Licensing Bases for
Prairie Island Nuclear Generating Plant
Turbine Building Internal Flooding

Prepared by: Bill Scholberg Date: 7-16-10

Bill Scholberg, Engineering Design, PINGP

Reviewed by: Thomas J Roddey Date: 7-16-10

Thomas Roddey, Engineering Design Manager, PINGP

Approved by: Mark A Huting Date: 7-16-10

Mark Huting, Engineering Programs Director

Table of Contents

1. Licensing Basis for Turbine Building Internal Flooding

The following information provides a summary of the licensing basis for the Turbine Building internal flooding program at PINGP. The summary contains a review of regulatory correspondence associated with internal flooding, highlights the relevant sections from those documents, and summarizes their impact on the licensing basis of PINGP. See page 9 for a flow chart that shows the sequence of correspondence and events.

A. Random/Non-Seismic Induced Flooding

Atomic Energy Commission Requirement

By letter dated August 3, 1972 (Skovholt letter) (Reference 1), the Atomic Energy Commission (AEC) requested that Northern States Power (NSP), the plant licensee at the time, review the design of its facilities in light of industry operating experience (OE). The industry OE was failure of an expansion bellows at Quad Cities Unit 1 that resulted in an internal flooding event. NSP was specifically asked to (1) review whether failure of any equipment that does not meet the criteria of Class I seismic construction, particularly the circulating water system, could cause flooding sufficient to adversely affect the performance of an engineered safety system, and (2) whether failure of any equipment could cause flooding such that common mode failure of redundant safety related equipment would result.

Additionally, in a letter dated September 26, 1972 (DeYoung letter) (Reference 2), the aforementioned review was reiterated. The following is an excerpt from the letter.

> "You are requested to review PINGP, Unit 1 and 2 to determine whether the failure of any non-Category I (seismic) equipment, particularly in the circulating water and fire protection system, could result in a condition, such as flooding or the release of chemicals, that might potentially adversely affect the performance of safety-related equipment required for safe shutdown of the facilities or to limit the consequences of an accident."
>
> "The integrity of barriers to protect critical equipment from potential damaging conditions should be assumed only when the barrier has been specifically designed for such conditions."

This review was requested within 30 days from the date of issuance.

PINGP Response

In a letter dated October 23, 1972 (Reference 3), NSP responded to the AEC request. The following is an excerpt from the letter.

> "We have reviewed the PI design for units 1 and 2 and conclude that where the potential of flooding engineered safety features exist, the operator is provided sufficient information and means to take corrective action in a timely manner."

"Each Turbine Building condenser/condensate pump pit is equipped with a sump and two sump pumps, one of which starts on a high water level (674' m.s.l.) signal in the sump. At 678'6" m.s.l. a high-high water level signal starts a second sump and finally a high-high-high water level (678'9" m.s.l) annunciates in the control room. Since all safety related electrical/ mechanical components are on or above floor elevation 695', when the high-high-high water level annunciates there will still be ample time for visual operator inspection of the situation and initiation of corrective action (such as manual shutdown of the circulating water pumps). There is no further danger of loss of safeguards by flooding after shutdown of the circulating water pumps because normal river elevation is 674.5' m.s.l."

"Furthermore, a study was made in the Class I areas of the Auxiliary Building for any non-class I pipes whose failure might constitute a flooding problem. Only those systems that have access to large volumes of water and/or potentially large flow rates were considered. The results are that only various size fire protection and feed water lines are potentially problematic. However, at most, the feed water can only raise water to 6.4 inches. Failure of a fire protection line would raise the water level only 1 inch in 15.5 minutes (pumping at 2,000 gpm). Numerous sump level alarms would notify the operator of an abnormal condition and provide him with adequate time to terminate the incident prior to damaging any safeguards equipment."

"Hence, it can be concluded that any potential failure of non-class I equipment does not pose a threat to the overall plant safety, either be impeding safeguard performance or by causing common mode failure of redundant safeguard related equipment."

The Turbine Building condenser pits, in which no safety related equipment is installed, are each capable of containing greater than 750,000 gallons. Each provides a large volume for water collection prior to flood waters reaching safety related equipment located on elevation 695'. (Reference 14)

A plant modification in late 1980s (Reference 6) added level switches in the condenser pits at approximately 685' m.s.l. (approximately 1/3 of the condenser pit volume). Actuation of these switches, on a two-out-of-three logic, will automatically trip the main circulating water pumps and will alarm in the Control Room. The modification eliminated the need for operator action and provided an improvement on the original configuration.

It was not necessary to establish a new bounding flood because all other leakage in the Turbine Building, such as the cooling water or fire protection systems, would flow to the condenser pits and would be bounded by the circulating water event from the perspective of time to isolate flooding sources. When the circulating water pumps trip and the high condenser pit level alarm is received in the control room, operators would be dispatched. If large amounts of water were still flowing into the pits, the operators would locate the source and contact the Control Room. Sufficient time to isolate the flooding would remain since approximately 2/3 of the condenser pit volume would still

be available to contain flood waters before reaching safety related equipment in the Turbine Building at elevation 695'.

While no Safety Evaluation Report (SER) could be located regarding the PINGP response to the Skovholt and DeYoung flooding letters, no records could be located that indicated the response was inadequate.

FSAR Amendment 31, Section I.4-4, (Reference 10) discusses flooding in the Auxiliary Building, but does not specifically reference the Turbine Building. It states that the seismic Class 1 areas of the Auxiliary Building were surveyed and the main feedwater and fire protection systems were considered the only non-seismic flooding sources with access to large water volumes. The expected water flow rates and/or volumes would not endanger any equipment required for safe reactor shut down.

The review of non seismic piping systems for potential to flood and damage safety related equipment was not originally performed in the Turbine Building. It was determined that the main circulating water system break would conservatively bound any other non-seismic breaks.

A 2010 evaluation (Reference 13) of non-seismic cooling water and fire protection piping in the Turbine Building (¾" and larger) was performed with the following results:

- Confirmed that the non-seismic cooling water and fire protection piping, that could cause major flooding, would survive seismic events equal to or greater than the design basis seismic event of 0.12g.
- Confirmed that the total leakage from those non-seismic pipes and components, that would not survive the design basis seismic event, did not result in damage to safety related equipment; i.e., ample time existed for operator actions to isolate. Ample time is defined as 3 hours or greater.

Prairie Island current USAR, Section I.5.5, Flooding (Reference 12):

- Describes two types of floods; high energy systems and non high energy/non Seismic I systems
- High energy pipe leakage is described as leakage from breaks and cracks
- Does not discuss requirement to assess flooding from consequential damage as a result of HELB

Conclusion:

The AEC regulatory requirements for evaluating non-seismic Class 1 systems for the potential to damage safety related equipment from flooding is defined in the Skovholt and DeYoung letters (References 1 and 2). An evaluation and response was completed by PINGP demonstrating compliance with these regulatory requirements. PINGP continues to be in compliance with the initial licensing basis requirements.

B. HELB Induced Flooding

On December 12, 1972, the AEC issued a letter (Giambusso letter) to NSP (Reference 4) on the subject of High Energy Line Break (HELB). This letter discusses flooding in paragraph 9.29.15 (below)

"9.29.15
A discussion should be provided of the potential for flooding safety related equipment in the event of failure of a feedwater line or any other high energy fluid line."

AEC/NSP meetings were held on January 4, 1973, to clarify requirements of the Giambusso letter. The meeting minutes and clarifications were provided by AEC in a letter dated January 11, 1973 (Reference 5).

NSP addressed the requirements of the Giambusso letter in FSAR Amendment 28 (Reference 7).

The AEC performed a review of FSAR Amendment 28 and responded to NSP through a letter dated February 9, 1973 (Reference 11). The AEC concluded that NSP's response was not complete for several of the items requested in the Giambusso letter. One of those items was response to paragraph 9.29.15 (flooding).

NSP addressed flooding with regard to the Giambusso letter in FSAR Amendment 31, Section I.4-4, on March 17, 1973 (Reference 12).

This section is specific to the Auxiliary Building, but it establishes a basis for NSP evaluation of high energy line break flooding. One of the systems evaluated for flooding potential was the feedwater system. The system was described as having a volume of 200,000 gallons at a flow rate of 28,000 gpm.

The evaluation states, "The total water volume of the feedwater system would not flood the Class I areas of the Auxiliary Building to a level sufficient to endanger any equipment required for safe reactor shut down."

This indicates that the flooding associated with high energy line break was confined to the contents of the line itself and did not include flooding from any other sources that may have been impacted and damaged from the whipping feedwater line.

The AEC approved the NSP response to the Giambusso letter through SER Supplement 1 dated March 21, 1973.

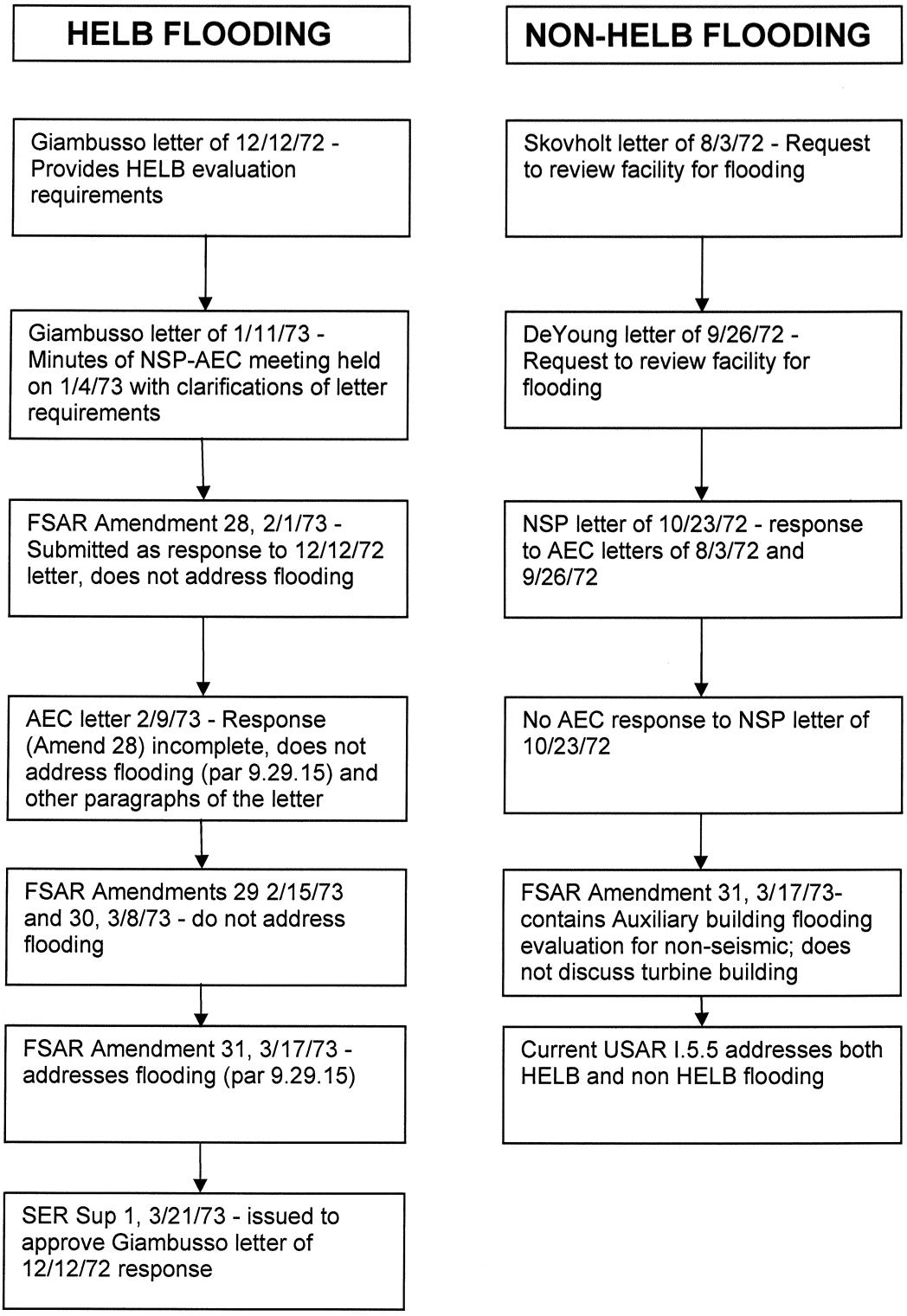
A review of documents related to the PINGP Giambusso letter response was performed. No additional correspondence could be found with requirements to evaluate consequential flooding from impacted piping due to high energy line breaks.

Conclusion: The Giambusso letter required NSP to provide a discussion of the potential for flooding safety related equipment in the event of failure of a feedwater line or any other high energy fluid line. This discussion was provided in FSAR Amendment 31 on March 17, 1973. The discussion described flooding from the contents of the

feedwater system only. It did not make any reference to consequential flooding from impacted piping due to high energy line breaks. The response to the Giambusso letter was reviewed and approved by the AEC through SER Supplement 1 dated March 21, 1973.

2. References

1. Letter from Skovholt (AEC) to Dienhart (NSP), Subject: "Flooding of Critical Equipment," dated August 3, 1972
2. Letter from DeYoung (AEC) to Dienhart (NSP), Subject: "Plant Flooding," dated September 26, 1972.
3. Response Letter from Dienhart (NSP) to Deyoung (AEC), Subject: "30 day response to the 9/26/1972 letter," dated October 23, 1972.
4. Letter from Giambusso (AEC) to Dienhart (NSP), Subject: "High Energy Line Break Analysis," dated December 12, 1972.
5. Letter from Giambusso (AEC) to Dienhart (NSP), Minutes of meeting held 1/4/1973, "Clarification of guidelines and criteria enclosed with the December 12, 1972 letter regarding a postulated break in a high energy pipe," dated January 11, 1973.
6. PINGP Modification 86L907, "High Turbine Building Level Trip of the Circulating Water Pumps."
7. FSAR Amendment 28, dated February 1, 1973.
8. FSAR Amendment 29, dated February 15, 1973.
9. FSAR Amendment 30, dated March 8, 1973.
10. FSAR Amendment 31, dated March 17, 1973.
11. AEC letter, States that the NSP response to the Giambusso letter dated December 12, 1972, is not complete for several of the items requested in the letter, dated February 9, 1973.
12. PINGP USAR Revision 31P, Appendix I, Section I.5.5.
13. Stevenson & Associates report, PRA Notebook V.SPA.10.011, "Seismic Fragilities for the Unit 1 and Unit 2 Turbine Building Piping and Equipment," dated June, 2010.
14. PINGP calculation ENG-ME-759, "GOTHIC Internal Flooding Calculation for the Turbine Building," Rev. 0, dated February 8, 2010.


HELB FLOODING
Giambusso letter of 12/12/72 - Provides HELB evaluation requirements
Giambusso letter of 1/11/73 - Minutes of NSP-AEC meeting held on 1/4/73 with clarifications of letter requirements
FSAR Amendment 28, 2/1/73 - Submitted as response to 12/12/72 letter, does not address flooding
AEC letter 2/9/73 - Response (Amend 28) incomplete, does not address flooding (par 9.29.15) and other paragraphs of the letter
FSAR Amendments 29 2/15/73 and 30, 3/8/73 - do not address flooding
FSAR Amendment 31, 3/17/73 - addresses flooding (par 9.29.15)
SER Sup 1, 3/21/73 - issued to approve Giambusso letter of 12/12/72 response
NON-HELB FLOODING
Skovholt letter of 8/3/72 - Request to review facility for flooding
DeYoung letter of 9/26/72 - Request to review facility for flooding
NSP letter of 10/23/72 - response to AEC letters of 8/3/72 and 9/26/72
No AEC response to NSP letter of 10/23/72
FSAR Amendment 31, 3/17/73- contains Auxiliary building flooding evaluation for non-seismic; does not discuss turbine building
Current USAR I.5.5 addresses both HELB and non HELB flooding