OCT 2 4 1984

Docket No. 50-412

MEMORANDUM FOR: Thomas M. Novak, Assistant Director
for Licensing, DL

FROM: William V. Johnston, Assistant Director
Materials, Chemical & Environmental Technology, DE

SUBJECT: BASIS FOR STAFF POSITION - BEAVER VALLEY-2 APPEAL

Plant Name: Beaver Valley Power Station - Unit No. 2
Licensing Stage: OL
Responsible Branch: Licensing Branch No. 3, M. Ley, PM

Reference: Memorandum, W. Johnston to T. Novak, subject "Basis for Staff Position on PMP - Beaver Valley-2 Appeal", October 18, 1984.

Attached is the revised staff position which has incorporated the supplemental information promised in the above referenced memorandum. The revision consists of additional information not previously furnished. This revision begins on page 3 and is highlighted by a vertical line drawn in the right margin.

William V. Johnston, Assistant Director
Materials, Chemical & Environmental Technology
Division of Engineering

Attachment: As stated

cc: w/o attachment
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w/attachment
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NRC STAFF POSITION REGARDING USE OF HYDROMETEOROLOGICAL REPORTS 51 AND 52 IN EVALUATING LOCAL FLOODING AT BEAVER VALLEY-2

General Design Criterion 2 (GDC-2), "design bases for protection against natural phenomena," of 10 CFR 50, Appendix A, requires, in part, that nuclear power plant structures, systems and components be designed to withstand the effects of floods without loss of capability to perform their safety functions.

The staff has not been able to confirm that safety-related facilities at Beaver Valley 2 are designed to withstand the effects of site and roof flooding resulting from local intense precipitation. GDC-2 requires that safety-related structures be designed to prevent water from entering and affecting vulnerable safety-related equipment. Structural failures such as collapse of a roof due to excessive ponding or water entering through an inadequately designed door could inundate safety-related equipment and potentially prevent the plant from being safely shut down.

GDC-2 addresses appropriate design basis for floods but only in general terms. It requires that design bases reflect consideration of the most severe historical data with <u>sufficient</u> margin for the limited accuracy, quantity, and period of time in which data have been accumulated. Guidance on what constitutes sufficient margin is contained in Regulatory Guides 1.59, "Design Basis Floods for Nuclear Power Plants", and 1.102, "Flood Protection for Nuclear Power Plants". These documents state that the appropriate design basis for precipitation induced flooding is the Probable Maximum Flood (PMF) as developed by the Corps of Engineers. This PM criterion has been used by the staff since at least 1970 and we are not aware of any previous guidance defining "sufficient margin" to be less severe than the PM hydrologic event. Thus it is well established that the PM criterion best meets GDC 2 with respect to hydrologic events.

In reviewing Section 2.4 of the Beaver Valley Power Station, Unit 2 FSAR, the staff determined that the applicant, Duquesne Light Company (DLC), had not provided sufficient information to support its conclusion that flooding would not affect safety-related equipment. On August 31, 1983, several questions requesting additional information on the site flooding analysis were submitted to the applicant. In one of these questions, the staff requested that DLC use the National Weather Service (NWS) Hydrometeorological Reports (HMR) 51 and 52 in their flood analysis because these reports contain more current information than HMR-33 which the applicant had used in its analysis.

In response, on November 15, 1983, the applicant requested that the staff's questions be rescinded and that the Beaver Valley site drainage plan be reviewed in accordance with the current standard review plan, NUREG-0800. The reason given for this request was that the staff had changed its review criteria for Probable Maximum Precipitation (PMP) by requesting that the latest NWS reports be used. It was DLC's opinion that such a change was not in accordance with NRR policy as outlined in NRR Office Letter No. 2, Revision 2, April 28, 1982, which stated that "staff reviewers should not decrease or go beyond the scope and requirements of any specific SRP section." A meeting was held between the staff and DLC on March 21, 1984 to discuss DLC's letter of November 15, 1984. As a result of that meeting the staff concluded that its questions should not be rescinded because they were, in general, in conformance with the SRP and reflected a valid safety concern.

In a letter dated May 30, 1984, DLC requested, "that the proposed staff requirements [to use the latest NWS reports] be submitted to NRC management for approval, in accordance with the Office of Nuclear Reactor Regulation (NRR) procedure for management of plant specific backfitting, prior to transmittal as a licensing requirement."

It is the staff's position that requiring the use of the most current information to determine flood levels at Beaver Valley-2 is not a backfit as claimed by DLC. Reasons for the staff's position follow.

The staff has always recognized the importance of utilizing the most recent engineering technology in evaluating the potential impacts of flooding on site safety. SRP Section 2.4.2 specifically points out the use of the probable maximum concept. It also states that if new information becomes available at the OL stage, a brief review should be carried out to evaluate its significance. Where the OL review reveals that the controlling flood level differs more than 5% less conservatively from the CP evaluation, any supplemental provisions needed in the flood protection design basis should be directed toward early warning measures and procedures for assuring safe shutdown of the plant or toward minor structural modification to accommodate the design flood level.

At the CP stage, the applicant stated that:

> "Yard drainage is designed for 4 in./hr intensity and is shown in Fig. Response 2.17-2. For rainfall intensities greater than 4 in./hr, some puddling and buildup of water will take place. However, since the site pitches toward the Ohio River and Peggs Run, surface drainage will aid the yard storm drainage system in minimizing the buildup to less than a few inches."

> "The design of roofs and roof drainage systems in all buildings containing Category I equipment will be designed to prevent the collapse of the roofs during the local probable maximum precipitation intensity of 9.3 in./hr. This will be accomplished either by increasing the roof drainage system capacity from 4 in./hr to 9.3 in./hr or by modifying the design of the roof and parapets such that the buildup of water at the higher 9.3 in./hr rate will not overload the roof."

On the basis of these statements by the applicant, the staff concluded in the CP-SER that:

> "Although the design basis selected for site drainage is substantially less severe than would be produced by local probable maximum precipitation, the ground in the plant area slopes toward the Ohio River and Peggs Run, and runoff in excess of storm drainage inlet and piping capacity is not expected to cause water levels greater than a few inches above the ground surface. We have reviewed the applicants' evaluation of site drainage and have concluded that such levels should not constitute a flood threat to safety-related facilities."

At the OL stage, the applicant reanalyzed site flooding, except that now instead of having a buildup of a few inches of water against safety-related buildings during a PMP event, the depth of ponded water is 2.25 ft at the Reactor Building, 5.64 ft at the Control Building and 5.56 ft at the Radwaste Building. The criteria used in both the CP and OL analyses were the same, i.e., HMR-33 and EM 1110-2-1411; only the results were considerably different. The following table summarizes the applicant's analysis presented in the FSAR.

Safety-Related Building	Lowest Access to Building (ft. msl)	Plant Grade Elevation (ft. msl)	PMP Flood Elevation (ft. msl)	Depth of Flooding (ft)	Difference between the PMP Flood Elevation & the Lowest Access to the Building (ft)
Reactor Building	767.83	730.	732.25	2.25	35.56
Control Building	735.77	730.	735.64	5.64	0.13
Radwaste Building	735.66	730.	735.56	5.56	0.10

As stated above, at the CP stage the applicant committed to increase the roof drainage system or to modify the design of roofs and parapets as required. However, the FSAR contains no information as to how or if this commitment was complied with. The staff therefore is unable to determine whether roofs are capable of supporting the loads that would be imposed by ponded water during a PMP event.

Concerning ponding of water at plant grade against safety related buildings, the applicant has not provided sufficient information to explain the significant difference in ponding levels determined in the CP and OL analyses, i.e., ponding depths of a few inches to more than 5 feet. Therefore, the staff has been unable to determine why such significant differences occurred. The staff has requested that the applicant provide additional information so that an independent evaluation can be performed.

When the staff became aware that the NWS, an arm of the National Oceanic and Atmospheric Administration (NOAA), had published two new reports which relate to PMP, applicants for OL's, including DLC, were requested to assess the effects of the use of the new reports on plant safety.

The two new NWS reports provide the results of recent extensive technical studies that NWS conducted jointly with the Corps of Engineers. The reports were published in June 1978 and August 1982. The first of those reports, Hydrometeorological Report No. 51 (HMR-51), essentially expanded the information previously presented in HMR-33 which is cited in the SRP Sections 2.4.2 and 2.4.3 and which the applicant had used in its analysis. The expansion consisted of extending the precipitation duration from 48 hours to 72 hours and increasing the drainage areas from 1,000 square miles to 20,000 square miles. The second report, HMR-52, provides, among other things, techniques to analyze PMP for drainage areas of 1 square mile and durations of 1 hour and less. These techniques have the effect of increasing the calculated PMP at specific sites.

In order to better understand the situation at the Beaver Valley site, it is necessary to briefly review the development of NRC flood criteria in general and localized PMP in particular.

Procedures for estimating Probable Maximum Floods (PMF's) are given in Regulatory Guide 1.59 in Appendix A, "Probable Maximum and Seismically Induced Floods on Streams and Coastal Areas", which references ANSI Standard N170-1976 "Standards for Determining Design Basis Flooding at Power Reactor Sites", and Appendix B, "Alternative Methods of Estimating Probable Maximum Floods". It is clear, however, from reading the Regulatory Guides that the PMF is the criteria and not the methodology of its estimation.

An integral component in the PMF determination is the PMP. The definition of PMF given in the ANSI standard is "...the hypothetical flood...that is considered to be the most severe reasonably possible, based on comprehensive hydrometeorological application of probable maximum precipitation and other hydrologic factors favorable for maximum flood runoff..." The discussion of PMP in the ANSI standard references a number of individual reports, most of which are National Weather Service (or U.S. Weather Bureau) publications. It is clear from the context, however, that it is the procedures established by the NWS, and not a particular report available at one point in time, that form the basis for determining the PMP. Thus ANSI N170-1976 states in Section 5.2, which is titled, "Probable Maximum Precipitation:"

> "Probable maximum precipitation estimates for the United States are available in generalized studies prepared by the National Weather Service. They are presented in varying degrees of completeness. Specific probable maximum precipitation estimates for areas not adequately covered by these studies may be made using techniques similar to those employed by the National Weather Service."

The most recent version of the standard, ANSI/ANS 2.8-1981, which has not yet been formally incorporated in Regulatory Guide 1.59, states:

> "Probable maximum precipitation estimates for the United States are available in generalized studies prepared by the National Weather Service. They are presented in 12.1 [the reference section of the standard]. These should be used whenever applicable."

It should be noted that these ANSI standards were written by working groups composed primarily of individuals from utilities and their consultants. The clear implication of both of these statements is to rely upon the expertise of the NWS and to accept newer NWS PMP studies as they become available. We note that the 1981 ANSI standard lists Hydrometeorological Report 51 as a reference.

The Standard Review Plan recognizes that improved methodologies may be developed and allows for their use in the period before they are actually incorporated in the SRP. For example, the Review Procedures section of SRP 2.4.2 states that "Improvements in calculational methods may occur..." and discusses their use.

Local flooding or plant site drainage, as it is called in the ANSI standards, is a subcategory of PMF's resulting from local precipitation. Both ANSI standards state "The effects of local probable maximum precipitation on the plant site shall be determined and summarized." and direct the reader to the section on PMP for its determination.

There are two characteristics of local PMP that differentiate it from PMP in general; the small areas and short durations involved. HMR-51 and its predecessor, HMR-33, define PMP for various combinations of duration and drainage area in the central and eastern parts of the U.S. The shortest duration and smallest drainage area addressed are 6 hours and 10 square miles, respectively. Local flooding determinations usually require consideration of PMP's with durations of less than 1 hour and limited local areas contributing to potential flooding at plant grade; typically less than 1 square mile. Prior to publication of HMR-52, procedures for evaluating PMP for smaller drainage areas were not documented. Thus it was the staff's practice to use the 10-square mile PMP value for all areas less than or equal to 10 square miles. Procedures for distributing the 6 hour PMP value into shorter time intervals were not documented either. Clearly, assuming that one-sixth of the 6 hour depth occurs in each hour would not only be non-conservative, it would also be unreasonable. In actual storms, the rainfall intensity continually changes such that the most intense hour contains considerably more rainfall than one-sixth of the six hour amount. In the absence of criteria for distributing the 6 hour PMP value into shorter time intervals, the staff had been using a time distribution taken from U.S. Army Corps of Engineers Engineering Manual (EM) 1110-2-1411, "Standard Project

Flood Determinations", revised March 1965. Originally this information was published as Civil Engineer Bulletin (CEB) No. 52-8 (March 1952). The rainfall distribution in the EM indicates 38 percent of the six hour standard project storm (SPS) rainfall in the most severe one hour. (The SPS rainfall is not as intense a rainfall event as the PMP.) This is the distribution that is referenced in SRP 2.4.2 and 2.4.3 and is one of several referenced in the ANSI standard. The time distribution taken from the original version, i.e., CEB No. 52-8 put 55 percent of the 6 hour rainfall in the most severe hour.

HMR-52, "Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian", was published in August 1982. In addition to providing a stepwise approach to evaluating the temporal and spatial distribution of PMP estimates derived from HMR-51, this report presents procedures for determining PMP values for durations less than 6 hours. HMR-52 presents a map of the eastern United States with values of the 1 hour-10 square mile PMP contoured. Comparison with a similar map in HMR-51 for the 6 hour-10 square mile PMP indicates that the percentage of the 6 hour PMP in the most severe hour ranges from less than 50 percent near the Gulf of Mexico to about 65 percent in Maine, with most values being between 50 and 60 percent. Thus, while the time distribution of HMR-52 is more severe than that of EM 1110-2-1411, it is similar to that of the earlier Civil Engineer Bulletin No. 52-8, which as stated above put 55 percent of the 6 hour rainfall in the most severe hour.

HMR-52 also gives values for PMP's with areas as small as 1 square mile. Since the appropriate drainage area for most local site flooding situations is less than 1 square mile, this aspect of HMR-52 is also appropriate for local flooding analysis. HMR-52 shows that the 1-hour 1 square mile PMP, is 22 percent more intense than the 1-hour 10 square mile PMP. While the staff had not considered this increase in PMP intensity for drainage areas less than 10 square miles before the issuance of HMR-52, it is appropriate for small drainage areas.

Thus, the use of HMR-52 results in two improvements in calculating local PMP. It presents the most current estimation of the time distribution of PMP and it allows calculation of PMP for areas as small as 1 square mile. Based upon our conclusion that the Regulatory Guides and ANSI standards define the flood criteria in terms of the PMP rather than specific evaluation techniques and the SRP guidance concerning use of improved calculational methods and the OL-stage, we conclude that the staff's use of HMR-51 and HMR-52 is neither a "rachet" nor a "backfit".

Since GDC-2 requires that flood design bases reflect consideration of the most severe historical data with sufficient margin for limited accuracy, quantity and period of time in which data have been accumulated, and since the staff is not aware of any previous guidance defining "sufficient margin" to be less severe than the PMF, the staff concludes the BVPS-2 must be shown to be safe from design basis floods as determined by the most up-to-date PMP data; which are contained in HMR-51 and HMR-52. To do otherwise would bring into question the assurance that the plant design meets GDC-2 with respect to hydrologic events.