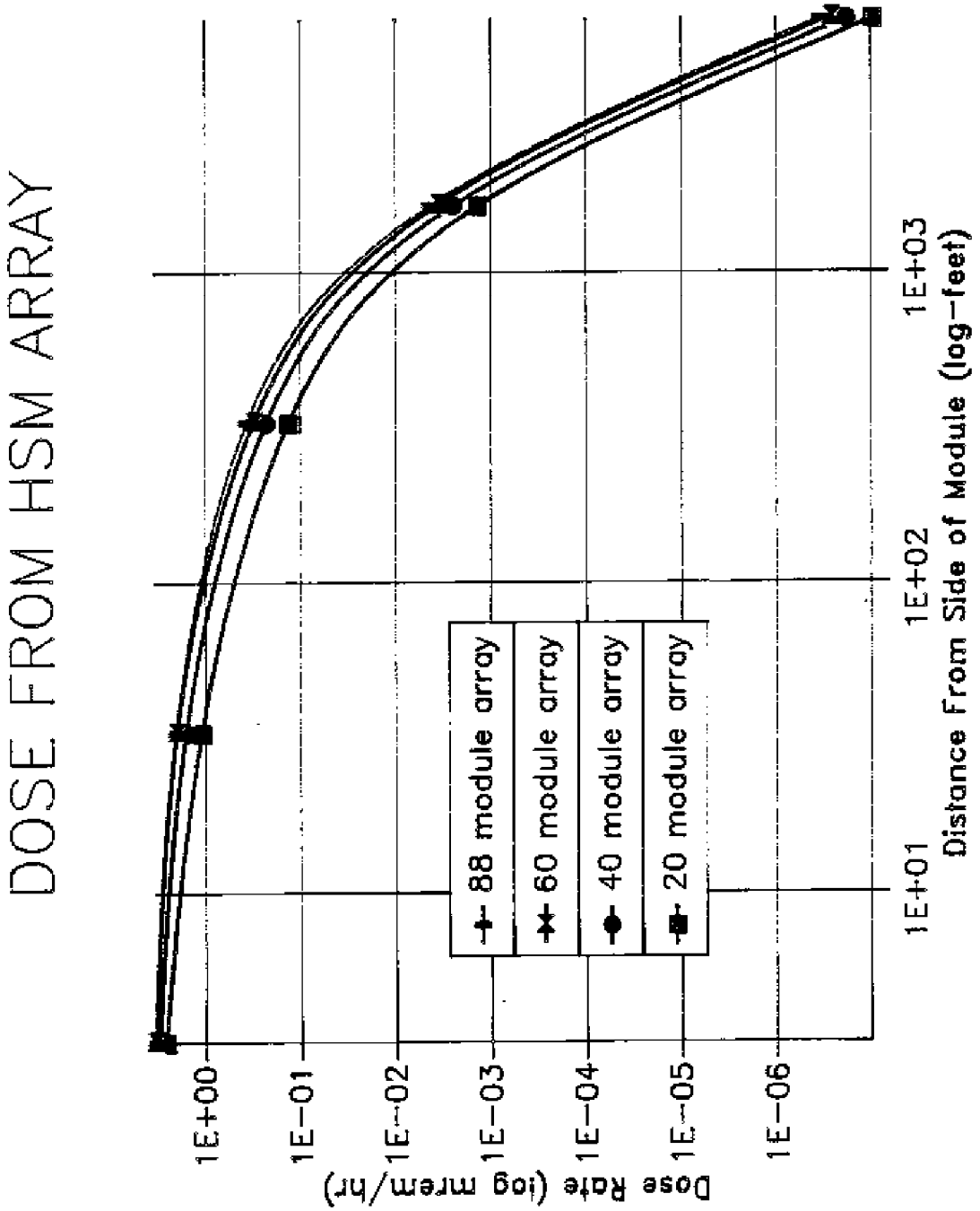
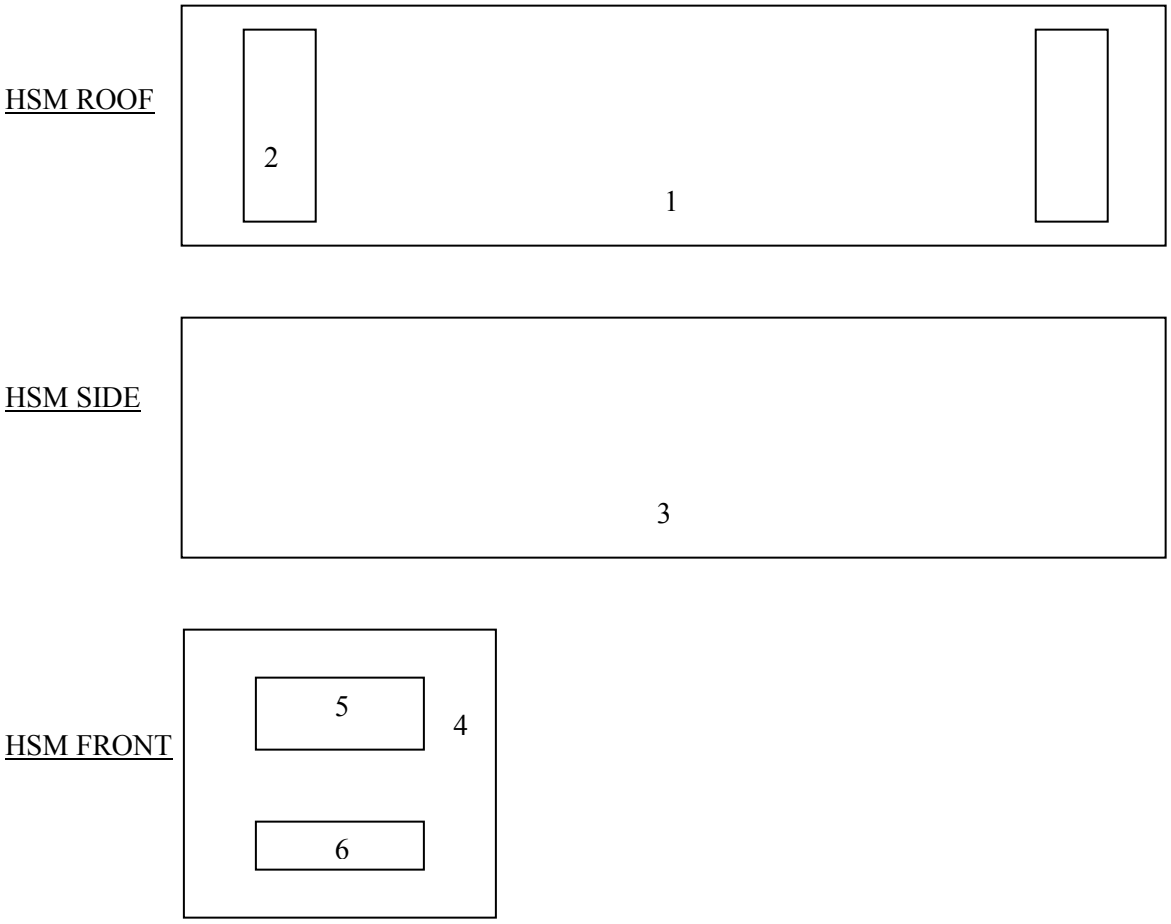


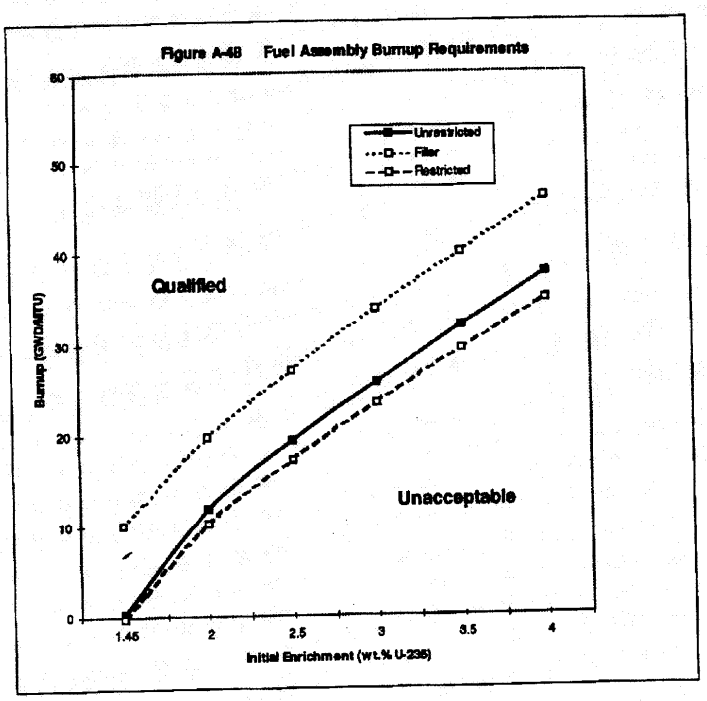
Figure B-46. Radiation Zone Map of Modules Surface Dose Rates



Location	Eff Area (ft2)	Generic Dose Rates (mrem/hr)			Phase II Dose Rates (mrem/hr)		
		Neutron	Gamma	Total	Neutron	Gamma	Total
1 Roof	98.6	0.11	6.5	6.6	0.13	7.05	7.18
2 shield block	6.0	0.20	50.0	50.2	0.24	12.10	12.34
Average	--------	0.04	3.38	3.42	0.05	2.76	2.81
3 Side	186.0	0.11	6.5	6.6	0.13	7.05	7.18
Average	--------	0.06	3.71	3.77	0.07	4.02	4.09
4 Front	49.0	0.11	6.5	6.6	0.13	7.05	7.18
5 Door	26.0	37.0	7.6	44.6	10.50	2.60	13.1
6 Air Inlet	6.0	2.1	94.3	96.4	2.1	94.3	96.4
Average	--------	5.18	5.76	10.94	1.55	5.21	6.76

Figure B-47. Deleted per 1991 Update

Figure B-48. Fuel Assembly Burnup Requirements



Single Region Storage: each fuel assembly must meet or exceed the "Unrestricted" curve

Mixed Region Storage: assemblies in the four center locations of the DSC must meet or exceed the "Filler" curve, and assemblies in the remaining 20 locations in the DSC must meet or exceed the "Restricted" curve.