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February 22, 1982

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Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

Enclosed for NRC review is TVA's revised response to NRC question 371.29 concerning hydrologic engineering at Watts Bar Nuclear Plant. This information includes oversize figures as requested by the NRC Hydrologic Engineering Branch reviewer. The enclosed information will be included in a future amendment of the Watts Bar Nuclear Plant Final Safety Analysis Report.

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Regulation and Safety

Sworn to and subscribed before me
this 22nd day of February 1982
Paulette H. White
Notary Public
My Commission Expires 9-5-84

Enclosure
cc: U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

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Drawings To:
Hydrologic Engineering Branch

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Question 371.29 Local Site Drainage (PMP)

References: Previous question Nos. 371.1, 371.18, 371.19, and 371.20

The staff has many problems with regard to performing an adequate review of the provisions for site drainage at the Watts Bar site. The biggest obstacle is the poor quality of material that we have to work with. Namely, the topographic maps are too small a scale and difficult to read, much of the data is provided on mapping rather than in tabular form, and some data have not been provided at all. The following is a list of information that we will require to complete our review.

1. Provide full-size (unreduced) drawings that show the final grading plans and site drainage features. As a minimum these should show the outline of drainage subareas with the drainage areas and peak discharges, the direction of flow for runoff, change of grade elevations for all roads and railroads, culvert locations, ponding areas (areal extent), building outlines, and plant grade elevations adjacent to safety-related buildings.

2. Where credit is taken for flow-through catch basins or culverts, provide pertinent details of the structure, i.e., size, shape, inlet and outlet invert elevations, roughness, erosion protection, and assumed coefficients. In addition, where these facilities are exposed to heavy loads, you should show that they won't fail under maximum loading conditions (state conditions) or show that their failure won't increase your maximum predicted water level. Provide a discussion on the assumptions on potential debris blockage of these structures. A tabular listing of pertinent data requested above would be appreciated.

3. Where weir flow is used as the basis for a maximum water level, provide the weir length, width, and coefficient. Consider the effects of downstream submergence.

4. Where credit is taken for storage, provide area-capacity curves for the storage area and the time increment used for routing.

The table presented in section 2.4.1.1 lists several exterior accesses that are below elevation 729.0 feet msl. Explain how runoff water is precluded from entering these openings during maximum local site flooding events. If flood doors are used, explain procedures for ensuring doors are closed during flood event.

Response

The response is divided into three sections which provide the following information: (1) full-size drawings that show the final grading plans, site drainage features, culvert locations and plans and profiles for plant roads and railroads which will permit review of site drainage provisions; (2) a new analysis

for the 150-acre area north of the plant; and (3) additional information for drainage subareas 3 and 4 which supplement information provided earlier in responses to questions 371.1 and 371.20.

Plant Layout--Figure Q371.29-1 shows the Watts Bar site grading and drainage system and building outlines for the main plant area. This figure is identical to figure Q371.1-2, sheet 1, provided in response to question 371.18 except that the delineation of paved and unpaved areas has been removed and the drainage areas have been outlined. Direction of flow for runoff has also been indicated by arrows. Figure Q371.29-1a shows the Watts Bar general plan; figure Q371.29-1b shows the site grading and drainage system for the area north and northwest of the plant along with the outline of the low-level radwaste storage facility. The 150-acre drainage area north of the site has been outlined on figure Q371.29-1a with direction of flow for runoff indicated by arrows.

Figure Q371.29-2 (three sheets) shows the plans and profiles for the perimeter roads; figure Q371.29-2a (two sheets) shows the plan and profile for the access highway. Figure Q371.29-3 (three sheets) shows the plan, sections, and profiles for the main plant railroad tracks. Figure Q371.29-4 (three sheets) shows the yard grading, drainage, and surfacing for the switchyard.

150-Acre Area North of Plant--The addition of the low-level radwaste storage facility has altered drainage conditions for the 150-acre drainage area north of the site from that in our earlier analysis and provided in responses to questions 371.1, 371.19, and 371.20. In the original analysis the total 150 acres drained through the double 96-inch culvert under the access railroad shown on figure Q371.29-1b. Now only 50 acres drain through the double 96-inch culvert. Drainage from the remaining 100 acres is diverted to the west through

an 81-inch X 59-inch pipe arch and when flows exceed the pipe capacity, south over a swale in the construction access road. The flow over the construction access road drains to the west across the access highway. These drainage changes have been examined and found adequate to prevent flooding of plant facilities in the local probable maximum flood. The following information provides details of our analysis.

The discharge hydrograph for the 100-acre area north of the plant and upstream from the construction access road was determined using a dimensionless unit graph based upon SCS procedures and probable maximum precipitation (PMP) defined by the National Weather Service. The PMP mass curve used in the determination is shown on figure Q371.1-1, a supporting figure provided in response to question 371.1. Runoff was assumed equal to rainfall. The discharge hydrograph is shown on figure Q371.29-5. The construction access road will act as a dam with the 81-inch X 59-inch pipe arch acting as a low-level outlet. Flow is prevented from draining to the east above the construction access road by a dike with top elevation at 735.3 (dike location and cross section shown on figure Q371.29-1b). The profile of the construction access road and the location of the pipe arch are shown on figure Q371.29-1b. The discharge hydrograph was routed using 2-minute time intervals through the pipe arch and over the construction access road using standard storage routing techniques. The rating curve for flow over the construction access road was developed from critical flow relationships with losses assumed equal to $0.5\ V^2/_{2g}$. The storage curve used in the routing is shown on figure Q371.29-6. The following tabulation provides pertinent details of the 81-inch X 59-inch pipe arch and the discharge coefficients used in the analysis.

Material - Corrugated metal, 14 gage, 3- X 1-inch corrugations

Length - 102 feet

Inlet invert elevation - 727.5

Outlet invert elevation - 726.5

Type of inlet - Flared end section

Entrance loss - 0.23 $V^2/_{2g}$

Manning's "n" - 0.024

Erosion protection - To be determined in field by construction forces

The maximum elevation reached at the construction access road was 735.

Flow over the construction access road discharges into the 67-acre area west of the service, auxiliary, reactor, and diesel generator buildings and north of the office building and gatehouse (area 2 of figure Q371.29-1) before flowing west across the access highway (figure Q371.29-2a). Elevations for area 2 provided earlier in response to question 371.20 were reevaluated to include this additional flow. Backwater was computed from the access highway, crossing the perimeter road, to the reactor, diesel generator, and waste evaporation system buildings. The rating curve for flow over the access highway was developed from critical flow relationships with losses assumed equal to 0.5 $V^2/2g$. The starting elevation at the access highway control was computed conservatively assuming that the peak flows from area 2 and over the construction road added directly. The maximum flood elevation reached in the main plant area was elevation 728.7. This is the same elevation computed in our original analysis, thus the potential for plantsite flooding is not affected by this change.

The pipe arch is designed for AASHTO H-20 loading which we judge is adequate for the loading expected. In the unlikely event of pipe arch failure and

flow blockage, the maximum flood level at the construction access road would increase only 0.15 foot, from elevation 735 to 735.15. The small increase in flow (about 13 percent) over the construction access road would not change maximum flood levels in the main plant area.

The discharge hydrograph for the 50-acre area north of the plant was conservatively assumed equivalent to the PMP hyetograph using 2-minute time intervals and is shown on figure Q371.29-5. This hydrograph was routed using 2-minute time intervals through the double 96-inch culvert using standard storage routing techniques. The storage curve used in the routing is shown on figure Q371.29-6. The following tabulation provides pertinent details of the double 96-inch culvert and the discharge coefficients used in the analysis.

Shape - Circular

Material - Corrugated metal, 10 gage, 3- X 1-inch corrugations

Length - 82 feet, flowline length

Inlet invert elevation - 716

Outlet invert elevation - 715.5

Type of inlet - Beveled, 2:1 slopes

Entrance loss - $0.5\ V^2/_{2g}$

Manning's "n" - 0.021

Erosion protection - Riprapped for approximately 20 feet, upstream and downstream

The maximum elevation reached at the culvert was 724.8. Flow is prevented from entering the main plant area by site grading as shown on figure Q371.29-1b.

The double 96-inch culvert is designed to carry a Cooper E-80 loading as recommended by the American Railway Engineering Association (AREA). The culvert

has already been exposed to the maximum loading--the generator stator with a total load of 792 tons on 22 axles--with no damage to the pipes or tracks. This maximum loading is less than the design load. Loading conditions will not be a problem.

The site will be well maintained and any debris generated from it will be minimal; therefore, debris blockage of the double 96-inch culvert or the 81- X 59-inch pipe arch will not be a problem.

Areas 3 and 4--A description of drainage areas for subareas 3 and 4, shown on figure Q327.29-1, together with computed flood hydrographs and maximum water surface elevations were provided in response to question 371.20.

The site probable maximum flood hydrographs for areas 3 and 4 shown on figure Q371.20-1, a supporting figure to the response to question 371.20, were routed using 2-minute time intervals over a weir section(s) created by the plant road and/or railroad using standard storage routing techniques. The storage curves used in the routings are shown on figure Q371.29-7. The tabulation below provides the weir length, description, and coefficient of discharge used in the analysis. An examination was made and discharges were found not affected by submergence.

Watershed Area	Description	Weir Parameters: Length, Feet	Description of Control	Coefficient of Discharge "C" in $Q=CLH^{3/2}$
3	Area bounded by reactor and turbine buildings to the west, embankment to the north, and railroad tracks to the east and south	675	Main plant track, elevation = 728.0	3.0
		955	Transformer yard track, elevation = 728.25	3.0
4	Area consisting of the switchyard area west of the condenser tube access track and south of the turbine building	590	East condenser tube access track elevation = 728.22	3.0
		1220	Perimeter road, elevation = 728.0	3.0
	Area consisting of the switchyard area east of the condenser tube access track and south of the transformer yard track	540*	East and south end of switchyard area, elevation = 728.0	3.0

*Actual crest length is 1080. Length reduced 50 percent to conservatively account for decreased flow through fence.

The maximum elevation reached for area 3 was 728.4; the maximum elevations reached for area 4 was 728.4 for the west switchyard area and 728.3 for the east switchyard area.

Those "exterior" accesses identified in section 2.4.1.1 of the WBNP FSAR that are below the grade elevation for that specific structure, exit from that structure into another structure and are not "exterior" in the sense that they exit or are exposed to the environment. Should an access be exposed to the environment and located at grade elevation, sufficient drainage is provided to prevent runoff water from entering the opening. This is accomplished by sloping away from the opening. Your reference to elevation 729.0 is applicable only to the main powerblock. The intake pumping pumping station and the diesel generator building are located at grade elevation 710.0 and 742.0, respectively.

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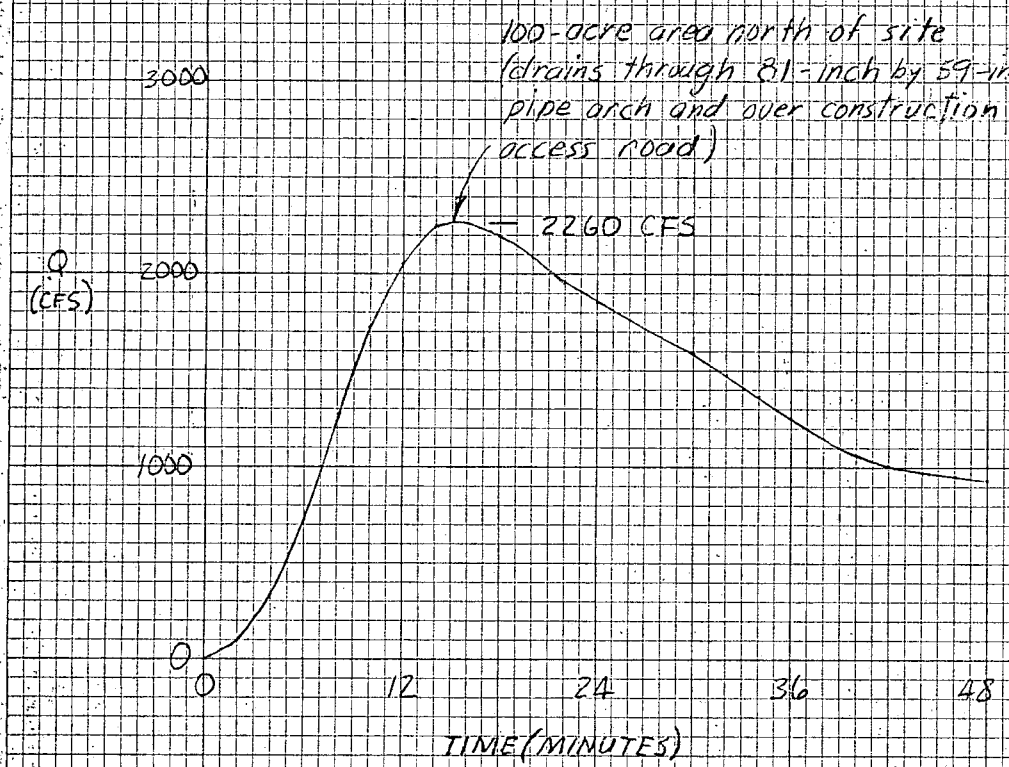

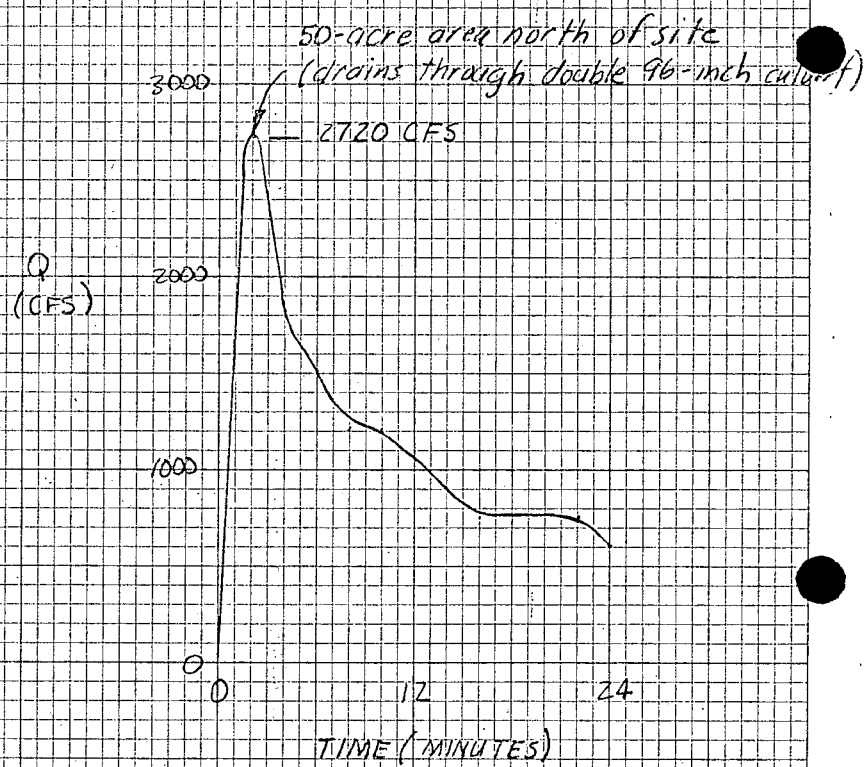

Watts Bar Nuclear Plant
Site Probable Maximum
Flood Hydrographs

Figure Q371.29-5

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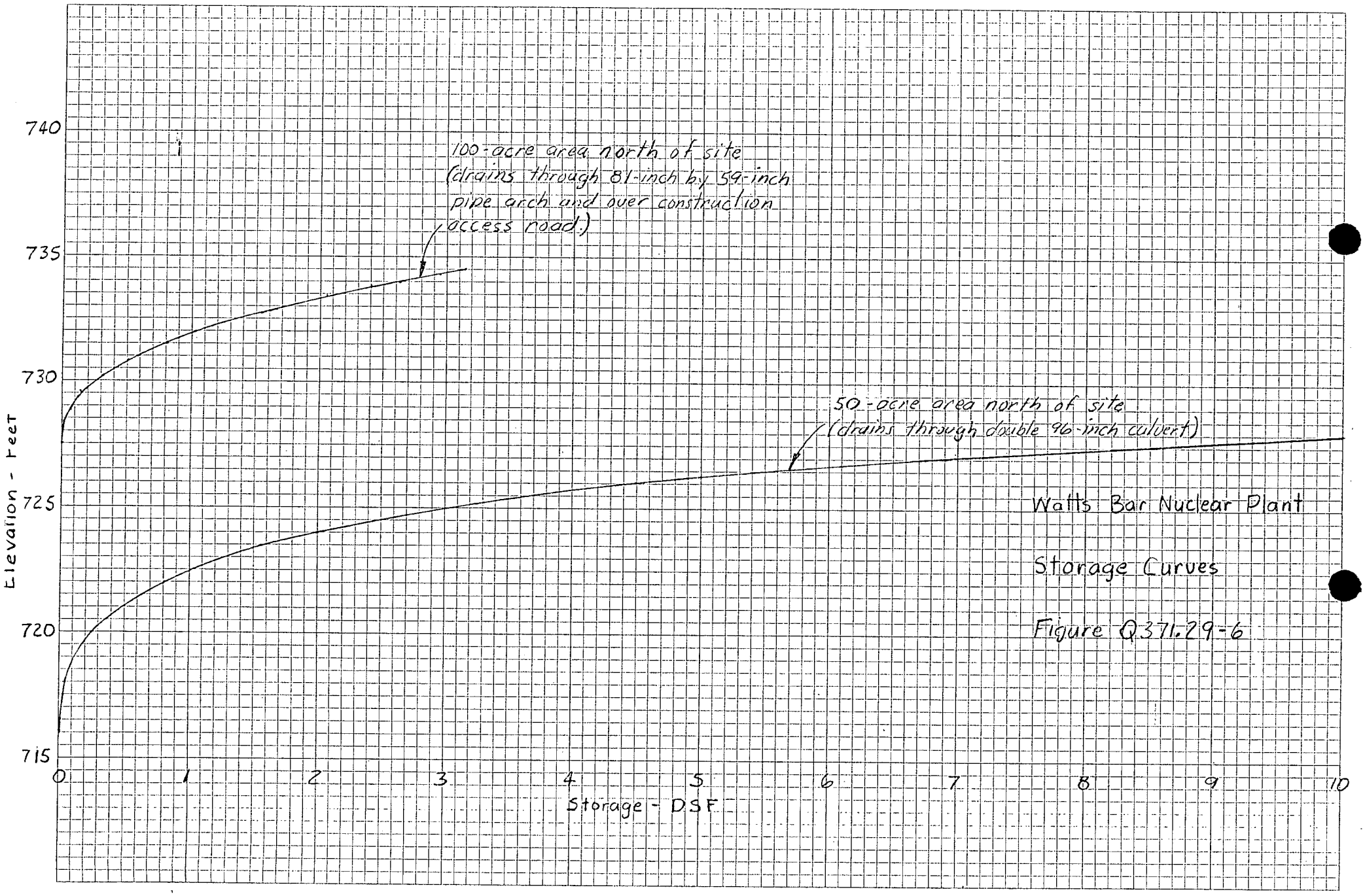

Watts Bar Nuclear Plant

Storage Curves

Figure Q371.29-6

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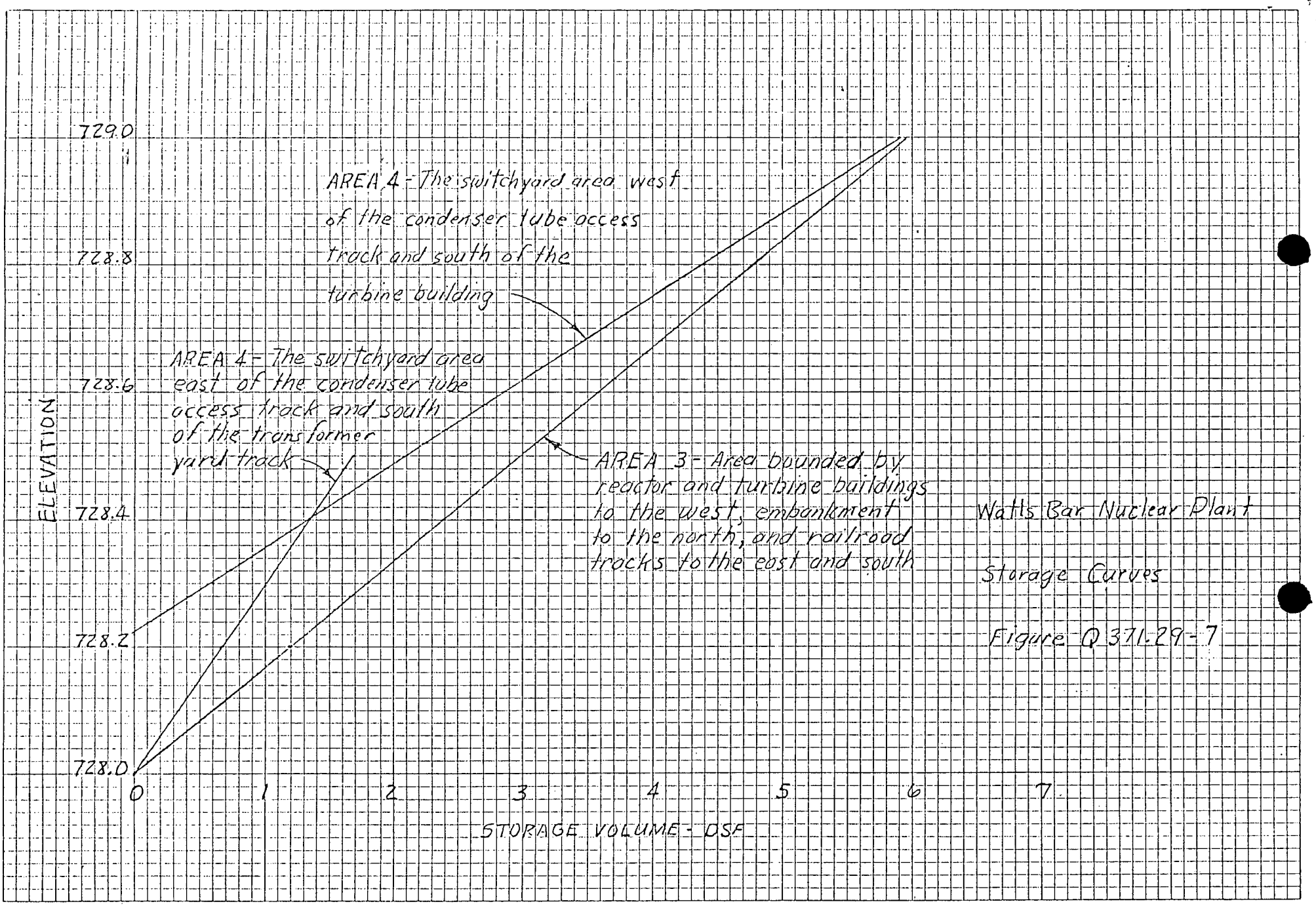

Watts Bar Nuclear Plant

Storage Curves

Figure Q 371.29-7