TECHNICAL EVALUATION REPORT

HYDROLOGICAL CONSIDERATIONS

(SEP, II-3A, B, D., C)

DAIRYLAND POWER COOPERATIVE
LACROSSE BOILING WATER REACTOR

NRC DOCKET NO. 50-255

NRC TAC NO. 41368, 41357, 41346, 41335

NRC CONTRACT NO. NRC-03-79-118

FRC PROJECT C5257

FRC ASSIGNMENT 16

FRC TASK 427

Prepared by

Franklin Research Center
20th and Race Street
Philadelphia, PA 19103

FRC Group Leader: J. S. Scherrer

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: G. Staley

September 27, 1982

Prepared by:	Reviewed by:	Approved by:
Principal Author	Project Manager	Department Director
Date: 9/24/82	Date: 9/27/82	Date: 9-27-82

Franklin Research Center
A Division of The Franklin Institute
The Benjamin Franklin Parkway, Phila., Pa. 19103 (215) 448-1000

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FOREWORD

This Technical Evaluation Report was prepared by Franklin Research Center under a contract with the U.S. Nuclear Regulatory Commission (Office of Nuclear Reactor Regulation, Division of Operating Reactors) for technical assistance in support of NRC operating reactor licensing actions. The technical evaluation was conducted in accordance with criteria established by the NRC.

Mr. J. S. Scherrer, Ms. S. Roberts, Mr. W. Erickson, and Mr. G. J. Overbeck contributed to the technical preparation of this report through a subcontract with WESTEC Services, Inc.

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

The purpose of this review is to evaluate the assumptions, conclusions, and completeness of documentation in submittals by the Dairyland Power Cooperative (DPC) on systematic evaluation program (SEP) Topics II-3.A (Hydrologic Description), II-3.B (Flooding Potential and Protection Requirements), II-3.B.1 (Capability . . Operating Plants to Cope with Design Basis Flooding Conditions), and II-3.C (Safety-Related Water Supply - Ultimate Heat Sink) for the LaCrosse Boiling Water Reactor (LACBWR). It includes independent analyses by the Franklin Research Center (FRC) needed to clarify and resolve several issues. The Nuclear Regulatory Commission (NRC) is reviewing other safety topics within the SEP and intends to coordinate an integrated assessment of plant safety after completion of the review of all applicable safety topics and design basis events (DBEs).

1.2 GENERIC BACKGROUND

The SEP was established to evaluate the safety of 11 of the older nuclear power plants. An important element of the evaluation is to judge the plants by current licensing criteria with respect to 137 selected topics, several of which relate to hydrologic assessments of the site.

In a letter dated January 14, 1981 [1], the NRC agreed to the SEP Owners Group's proposed redirection of the SEP whereby each licensee would select any 60% of the SEP topics and submit evaluations of these in time for a review by the NRC staff to be completed by June 1981. Evaluations of topics not selected by a licensee were the NRC's responsibility.

1.3 PLANT-SPECIFIC BACKGROUND

The present evaluation of the hydrologic influences at the LaCrosse Boiling Water Reactor (LACBWR) site compares the provisions of the LACBWR plant against the current NRC criteria for licensing new facilities. The Licensee, Dairyland Power Cooperative (DPC), will be instructed to inform the

NRC whether the as-built facility differs from the information provided in this assessment. This report organizes all previously submitted Licensee-developed information under appropriate SEP Topics. Where the NRC or other agencies have provided previous background information pertaining to hydrologic influences at the site, this information has been incorporated. The original Licensee submittal pertaining to SEP Topic II-3.A, Hydrologic Description, and II-3.C, Safety-Related Water Supply (Ultimate Heat Sink), is dated June 26, 1981 [2]. The Licensee's submittal on SEP Topic II-3.B, Flood Potential and Protection Requirements, and II-3.B.1, Capability of Operating Plants to Cope with Design Basis Flooding Conditions, is dated May 12, 1982 [3]. In many cases, the Licensee's submittals were deficient in evaluating all information pertinent to the appropriate SEP topic. This technical evaluation report presents an independent evaluation of all issues outstanding and a critique of the Licensee-supplied evaluations.

2. REVIEW CRITERIA

The criteria used for the hydrology topics were based on the Code of Federal Regulations, Title 10, Section 50 (10CFR50), Appendix A, General Design Criteria, Overall Requirements, Criterion 2, entitled "Design Bases for Protection Against Natural Phenomena." Specific criteria were taken from the following documents:

Standard Review Plan (SRP) [4]

- 2.4.1 Hydrologic Description
- 2.4.2 Floods
- 2.4.3 Probable Maximum Flood (PMF) on Streams and Rivers
- 2.4.4 Potential Dam Failures
- ~~2.4.5 Probable Maximum Surge and Seiche Flooding~~
- ~~2.4.6 Probable Maximum Tsunami Flooding~~
- 2.4.7 Ice Effects
- 2.4.8 Cooling Water Canals and Reservoirs
- 2.4.9 Channel Diversions
- 2.4.10 Flooding Protection Requirements
- 2.4.11 Cooling Water Supply
- 2.4.12 Groundwater
- 2.4.14 Technical Specifications and Emergency Operation Requirements

Regulatory Guides

- 1.27 Ultimate Heat Sink for Nuclear Power Plants [5]
- 1.59 Design Basis Floods for Nuclear Power Plants [6]
- 1.102 Flood Protection for Nuclear Power Plants [7]
- 1.127 Inspection of Water Control Structures Associated with Nuclear Power Plants [8]
- 1.135 Normal Water Level and Discharge at Nuclear Power Plants [9].

American National Standards Institute

- N170-1976 [10]

3. TECHNICAL EVALUATION

3.1 HYDROLOGIC DESCRIPTION (SEP TOPIC II-3.A)

3.1.1 Topic Background

This report is a review of Systematic Evaluation Program (SEP) Topic II-3.A, Hydrologic Description, for the LaCrosse Boiling Water Reactor. The purpose of this review is to adequately describe the site hydrologic environment and identify plant hydrologic design bases where available.

The information presented in this section was derived from several sources, including NRC docketed information, NRC staff files, the Licensee's submittals [2, 3], and a plant site visit [11].

3.1.2 Topic Review Criteria

The review criteria used for this section are identified in American National Standards Institute N170-1976 [10] and Standard Review Plan Section 2.4.1. - Hydrologic Description [4].

3.1.3 Evaluation

3.1.3.1 Site

The LaCrosse Boiling Water Reactor (also known as Genoa 2), is located on the east bank of the Mississippi River at Genoa, Vernon County, Wisconsin. The plant was completed in 1967 and has a generation capacity of 50 mW(e). The site is located at river mile 678.6 above the mouth of the Ohio River, approximately 3300 ft below U.S. Army Corps of Engineers Lock and Dam No. 8, and about 17 miles south of the city of LaCrosse, Wisconsin. A general site location map is presented in Figure 1. Figure 2 presents a site plan for reference.

3.1.3.2 The Mississippi River Basin

The drainage area upstream of the LaCrosse site is approximately 64,770 square miles with two tributaries emptying into the Mississippi River immediately above the site. These tributaries are the LaCrosse River, which

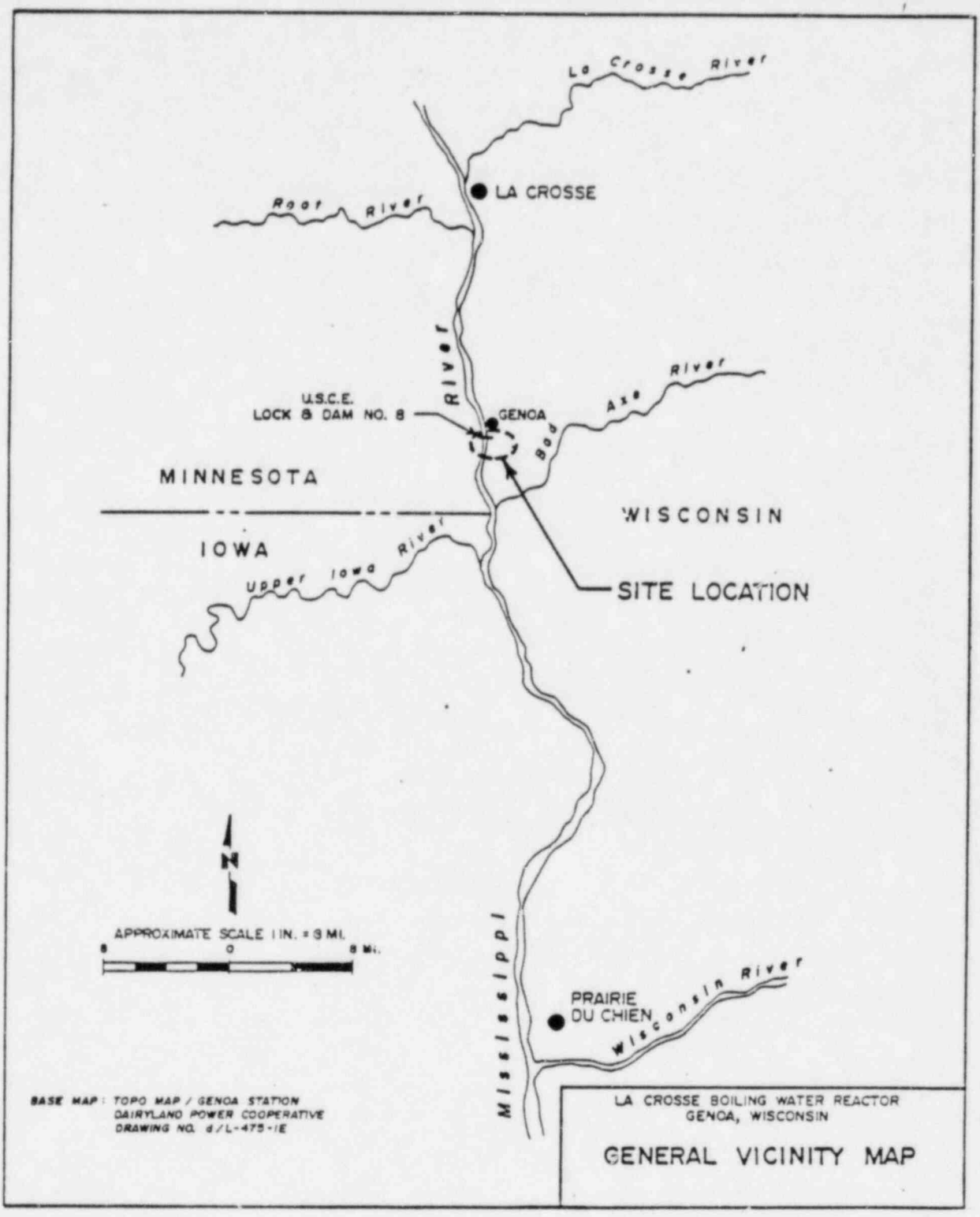


Figure 1. Site Location

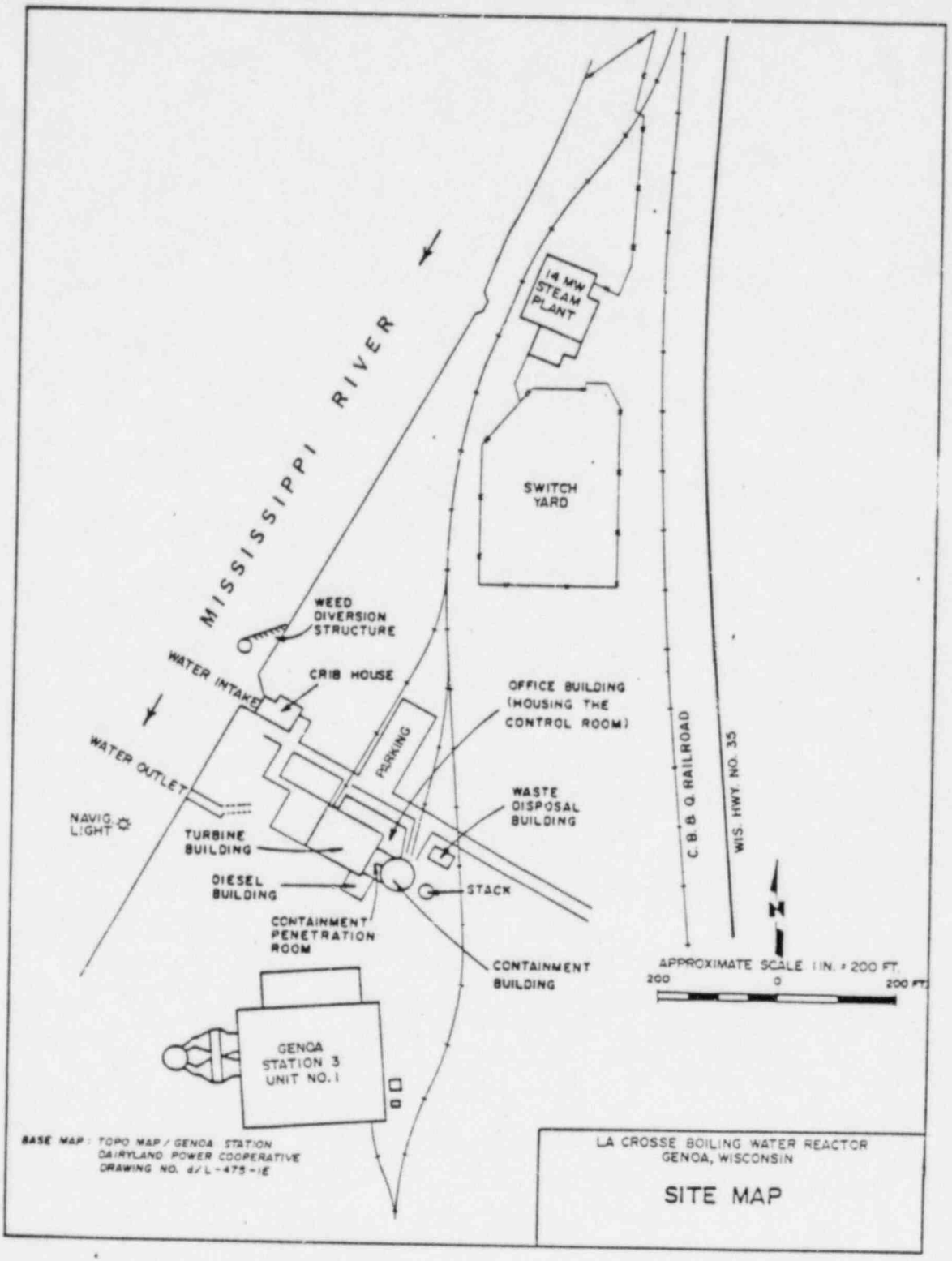


Figure 2. Site Map

drains an area in Wisconsin of 480 sq mi, and the Root River, which drains an area in Minnesota of 1,660 sq mi. Major tributaries upstream are the St. Croix and Minnesota Rivers.

3.1.3.3 Flood History

No site flooding has been identified to occur at the LACBWR site as a result of either onsite or offsite precipitation runoff.

Records of river stages on the Mississippi River date from June 1873, when the U.S. Weather Bureau installed a gage at Mount Vernon Street in LaCrosse, Wisconsin [19]. Flow measurements were conducted by the U.S. Geological Survey at this location from 1929 through 1955. Since 1955, stream records have been collected by the U.S. Army Corps of Engineers at Lock and Dam No. 7 (upstream of the LACBWR plant). The National Weather Service currently uses the Mount Vernon Street gage during flood periods.

Floods of record on the Mississippi River generally occur from spring snowmelt following a heavy accumulation of snow or from late winter rainfall on frozen ground. Some floods, however, have resulted from summer rain of long duration. The larger floods have generally been produced by melting snow or a combination of melting snow and spring rain. The maximum flood of record, which occurred on April 20, 1965, had an instantaneous peak discharge of 278,000 cfs at LaCrosse, Wisconsin. Unusually high floods of record on the Mississippi River at LaCrosse, Wisconsin are listed in Table 1.

3.1.3.4 Ice Effects

No major floods in the area of the LaCrosse site have been caused by ice during the period of record [19]. The Licensee has not reported any problems with ice since the plant began operation.

The LaCrosse crib house is well protected from the potential ice damage by the sheetpile weed diversion structure just upstream from the intake. Blockage of the intake forebay by freezing is prevented by a warmwater line that recirculates water from the discharge to the intake crib.

Table 1. Floods of Record, Mississippi River at LaCrosse, Wisconsin[1]

Date	Peak Discharge (cfs)
20 Apr 1965	278,000[2]
20 Apr 1969	214,000[2]
20 Apr 1952	196,000[2]
19 Jun 1880	191.000[2]
19 Apr 1951	184,000[2]
7 Apr 1967	180,000[3]
8 May 1888	167,000[3]
7 May 1954	166,000[2]
2 Apr 1920	158,000[3]
17 Oct 1881	154,000[3]
10 Apr 1922	145,000[3]
10 Apr 1897	145,000[3]
28 Apr 1916	142,000[3]
22 Jun 1943	137,000[2]
20 Sep 1903	135,000[3]
15 May 1950	125,000[2]
22 Jun 1944	124,000[2]
22 May 1894	123,500[3]
5 Jun 1942	123,000[2]
19 Mar 1945	121,000[2]

1. Upstream of the LaCrosse plant.
2. U.S. Geological Survey publications.
3. Estimated from rating curves by the St. Paul District.

3.1.3.5 Local Drainage

Roof Drainage

Safety-related structures at the LaCrosse plant are the turbine building, the office building (which houses the control room), the crib house, the containment structure, the containment penetration room, and the 1A and 1B diesel buildings.

The roofs of the turbine building, office building, and crib house have a design basis live loading of 65 psf. The containment structure, the containment penetration room, the 1A diesel building, and the 1B diesel building are designed for direct runoff [11].

Local Site Runoff

The site is generally flat with less than 1 ft of relief [11]; plant grade is 639.0 ft msl. Local runoff drains directly, and indirectly by storm sewers to the Mississippi River. The site is surfaced with grass and pavement.

East of the site is a river bluff, heavily wooded, rising to elevation 1100 ft msl. Drainage from this bluff is intercepted by a highway and railroad trending north and south at the foot of the bluff.

3.1.3.6 Groundwater

The LaCrosse plant is built on fill dredged from the river channel. The site is very flat, with an elevation of 639 ft msl. Groundwater readings are not available from the site.

Under the artificial fill, sand extends to a depth of 170 ft below plant grade. Underlying the sand are two different sandstone formations to a depth of 635 ft. These are all porous, water bearing formations.

3.1.3.7 Design Basis Elevations

The design bases for protection from hydrologic events are defined in Table 2. Table 2 is divided into three columns: Original (1967), Present (19[illegible], and NRC Criteria. The original design bases, in the first column, are

Table 2. Design Basis Elevations

Event	Elevation (ft msl) Original (1967)	Present (1982)	NRC Criteria
Local Flooding	Not defined	640.5 [11]	PMP (639.5 ft)
Groundwater			
Probable Maximum	639 (plant grade)	639 (plant grade)	639*
Normal High	Not defined	Not identified	634
Mississippi River			
High Water Level	635.8 (high water at crib house) [22]	640.5 (door sills) [11]	PMF (666 ft msl)
Low Water Level	615.4 [22]	615.4 [22]	601
Rainfall Loading on Roofs	65 psf [11]**	65 psf [11]**	PMP (108.8 psf) [11]**
Plant Grade (for reference)	639 [2]	639 [2]	639 [2]

*PMF (666 ft msl) is the controlling elevation for hydrostatic loading.
**This design basis live loading applies only to the turbine building, the office building (which houses the control room), and the crib house.

the hydrologic events from which the LaCrosse plant was designed to be protected. In some cases, the plant design included a safety factor above and beyond the design basis. The present design bases, in the second column, are the worst hydrologic events which the plant can now survive, based on the information available for this review. Hydrologic events more extreme than these would cause in-leakage or structural failure. The NRC criteria, in the third column of Table 2, are the hydroloigic events against which current NRC criteria require that the plant be protected. These values were computed or otherwise determined for this report using the best information available for review.

There was originally no design basis for local flooding. Presently, the elevation of the lowest opening into safety-related plant structures is 640.5 ft msl, 1.5 ft above plant grade [11]. This is the current level of protection against local flooding. Current NRC criteria require that protection be provided against local PMP, which is 639.5 ft msl or 6.4 in above plant grade, as computed in Section 3.2.3.3 of this report under SEP Topic II-3.B, Flood Potential and Protection Requirements.

Plant structures were originally designed to resist hydrologic pressure to an elevation of 639 ft msl, which is plant grade [3]. Plant grade is the highest elevation to which groundwater can rise, but surface water flooding necessitates a higher design basis for hydrostatic loading.

The original design basis for the crib house for protection from flooding on the Mississippi River is 635.8 ft msl [22]. The present level of protection from river floods is 640.5 ft msl, 15 ft above plant grade, which is the lowest opening in safety-related structures [11]. The PMF on the Mississippi River, the controlling elevation for hydrostatic loading, is derived in this report under SEP Topic II-3.B, Flooding Potential and Protection Requirements.

The original and present design basis low water level is 601 ft msl, which is the bottom of the forebay of the crib house [22]. The low water level which fulfills current NRC criteria was determined in SEP Topic II 3-C, Safety Related Water Supply, in this report.

3.1.4 Conclusion

The hydrologic environment is adequately described for the purpose of this report, with the exception of groundwater records.

3.2 FLOODING POTENTIAL AND PROTECTION REQUIREMENTS (Topic II-3.B)

3.2.1 Topic Background

The purpose of this topic is to identify the design basis flood level for the plant and site, under current licensing criteria, resulting from all potential flood sources external to the plant and site and from groundwater at the site. Significant differences between the levels or values used for design and construction of the plant and those derived under current licensing criteria are evaluated. This evaluation includes the flood effects on safety-related structures, roofs, systems, and equipment. Features of existing or proposed flood protection measures such as revetments, flood walls, or doors and emergency or administrative procedures are discussed.

3.2.2 Topic Review Criteria

This topic was reviewed against the following criteria:

- Regulatory Guide 1.59, Design Basis Floods for Nuclear Power Plants
- ANSI N170-1976
- Standard Review Plan, Sections 2.4.2, 2.4.3, 2.4.4, 2.4.7, 2.4.9, 2.4.10, and 2.4.12.

3.2.3 Evaluation

3.2.3.1 Introduction

Figure 1 depicts the placement of the LaCrosse site in the hydrologic environment. Pertinent flooding mechanisms appropriate to the site include flooding from the Mississippi River, flooding due to failure of upstream dams, local runoff from small tributaries adjacent to the site, and probable maximum precipitation loading on roofs of safety-related structures.

3.2.3.2 Flood History

Water level records for the city of LaCrosse, Wisconsin have been kept since 1873. The highest flood stage of the Mississippi River at LaCrosse, Wisconsin was 638.40 ft in 1965. The LaCrosse plant continued normal operation throughout that flood [3].

No floods have occurred on local drainageways at the site [3].

3.2.3.3 Local Flooding

Probable Maximum Precipitation

The probable maximum precipitation (PMP) for a 10-sq-mi area at the LaCrosse site is 25.74 inches in 6 hours [12]. The hourly distribution is 12.35 in, 4.38 in, 2.83 in, 2.32 in, 2.06 in, and 1.80 in [13]. The 12-hour PMP is 27.94 in, the 24-hour PMP is 31.02 in, and the 48-hour PMP is 33.22 in for a 10-sq-mi area [12].

Local Plant Flooding

Introduction

This study consists of an independent evaluation of the depth of flooding at the LaCrosse site. This hypothetical flood results from site runoff during rainfall equivalent to the PMP.

Drainage Location

There is a small, 35-acre watershed northeast of the LaCrosse Plant structures, as shown in Figure 3. It is an intermittent stream with a steep gradient and runs through wooded river bluffs. It drains an area of gently rolling fallow fields and low shrubs. During the heaviest hour of local PMP, this watershed would produce a flow of 520 cfs. At the foot of the river bluffs lie a highway and a railroad track which intercept the drainageway, diverting part of the flow and spreading the remainder across a much wider section than the intermittent stream bed.

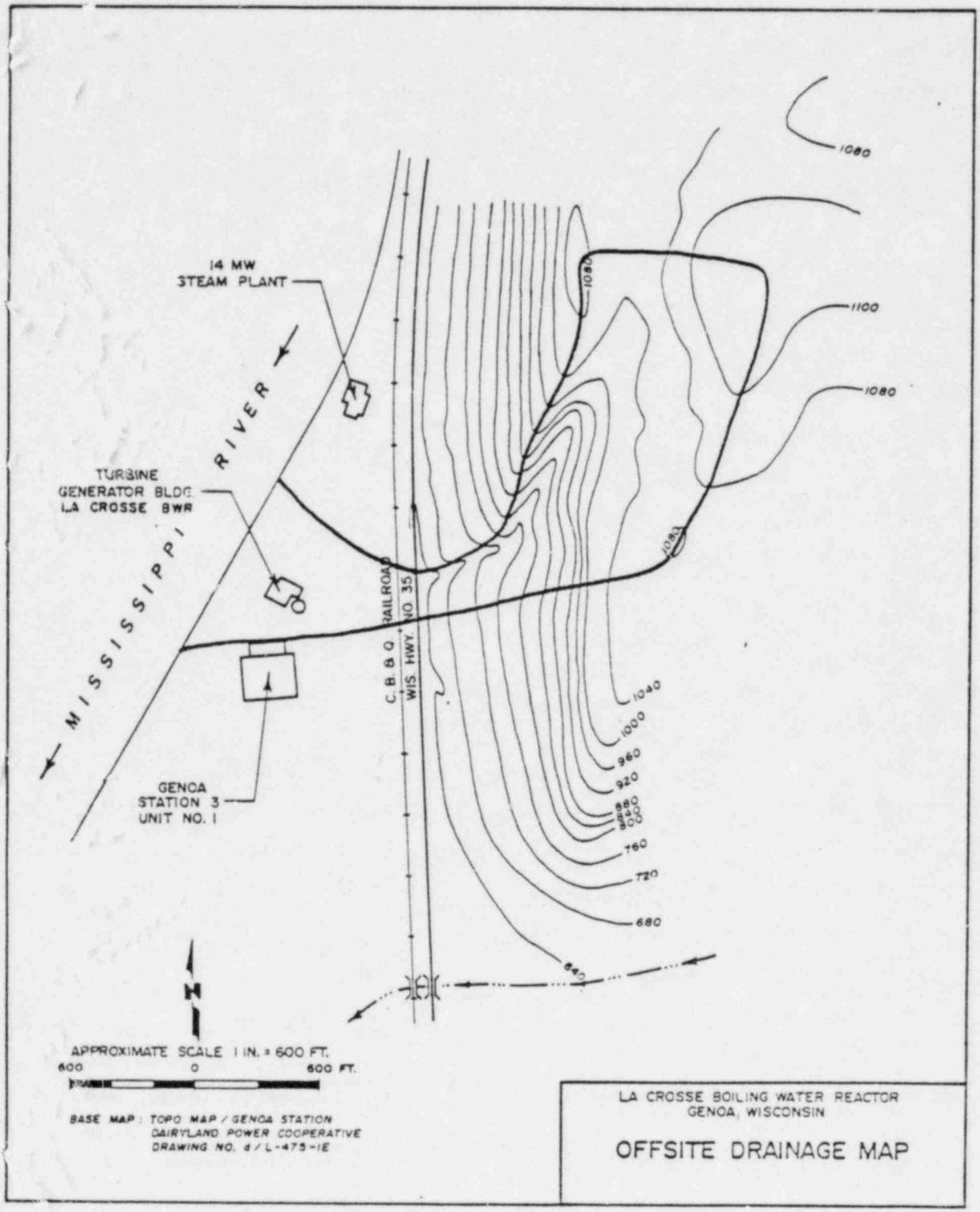


Figure 3. Offsite Drainage Map

PMP Runoff Analysis

In this analysis, all the runoff from the 35-acre watershed was conservatively assumed to flow directly across the plant site to the Mississippi River and was restricted to a cross section 600 ft wide. The slope between the base of the foothills and the river is approximately 1:900, and a value of 0.02 was chosen for Manning's "n". Under this conservative scenario, normal depth calculations show that storm water will flow past plant structures to a depth of 6.4 in.

Level of Protection

During a site visit, it was determined that all floor elevations of plant structures are 1 ft or more above grade, and that safety-related equipment is 6 in above the floor or higher. The total level of protection is 1.5 ft [11]. This is 11.6 in or 0.97 ft above the local PMF elevation.

Conclusion

The above analysis demonstrates that the LaCrosse plant is sufficiently protected from the local PMP.

Roof Flooding

The roofs of safety-related structures at the LaCrosse plant were designed to withstand a live loading of 65 psf [11].

The roofs of the containment structure, the 1B diesel building, and the containment penetration room have no parapets and rainwater runs off freely. The roof of the 1A diesel building has parapets 3 in high and a scupper to ensure direct runoff [11]. These three roofs will not pond water during PMP; thus, current NRC criteria are met.

The turbine building, the office building (which houses the control room), and the crib house all have parapets approximately 21 in high. Each building is equipped with roof drains [11], but if the drains are blocked, rainwater will pond on the roofs to the top of the parapets during PMP.

The design basis live loading for the turbine building, the office building, and the crib house roofs is 65 psf [11]. Two hours of PMP would cause ponding which would exert 86.7 psf and exceed the design basis live loading by 33%. Ponding to the top of the parapets would exert 108.8 psf, which exceeds the design basis live loading by 67.5%.

Ponding during PMP would exceed the design basis live loading by 67.5% on the roofs of the turbine building, the office building, and the crib house, and thus the building design basis does not meet current NRC criteria.

3.2.3.4 Flooding of Rivers

This evaluation first defines the level of flood protection required for the LaCrosse site under current NRC criteria, i.e., the probable maximum flood (PMF). Secondly, a description of the plant's present level of protection is provided.

PMF Definition

The Licensee did not present an analysis of the PMF in its submittal for SEP Topic II-3.B [3]; therefore, a PMF discharge and the associated elevation were determined for presentation in this report. Using Regulatory Guide 1.59 [6], a PMF discharge was determined for the 64,700-sq-mi [2] drainage area above the plant site. The resulting peak discharge for the PMF using Regulatory Guide 1.59 is approximately 1,300,000 cfs. The failure of Lock and Dam No. 8 (U.S. Army Corps of Engineers), which is located approximately 0.5 miles upstream, will have no appreciable effect on water surface profiles when the dam is submerged under PMF conditions. Historically, the head losses through the dam have resulted in a difference in elevation between the immediate upstream and downstream gages of less than 0.8 ft [17] for high flow conditions. Further, for flows above the standard project flood (SPF), the dam will be submerged and the failure of the dam at that time will not cause measurable increases of stage at the LaCrosse site.

The independent determination of the water surface elevation resulting from the PMF discharge was accomplished using Manning's Equations of normal

depth for uniform flow [14]. Historic data presented by the Corps of Engineers [17] were used extensively in the analysis.

The cross section used (labeled A-A) is depicted on Figure 4 and was taken from the intersection of two USGS topographic quadrangle maps (15-minute series) [15]. The lateral dimensions were scaled from the maps. The vertical dimensions for the main channel were taken from 1979 survey data (St. Paul District, U.S. Army Corps of Engineers) [16]. The vertical dimensions for the overbank section were read directly from the USGS topographic quadrangle maps. Field survey [11] indicates that vast areas of the overbank area are at an approximate elevation of 620 ft msl (pool elevation of Lock No. 9, downstream). The elements of the section were plotted as shown in Figure 5.

Using the cross section depicted in Figure 5, a curve was developed establishing the relationship between elevation and $AR^{2/3}$, where A is cross-sectional area and R is hydraulic radius.

The "n" value selected for use in the PMF was based on a calibration of Manning's Equation using lower discharge and determinations of $AR^{2/3}$ for various discharges. An average value of 0.060 was determined, which compares favorably with a determination of a weighted "n" value using procedures defined in Chow [14]. A comparison of surface roughness coefficients presented in Chow [14] with site survey information [11] indicates that appropriate "n" values are: approximately 0.035 for the main channel; approximately 0.125 for the natural levee (the natural flood-formed berm between the main channel and the overbank); and approximately 0.08 for the overbank area [14]. The main channel is dredged regularly and is generally clear of debris. The natural levee between the main channel and overbank (flood plain) is covered with standing trees and lush vegetation. The overbank area is variable, with intermittent areas of marsh, brush, and free-flowing open water.

The slope of 0.000069 was taken from the computed flood profiles [17] with a frequency of 500 years for the river reach in front of the site and was assumed to be the energy slope for Manning's Equation.

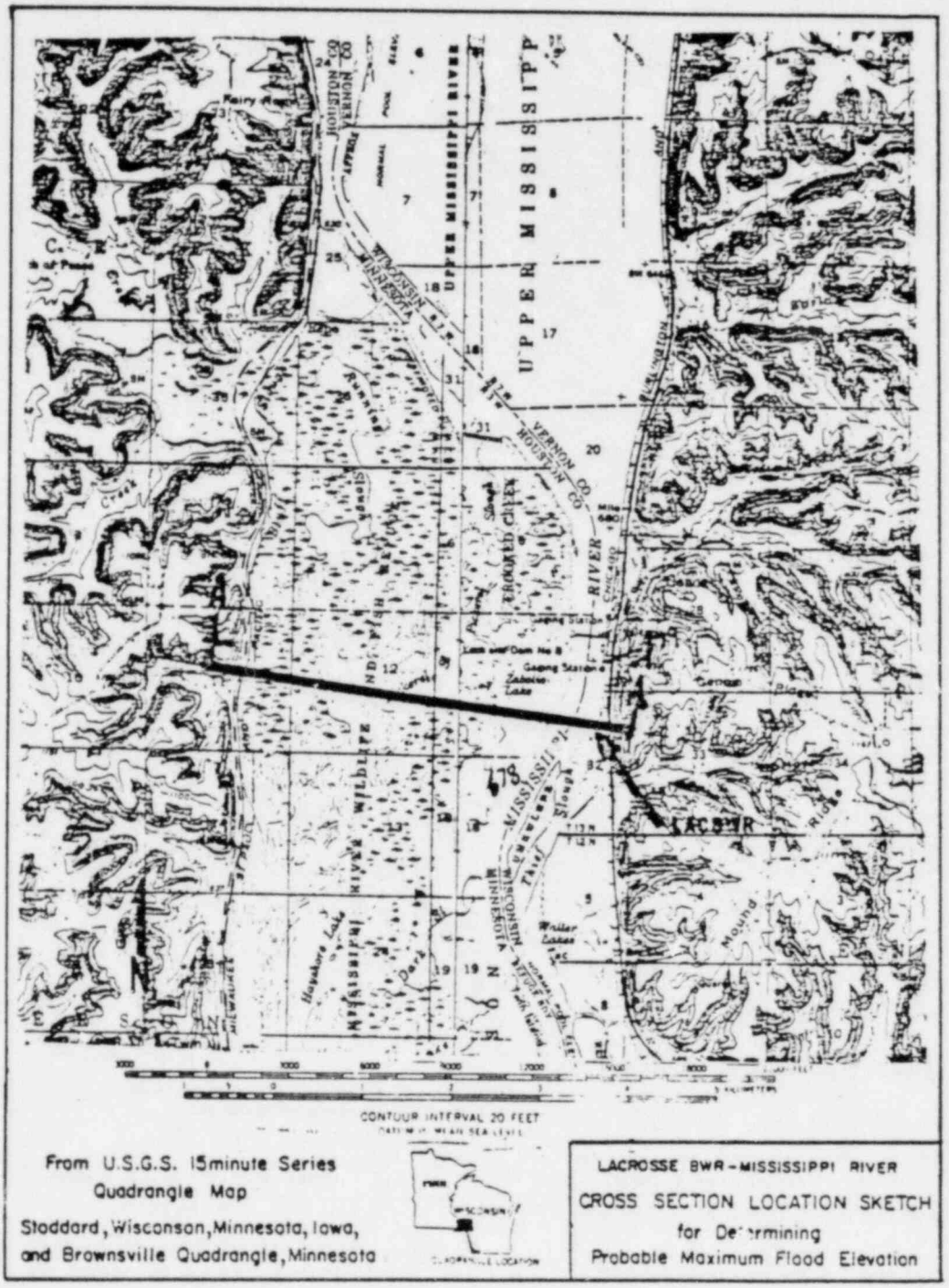
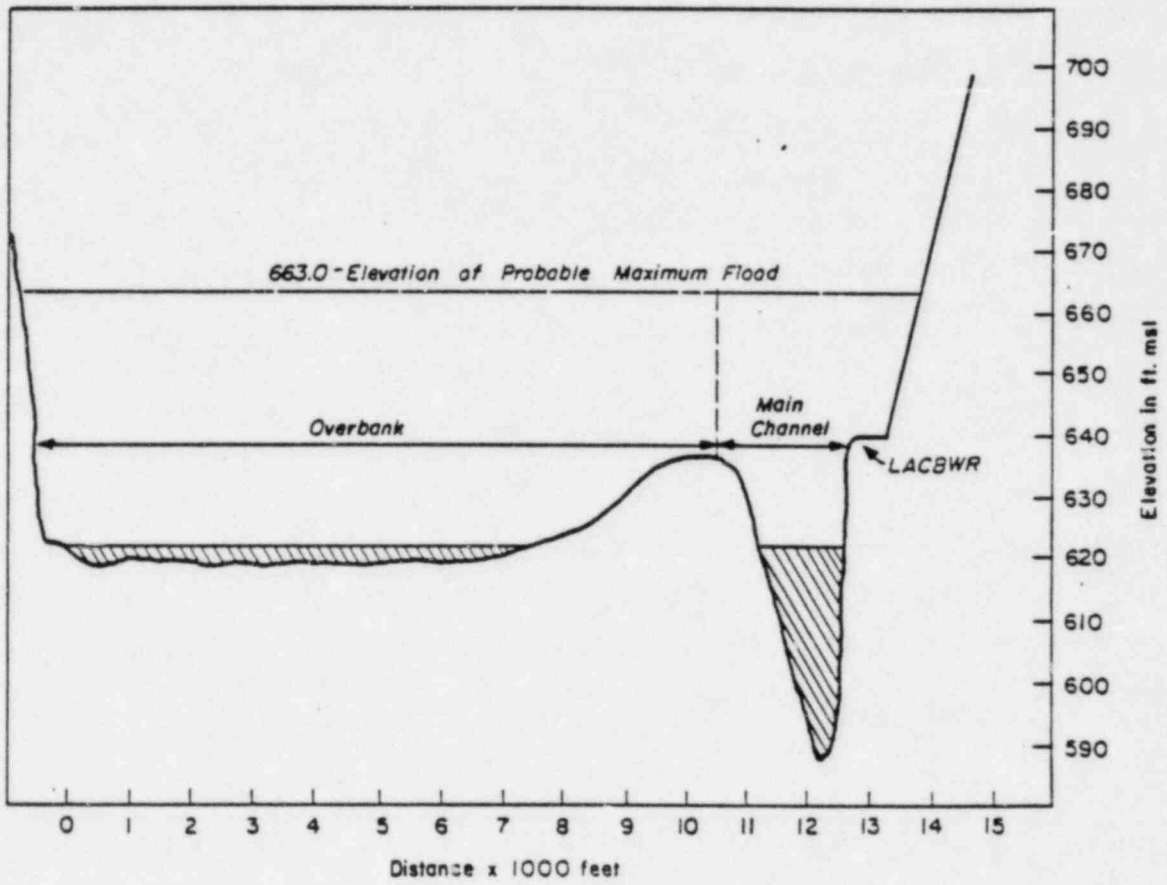


Figure 4. Cross Section A-A Location Sketch



NOTE:
Cross section taken looking upstream

Cross Section A-A on the Mississippi River
thru the LaCrosse BWR site
Computation using Manning Equation

$$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

Q = 1,300,000 cfs.
S = .000065 ft./ft.
"n" = 0.060

CHANNEL CROSS SECTION
MISSISSIPPI RIVER
LACROSSE BWR, RIVER MILE 678.5
ABOVE THE OHIO RIVER

Figure 5. Channel Cross Section

The PMF "Q" as determined by Regulatory Guide 1.59 for the 64,700-sq-mi drainage area [2] is approximately 1,300,000 cfs. Using this value in conjunction with the slope and roughness coefficient derived earlier, the value of $AR^{2/3}$ was computed. Plotting the $AR^{2/3}$ value on the graph produces the PMF water surface elevation of approximately 663 ft.

A rating curve is presented in Figure 6, depicting the relationship of stage and discharge. Elevations associated with the 5-, 10-, 15-, 100-, 500-year, and SPF discharges, which were computed by the Corps of Engineers [17], plant grade, and the calculated PMF discharge are shown in Figure 6.

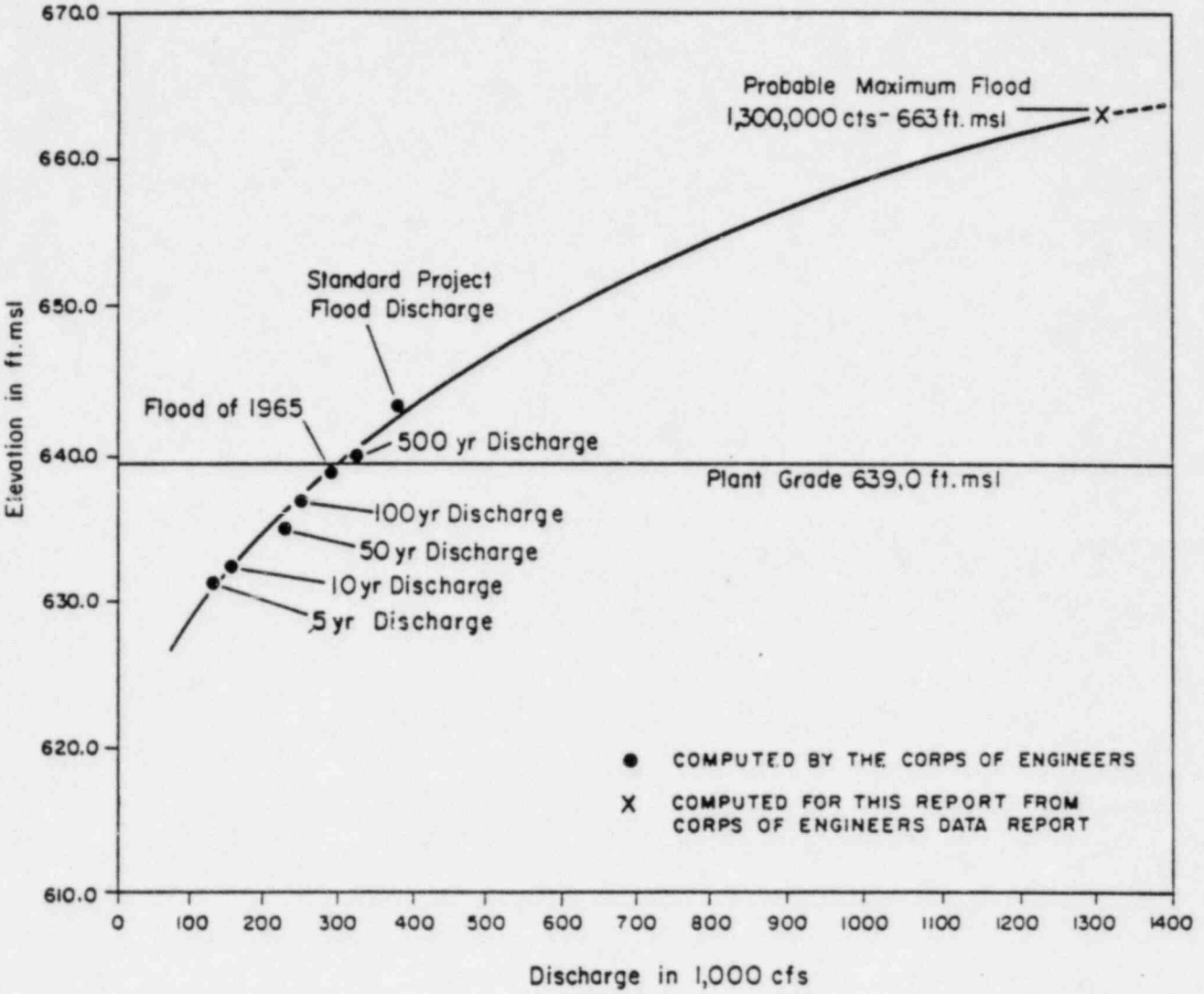
The slope of 0.000069 was taken from the computed flood profiles [17] with a frequency of 500 years for the river reach in front of the site and was assumed to be the energy slope for Manning's Equation.

Added water height at the plant occurring as a result of wind waves is approximately 3 ft [18]; the result is a total PMF of 666 ft msl. This total compares with the LaCrosse plant grade elevation of 639.0 ft msl, top of turbine building elevation of 700.0 ft msl, and top of diesel generator building elevation of 656 ft msl.

Flood Frequency

The LaCrosse site is not afforded passive protection from the PMF or the standard project flood (SPF). Additional information which serves to focus on the plant's present level of protection is provided in this section. The following evaluation presents the 5-, 10-, 50-, and 100-year, maximum historical, 500-year, SPF and PMF discharges and their associated elevations at the site. The following table includes data read directly from Reference 17, the SPF discharge and elevation from the Licensee's submittal [3], the maximum recorded flood level [17], and the PMF determined for this report.

During the SPF, the plant yard would be under 4.2 ft of water. This would allow waves to be transmitted up to the plant structures. The 50-mph wind, which has a 2-year frequency [10], would generate waves approximately 2 ft high along the Mississippi River [18]. Since half of the wave height is



LACROSSE BUILING WATER REACTOR SITE
ON THE MISSISSIPPI RIVER

STAGE DISCHARGE CURVE

CROSS SECTION A-A

Figure 6. Stage-Discharge Curve

above the still water level (SWL), the waves would add 1 ft to the SPF height, raising it to 644.2 ft msl.

Return Period C. Feature	Stage (ft msl) (1912 adjustment)	Discharge (cfs)
5 year	631.2	134,000
10 year	632.4	161,000
50 year	635.6	224,000
100 year	637.0	254,000
Maximum Historic (1965)	638.2	
Plant Grade	639.0	
500 year	639.8	321,000
Present Level of Flood Protection	640.5 [2, 11]	325,000 (approx.)
SPF	643.2 [3]	386,000 [3]
SPF plus windwaves	644.2 [6]	386,000 [3]
PMF	663 [6]	1,300,000 [6]
PMF plus windwaves	666 [6]	1,300,000 [6]

Present Level of Flood Protection

The LaCrosse site is situated on dredged fill to an elevation of 639 ft msl. Floor elevations for safety-related buildings are tabulated below.

Structure	Elevation	Reference Drawing
Turbine Building	640'0"	Sargent & Lundy B-6 Ground Floor Framing Plan LaCrosse Generator Plant
Crib House	640'0"	Sargent & Lundy B-37 Crib House Foundation Plans LaCrosse Generator Plant
1B Emergency Diesel	641'0"	Sargent & Lundy A-1 Diesel Generator Building Floor and Roof Plans

Since safety-related equipment is located on pedestals having a height of approximately 6 in [2, 11], the present level of Mississippi River flood protection at the LaCrosse site is 640.5 ft msl. The return period associated with floods rising to this elevation is approximately 500 years [17].

3.2.3.5 Failure of Dams

Upstream of the LaCrosse site are several lock and dam complexes owned and operated by the U.S. Army Corps of Engineers. Each of these dams stores a relatively small quantity of water at less than 10 ft above normal stage. Approximately 3,300 ft upstream of the LaCrosse site is Lock and Dam No. 8. Its right bank is earth-bermed to control water and directs flow to the dam spillway which is located in the main river channel. The locks are located on the left bank, adjacent to which is the U.S. Army Corps field office.

The failure of the main dam or adjacent earth berms will have a variable effect on the water surface elevations at the LaCrosse site, largely dependent upon the river discharge. The operating pool elevation of Lock and Dam No. 8 throughout the year is 631.0 ft msl. At a 5-year discharge (134,000 cfs), the difference in elevation between head and tail waters of the dam is 0.8 ft. The elevation difference decreases with increasing discharge so that at a 500-year discharge (321,000 cfs), the difference is reduced to 0.4 ft. Additional increases in discharge result in a smaller difference in elevation up to the SPF elevation, at which time the dam is submerged.

Should the dam fail at discharges ranging from 100,000 cfs to 300,000 cfs, the increase in dam tail water elevations will be attenuated as water reaches the LaCrosse site. The consequent increase of water elevation certainly would be less than 1 foot of elevation at the site. Therefore, it is concluded that the effect of a catastrophic failure of Lock and Dam No. 8 during high flow conditions would have negligible effect on water surface elevations measured at the LaCrosse site.

3.2.3.6 Groundwater

The focus of this evaluation is to define groundwater elevation for use in evaluating flood or structure hazards. Specifically, the probable maximum groundwater elevation will be defined. In addition, the normal high groundwater elevation to be used in combination with an appropriate seismic load (e.g., safe shutdown earthquake) is presented.

Generally, to define these elevations with a minimum of error requires that the site be monitored for long periods of time, incorporating groundwater data recorded during seasonal fluctuations and river level changes. No such data exist for the LaCrosse plant site. Hence, the levels presented are the best estimates based on the data available. Should the Licensee present further data for evaluation, a revision of the conclusions presented here could be effected.

The plant site is located on fill dredged from the river channel built up to elevation 639 ft msl. The elevation associated with the probable maximum groundwater elevation is controlled by the level of the Mississippi River. It should be recognized that the Mississippi River PMF elevation is well above plant grade and that safety-related structures and systems will be exposed to hydrostatic (and hydrodynamic) loads well above the design basis groundwater elevation.

The elevation of the normal high groundwater level is based on the 25-year Mississippi River flood elevation of approximately 634 ft msl. The choice of this elevation is based on the simplifying assumption that groundwater will rise rapidly with the increasing river level. The 25-year elevation is chosen on the basis of Regulatory Guide 1.59, Combination Events Criteria.

3.2.4 Conclusion

Local Flooding

Runoff from local PMP would be 6.4 in deep across the plant site. Plant structures are built 1.0 ft above plant grade, and safety-related equipment is 6.0 inches above the floors. Local floodwaters will be 11.6 inches below safety-related equipment. Protection from local PMF fulfills current NRC standards.

Roof Flooding

Ponding during PMP would exceed the design basis live loading by 67.5% on the roofs of the turbine building, the office building, and the crib house, and, therefore, the design basis for these buildings does not meet current NRC

criteria. The roof structural design basis for the containment penetration room, the 1A diesel building, and the 1B diesel building meets current NRC standards because they can safely shed the PMP.

Flooding of Rivers

Flood protection at the LaCrosse site does not conform with current NRC licensing criteria. Current criteria for plants which have considerable flood warning time stipulate that all systems and components necessary for shutdown must be passively protected from the SPF, while those systems required to maintain a safe shutdown condition must be passively protected from the PMF.

The site and safety-related systems are presently capable of being flooded by a Mississippi River flood with a return period of approximately 500 years. No structures are passively protected from the SPF or the PMF.

Failure of Dams

The failure of Lock and Dam No. 8 will have negligible effect on water surface elevations at the LaCrosse site for flows below the SPF. There will be no measurable effect for flows above the SPF.

Groundwater

The probable maximum groundwater level is not a controlling design basis at this site since the maximum hydrostatic level is produced by the PMF at elevation 663 ft.

The probable maximum groundwater elevation for the LaCrosse plant site is plant grade, or 639 ft msl. The normal high groundwater elevation for use in combination with appropriate seismic conditions is approximately 634 ft msl, the 25-year Mississippi River elevation. These elevations should be used under SEP Topic III-3.A, Effects of High Water Level on Structures.

3.3 CAPABILITY OF OPERATING PLANTS TO COPE WITH DESIGN BASIS FLOOD CONDITIONS (SEP TOPIC II-3.B.1)

3.3.1 Topic Background

Protection against postulated floods can be accomplished by implementing emergency procedures and technical specifications. The purpose of this evaluation is to focus on the adequacy and efficacy of the LaCrosse emergency procedures to preclude flooding of safety-related equipment necessary for maintaining the safe operation and cooldown of the reactor system. Further, this evaluation addresses technical specifications for flood control systems and procedures.

The following evaluation used information obtained during a LaCrosse site visit and from Docket No. 50-409 and other NRC-supplied sources.

3.3.2 Topic Review Criteria

The following references were used as review criteria:

- ANSI N170-1976
- NRC Regulatory Guides 1.59 and 1.102
- Standard Review Plan, Sections 2.4.10 and 2.4.14.

3.3.3 Evaluation

3.3.3.1 Emergency Procedures for Flood Protection

Regulatory Background

Regulatory Guide 1.59, Design Basis Floods for Nuclear Power Plants, states (in Regulatory Position 1) that safety-related structures, systems, and components identified in Regulatory Guide 1.29, Seismic Design Classification, must be designed to withstand and retain capability for cold shutdown and maintenance thereof under conditions resulting from the worst site-related flood probable at the nuclear power plant (i.e., PMF).

"As an alternative to designing hardened protection [*] [passive and in-place structural provisions] for all safety-related structures, systems, and components as specified in Regulatory Position 1 above, it is permissible not to provide hardened protection for some of these features if:

a. Sufficient warning time is shown to be available to shut the plant down and implement adequate emergency procedures;

b. All safety-related structures, systems, and components identified in Regulatory Guide 1.29 are designed to withstand the flood conditions resulting from a Standard Project event with attendant wind-generated wave activity that may be produced by the worst winds of record and remain functional;

c. [Not applicable.]

d. In addition to paragraph 2.b above, at least those structures, systems, and components necessary for cold shutdown and maintenance thereof are designed with hardened protective features to remain functional while withstanding the entire range of flood conditions up to and including the worst site-related flood probable (e.g., PMF, seismically induced flood, hurricane, surge, seiche, heavy local precipitation) with coincident wind-generated wave action as discussed in Regulatory Position 1 above." [Underlining added for emphasis]

In the following evaluation, the plant's flood protection design will be compared to these regulatory criteria, and compliance with or deviation from this regulatory position will be identified.

LACBWR Emergency Flood Procedures

The Licensee's flood emergency procedures are embodied in what the Licensee has described as a flood control program, which was presented in Reference 3. The purpose of the flood control program is to protect the plant

*Hardened protection means structural provisions incorporated in the plant design that will protect safety-related structures, systems, and components from the static and dynamic effects of floods. In addition, each component of the protection must be passive and in place, as it is to be used for flood protection, during normal plant operation. Examples of the types of flood protection to be provided for nuclear power plants are contained in Regulatory Guide 1.102.

from Mississippi River floods which could rise above plant grade (639 ft msl), and subsequently jeopardize the operation of the plant.

Pertinent elements of the Licensee's flood control program as excerpted from Reference 3 are defined in Table 3, Flood Condition Operations.

Comparison with Current NRC Flood Protection Criteria

The LaCrosse plant is not designed with hardened protection to the elevation of the probable maximum flood. In fact, hardened protection (passive and in-place protection) is available to elevation 639.0 ft msl (plant grade) plus 1.5 ft of additional protection from building foundation slabs and equipment pedestals (elevation 640.5 ft msl). This elevation is 3.7 ft below the SPF elevation of 644.2 ft msl (which includes windwaves). Therefore, the site does not comply with present criteria in Regulatory Guide 1.59.

Although the Licensee's flood control program indicates that, prior to the onset of flood waters from the Mississippi River, a flood barrier will be constructed to the height of the SPF, this protection is not "passive and in-place." Therefore, this protection and emergency plan does not conform to current NRC criteria in Regulatory Guide 1.59. Although sufficient warning will be available to initiate a flood warning condition prior to the onset of the SPF, the construction of flood protection dikes such as those suggested in the LaCrosse flood control program, which will take significant investments of time and materials, is not judged prudent, considering the consequences of flood water rising above plant grade. Therefore, flood protection from the SPF which is "passive and in-place" should be considered. Similarly, the proposed construction of a protective apron around the containment to an elevation of 3 feet above the predicted flood height also does not conform to the current position in Regulatory Guide 1.59.

The adequacy of the Licensee-identified flood protection plan for water surface elevations above the SPF and up to the PMF should be analyzed under SEP Topic III-3.A, Effects of High Water Level on Structures.

Table 3. Flood Condition Operations

Flood Condition	River Elevation	Key Operation
Flood Alert	630(1)	Alert DPC management. Initiate special inspection routines. Initiate continuous monitoring of flood forecasts. Plan flood control operations. Ensure availability of equipment and materials. If required based on flood forecast, mobilize personnel for dike construction.
Flood Warning	635(1)	Start temporary dike construction and install pumps. Coordinate flood control operations with Corps of Engineers, Lock and Dam No. 8.
Flood Emergency	639(1)	Continue temporary dike construction. Shut down LaCrosse.
Flood Crisis	643(2)	Shut down LaCrosse (if not prev ously shut down). Depressurize the reactor coolant system and initiate core cooling with the shutdown condenser. Initiate pressurization of containment vessel. Initiate installation of containment protective apron.

1. Flood condition to be initiated based on actual river stage.
2. Flood crisis to be initiated based on three-day flood forecast.

One item to be considered in the development of flood emergency procedures is the timing of a flood at the LaCrosse site. During past floods, 15 to 19 days elapsed between the initial rise of the river and the flood peak [19]. Approximately 20 to 25 days may pass before the peak of the PMF, but an extreme flood event could be expected to rise to plant grade about 6 days after the river begins to rise. This information should be considered in evaluating technical specifications and emergency procedures for the following items: pump placement and time required to locate and connect pumps, the efficiency of workers hampered by working conditions which include up to 15 ft of flowing water around plant structures with 2-ft-high wind waves, and the pump fuel requirements.

3.3.3.2 Technical Specifications

Dairyland Power Cooperative does not presently have plant technical specifications which would limit plant operation under conditions of flooding.

3.3.4 Conclusion

Emergency Procedure

The LaCrosse emergency flood control program does not comply with current NRC criteria in several areas.

Specifically, emergency flood control programs are acceptable only if passive and in-place protection is available to the SPF elevation. Protection through the full PMF range should be available for those systems which must maintain safe shutdown conditions. The adequacy of structural provisions to protect against the full range of the PMF should be addressed in SEP Topic III-3.A, Effects of High Water Level on Structures.

Technical Specifications

Plant Technical Specifications which limit plant operation at the onset of a significant flood should be adopted for the LaCrosse plant. These plant Technical Specifications should identify the criteria used in initiating plant shutdown, such as rate of rise of flood waters and expected flood height.

3.4 SAFETY-RELATED WATER SUPPLY (TOPIC II-3.C)

3.4.1 Topic Background

This topic reviews the acceptability of a particular feature of the cooling water system, namely, the ultimate heat sink (UHS). The review is based on current criteria contained in Regulatory Guide 1.27, Rev. 2, which is an interpretation of General Design Criterion (GDC) 44, "Cooling Water," and GDC 2, "Design Bases For Protection Against Natural Phenomena," of 10CFR50, Appendix A.

GDC 44 requires, in part, that suitable redundancy of features be provided for cooling water systems to ensure that they can perform their safety function. GDC 2 requires, in part, that structures, systems, and components important to safety be designed to withstand the effects of natural phenomena without loss of ability to perform their safety functions. Regulatory Guide 1.27 has been specifically cited by the NRC's Regulatory Requirements Review Committee for consideration in the backfitting of operating reactors. This guide is used in judging whether the facility design complies with current criteria.

The UHS, as reviewed under this topic, is the complex of cooling water sources, including necessary retaining structures (e.g., a pond with its dam or a cooling tower supply basin), and the canals or conduits connecting the sources to the cooling water system intake structures, but excludes the intake structures themselves. The UHS performs two principal safety functions: (1) dissipation of residual heat after reactor shutdown, and (2) dissipation of residual heat after an accident.

Availability of an adequate supply of water for the UHS is a basic requirement for any nuclear power plant. Since there are various methods of satisfying the requirement, UHS designs tend to be unique to each nuclear plant, depending upon its particular geographic location. Regulatory Guide 1.27 provides UHS examples that the NRC staff has found acceptable.

The UHS must also be able to dissipate the maximum possible total heat, including the effects of a loss of coolant accident (LOCA) under the worst combination of adverse environmental conditions. The maximum tolerable

temperature of an UHS such as a cooling pond may significantly limit its ability to dissipate the heat load following a LOCA or plant shutdown, while maximum temperature may not be a significant concern for an UHS such as a large lake, river, or ocean.

Because of the importance of the UHS, it should be able to perform its safety function during and following the most severe natural phenomena or accidents postulated at the site. In addition, the UHS safety functions should be ensured during other applicable site-related events that may be caused by less severe natural phenomena and accidents in reasonable combination.

3.4.2 Topic Review Criteria

The criteria for evaluating the UHS were taken from Regulatory Guide 1.27, "Ultimate Heat Sink For Nuclear Power Plants," and are as follows:

"1. The ultimate heat sink should be capable of providing sufficient cooling for at least 30 days (a) to permit simultaneous safe shutdown and cooldown of all nuclear reactor units that it serves and to maintain them in a safe shutdown condition, and (b) in the event of an accident in one unit, to limit the effects of that accident safely, to permit simultaneous and safe shutdown of the remaining units, and to maintain them in a safe shutdown condition. Procedures for ensuring a continued capability after 30 days should be available.

2. The ultimate heat sink complex, whether composed of single or multiple water sources, should be capable of withstanding, without loss of the sink safety functions specified in regulatory position 1, the following events:

   a. the most severe natural phenomena expected at the site, with appropriate ambient conditions, but with no two or more such phenomena occurring simultaneously,

   b. the site-related events (e.g., transportation accident, river diversion) that historically have occurred or that may occur during the plant lifetime,

   c. reasonably probable combinations of less severe natural phenomena and/or site-related events,

   d. a single failure of manmade structural features.

3. The ultimate heat sink should consist of at least two sources of water, including their retaining structures, each with the capability to perform the safety functions specified in regulatory position 1, unless it can be demonstrated that there is an extremely low probability of losing the capability of a single source.

4. The technical specifications for the plant should include provisions for actions to be taken in the event that conditions threaten partial loss of the capability of the ultimate heat sink or the plant temporarily does not satisfy regulatory positions 1 and 3 during operation."

In addition to Regulatory Guide 1.27, clarifications are contained in Standard Review Plan (SRP), Sections 2.4.11, "Low Water Considerations," and 9.25, "Ultimate Heat Sink."

3.4.3 Evaluation

The ultimate heat sink for the LaCrosse plant is the Mississippi River. The low pressure service water and the alternate core spray systems draw water from the Mississippi River. Pumps for both systems are located in the crib house. The low pressure service water system is a once-through system that provides cooling water to the CCW heat exchangers and discharges to the Mississippi River. The alternative core spray system is a water supply system for the fire protection, overhead storage tank, and high pressure core spray systems. A third system, the emergency service water supply system, provides an alternate means for restoring the supply of Mississippi River water to the alternate core spray system, LPSW/tube-side CCW coolers, shutdown condenser, emergency core spray system, and the overhead storage tank in the event that normal crib house supply systems and associated underground piping are damaged. The emergency service water system is principally designed to restore the necessary in-plant cooling water services (i.e., UHS) in the event of a SSE.

In Reference 2, DPC provided a Safety Assessment Report for SEP Topic II-3.C, Safety Related Water Supply (Ultimate Heat Sink). An evaluation of DPC's assessment of the LaCrosse UHS against each of the review criteria is provided in the following paragraphs.

Criterion 1 of Regulatory Guide 1.27 was established for heat sinks for which the supply may be limited and/or the temperature of plant intake water from the heat sink may become critical. DPC stated:

> "The ultimate heat sink is the Mississippi River where well documented historical flow records indicate sufficient cooling even during periods of low-flow to exceed the 30-day requirement for both operating and shutdown cases. No procedures are required for capacity beyond 30 days because the river itself is the ultimate long-term available cooling source. The highest normal summer water temperatures for the river are in the 80°F to 85°F range. Because of the relatively low maximum temperature and the high flow rate compared to plant needs (even in the case of historic low flow), no meteorological conditions can occur which will impair the ability of the river to act as the utimate heat sink."

At the LaCrosse plant, the ability to dissipate the total essential heat load, the effect of environmental conditions on the ability of the UHS to furnish the required quantities of cooling water for extended periods after shutdown, and the sharing of cooling water with other units do not require further consideration due to the type, large size, and proximity of the water supply.

Similarly, Criterion 2 of Regulatory Guide 1.27 was established to ensure that the heat sink function would not be lost due to natural phenomena, site-related events, or a single failure of manmade structural features. DPC stated:

> "The ultimate heat sink (Mississippi River) is capable of withstanding the types of severe natural phenomena predicted for the site (e.g., the relatively low Safe Shutdown Earthquake). The intake/outfall manmade structures consisting of a Crib House, a 60" circulating water inlet pipe, a 6" high pressure service water supply pipe, a 16" low pressure service water pipe and a 60" circulating water discharge pipe, were not specifically designed to withstand the proposed .11g site specific criteria which is the basis for the Design Basis Earthquake.
>
> The Emergency Service Water Supply System was designed to provide the capability for portable pumps to draw directly from the river to provide for shutdown, cooldown or post-accident situations in the case where a seismic event results in loss of any of the manmade structures. This redundancy is available for other events including the single failure of a manmade structure, transportation accidents, etc. It also provides a second system located in a separate building in the event of high winds. The Crib House has actually been subjected to a greater than 200 year frequency flood and the manmade structure portion of the ultimate heat sink is capable of withstanding waterflow based on historical events in the region.

> The ultimate heat sink including manmade structures when redundancy is considered, are capable of withstanding even low probability natural phenomena without total loss of heat sink function."

The effects of earthquakes on the intake/outfall manmade structures are being reviewed under Topic III-6, "Seismic Design Considerations." As stated in Section 3.4.1, the UHS is the complex of water sources, including necessary retaining structures, and canals or conduits connecting the sources to the cooling water system intake structures, but excludes the intakes themselves. Consequently, failure of the intake/outfall manmade structures at the LaCrosse plant is not reviewed in the UHS topic. However, it should be noted that, in a safety evaluation [20], the NRC concluded:

> "...liquefaction remained a concern for the crib house and underground piping, we found that a site dewatering system was not necessary to resolve this concern. We also concluded that the concept for a dedicated safe shutdown system to preclude reliance on the crib house and underground piping was feasible and that engineering details and installation could be completed by February 25, 1981. The dedicated shutdown system would provide additional assurance that the reactor could be safely shutdown by providing sufficient river cooling water in the unlikely event that the normal supply capability is lost due to seismically induced soil liquefaction at the pumps intake structure and buried piping."

The effect of earthquakes on the Mississippi River is not considered by the Licensee to pose a significant threat to the availability of the water source. Other natural phenomena such as tornadoes and floods do not endanger the water source.

Low water level caused by prolonged drought or icing also is not considered by the Licensee to be a threat to the water source at the LaCrosse plant. With respect to low river flow, DPC stated:

> "The low flows in the Mississippi River at the site are subject to a certain amount of control and regulation by the 11 navigation dams on the river above the site and by several power reservoirs on the river and its tributaries. However, the basic low-flow discharge pattern has not been altered, the effect of the regulation being largely transitory and of small influence on average monthly flows. Low flow at the site occurs in the fall and winter; the lowest monthly average flow is most frequently recorded in February. In periods of drought, miminum flows have also occurred in August and September."

Further review of the potential of low water on the Mississippi River was performed for this report. Based on records collected by the U.S. Geological Survey at LaCrosse, Wisconsin from 1930 to 1955, the minimum daily flow of 3,200 cfs occurred on December 30 and 31, 1933. Although the elevation associated with this flow is not identified, DPC indicates that this low flow remains the historic minimum. Normally, Lock and Dam No. 9 maintains the pool river level at elevation 620 ft msl, approximately 5 ft over the minimum required level at the intake structure. As long as the Lock and Dam No. 9 is functional, the river level will not fall below the design basis low water level (shown on Sargent and Lundy Drawing M-32). The design low water level at the crib house is 615.4 ft msl (see Reference 22). If a catastrophic failure of the Lock and Dam No. 9 is postulated, then the river level can be expected to fall below the design basis low water level for the service water pumps. In this case, the UHS capability will be lost. An exception to this conclusion would occur when the river flow rate is large enough to maintain sufficient river level regardless of the catastrophic failure of the Lock and Dam No. 9. It is recognized that the LaCrosse emergency service water supply system (ESWSS) was designed to ensure the supply of cooling water following a seismic event which caused failure of the intake structure. It is also apparent, although not stated by the Licensee, that the ESWSS could also be used in case of failure of Lock and Dam No. 9 and fall of the water level below the design low water level of 615.4 ft msl. The capability of the plant to cope with a loss of Lock and Dam No. 9 function at various river flow rates remains an open item to be addressed by the Licensee.

The LaCrosse plant is designed with a 18-in ice melting line that connects the outfall to the crib house structure. During periods of extreme cold, the thermal effluent from this line can be directed to the crib house to prevent ice formation.

The effect of site-related events (e.g., a transportation accident) on the crib house is being reviewed under Topic II-1.C, Potential Hazards Due to Nearby Industrial, Transportation, and Military Facilities, and Topic III-4.D, Site Proximity Missiles. Site-related events are not considered a threat to the availability of the LaCrosse water source.

Single failure of the service and cooling water systems that draw water from the crib house has been evaluated in the evaluation report [21] of SEP Topic IX-3, "Station Service and Cooling Water Systems." With the exception of the loss of Lock and Dam No. 9, no single failure of any manmade structure will adversely affect the UHS water source.

Criterion 3 of Regulatory Guide 1.27 was established to provide a high level of assurance that a plant's UHS would be available when needed. Specifically, the guide is concerned that, for once-through cooling systems, there should be at least two aqueducts connecting the source with the intake structure and two discharge aqueducts to carry the cooling water away to preclude flooding. DPC states:

> "The manmade portions of the ultimate heat sink intake have redundancy for shutdown, cooldown, and post-accident situations by the use of the emergency service water supply system. Plant cooldown and post-accident conditions which are primarily water makeup situations, are also provided redundancy by the emergency service water supply system. The river is a single source of water which due to high volume even in recorded historical low flow, demonstrates a low probability of unavailability."

At the LaCrosse plant, the crib house is located along the Mississippi River, and aqueducts are not used. The UHS at the LaCrosse plant does not require two sources of water in that the probability of losing the capability of the Mississippi River to supply the crib house and to accommodate the discharge is extremely low.

Criterion 4 requires that the plant Technical Specifications include provisions for actions to be taken in the event that conditions threaten partial loss of the UHS. This criterion was established to ensure that the manner in which plant technical specifications were written was such that the plant would be placed in a safe condition or appropriate provisions would be implemented if a condition existed which threatened the availability of the UHS. An example of such a condition might be the prediction of a severe flood which would jeopardize a UHS dike or retaining structure, a severe drought with the potential to reduce the capacity of a cooling pond, or a prediction of severe river icing conditions that could preclude or inhibit water flow for a once-through cooling system. In each of these situations, technical

specifications require that the NRC be notified if the UHS does not satisfy the limiting condition for operation and that if its capability cannot be restored to this condition within a reasonable period of time, all units served by the UHS be shutdown and remain shutdown until this capability is restored. DPC stated:

> "The Technical Specifications for the emergency service water supply system provide provisions to be taken in the event of loss of system capability. They also provide a requirement for routine surveillance to insure a high probability of system availability."

DPC is referring to technical specifications that ensure that the emergency service water supply system is operable for plant operations other than cold shutdown or refueling. The entire system is tested every 18 months to ensure that the system can be assembled under simulated emergency conditions and deliver the required flow. Inspection and maintenance of the pumps, and inspection and testing of the hoses and other fittings at more frequent intervals provide added assurance that the system will function if needed. In Reference 20, the NRC stated:

> "Based on our review of the proposed Technical Specifications, we conclude that the Technical Specifications changes are acceptable." Events other than an earthquake do not threaten a partial loss of UHS at LaCrosse; therefore, additional Technical Specifications addressing such concerns are not required.

It should be noted that the LaCrosse UHS is not susceptible to damage from natural phenomena and most site-related events. The UHS complex is potentially susceptible to damage from a single catastrophic failure of the Lock and Dam No. 9. It is critical that the Mississippi River level be maintained above the design low water level at the crib house to ensure the safe shutdown of the LaCrosse plant. A dam failure is an event which cannot be predicted sufficiently in advance to allow the plant to be placed in a safe shutdown condition; therefore, it can be concluded that technical specifications on the UHS complex are not necessary. If a failure of the downstream dam is a credible event and further study concludes that the river level cannot be maintained above the design low water level at the crib house for frequent historical flow rates, then plant emergency procedures and/or design modifications may be necessary.

Although the UHS complex is not affected by flooding, other safety-related components and structures are affected. A discussion of protection against postulated floods by implementing emergency procedures and technical specifications is provided in Section 3.3, SEP Topic II-3.B.1.

3.4.4 Conclusion

The following is a summary of the degree of conformance of the LaCrosse UHS to the criteria of Regulatory Guide 1.27:

Criterion 1 - Complies with no exceptions or clarifications

Criterion 2 - Complies with the exception that the capability of the intake system to maintain communication with the ultimate heat sink following a failure of Lock and Dam No. 9 should be verified

Criterion 3 - Complies with no exceptions or clarifications

Criterion 4 - Complies with no exceptions or clarifications.

In summary, to conclude fully that the UHS at LaCrosse plant complies with the intent of Regulatory Guide 1.27, the likelihood of a catastrophic failure of Lock and Dam No. 9 or a failure of the dam due to natural phenomena (i.e., earthquake or flood) should be evaluated to determine whether or not the river level remains above the design low water level at the crib house.

4. CONCLUSIONS

4.1 HYDROLOGIC DESCRIPTION

The hydrologic environment is adequately described for the purpose of this report, with the exception of groundwater records.

4.2 FLOOD POTENTIAL AND PROTECTION REQUIREMENTS

Local Flooding

Safety-related equipment is 11.6 inches above local PMF level. Protection against local PMF fulfills current NRC criteria.

Roof Flooding

Ponding during PMP would exceed the design basis live loading by 67.5% on the roofs of the turbine building, the office building, and the crib house, and, therefore, the design basis for these buildings does not meet current NRC criteria. The roof structural design basis for the containment penetration room, the 1A diesel building, and the 1B diesel building meets current NRC standards because they can safely shed the PMP.

Flooding of Rivers

Flood protection at the LaCrosse site does not conform with current NRC licensing criteria. Current criteria for plants which have considerable flood warning time stipulate that all systems and components necessary for shutdown must be passively protected from the SPF, while those systems required to maintain safe shutdown conditions must be passively protected from the PMF.

The site and safety-related systems are presently capable of being flooded by a Mississippi River flood with a return period of approximately 500 years. No structures are passively protected from the SPF or the PMF.

Failure of Dams

The failure of Lock and Dam No. 8 will have negligible effect on water surface elevations at the LaCrosse site for flows below the SPF. There will be no measurable effect for flows above the SPF.

4.3 EMERGENCY PROCEDURES AND TECHNICAL SPECIFICATIONS

The LaCrosse emergency flood control program does not comply with current NRC criteria in several areas.

Specifically, emergency flood control programs are acceptable only if passive and in-place protection to the SPF elevation is available. Protection through the full PMF range should be available for those systems which must maintain the safe shutdown conditions. The adequacy of structural provisions to protect against the full range of the PMF should be addressed in SEP Topic III-3.A, Effects of High Water on Structures.

The LaCrosse plant is not designed with hardened protection to the elevation of the probable maximum flood. In fact, hardened protection (passive and in-place protection) is available to the elevation 639.0 ft msl (plant grade) plus 1.5 ft of additional protection from building foundation slabs and equipment pedestals (elevation 640.5 ft msl). This elevation is 3.7 ft below the Standard Project Flood elevation of 644.2 ft msl (which includes windwaves). Therefore, the site does not comply with present criteria in Regulatory Guide 1.59.

Although the Licensee's flood control program indicates that, prior to the onset of flood waters from the Mississippi River, a flood barrier will be constructed to the height of the SPF, this protection is not "passive and inplace." Therefore, this protection and emergency plan does not conform to current NRC criteria in Regulatory Guide 1.59. Although sufficient warning will be available to initiate a flood warning condition prior to the onset of the SPF, the construction of flood protection dikes such as those suggested in the LaCrosse flood control program, which will take significant investments of time and materials, is not judged prudent, considering the consequences of flow water rising above plant grade. Therefore, flood protection to the SPF which

is "passive and in-place" should be considered. Similarly, the proposed construction of a protective apron around the containment to an elevation of 3 feet above the predicted flood height also does not conform to the current position in Regulatory Guide 1.59.

The adequacy of the Licensee-identified flood protection plan for water surface elevations above the SPF and up to the PMF should be analyzed under SEP Topic III-3.A, Effects of High Water on Structures.

Dairyland Power Cooperative does not presently have plant technical specifications which would limit plant operation under conditions of flooding.

Plant Technical Specifications which limit plant operation at the onset of a significant load should be adopted for the LaCrosse plant. These plant Technical Specifications should identify the criteria used in initiating plant shutdown, such as rate of rise of flood waters and expected flood height.

4.4 ULTIMATE HEAT SINK

The following is a summary of the degree of conformance of the LaCrosse UHS to the criteria of Regulatory Guide 1.27:

Criterion 1 - Complies with no exceptions or clarifications

Criterion 2 - Complies with the exception that the capability of the intake system to maintain communication with the ultimate heat sink following failure of Lock and Dam No. 9 should be verified

Criterion 3 - Complies with no exceptions or clarifications

Criterion 4 - Complies with no exceptions or clarifications.

In summary, to conclude fully that the UHS at LaCrosse Plant complies with the intent of Regulatory Guide 1.27, the likelihood of a catastrophic failure of Lock and Dam No. 9 or a failure of the dam due to natural phenomena (i.e., earthquake or flood) should be evaluated to determine whether or not the river level remains above the design low water level at the crib house.

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