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February 11, 1985

United Sta.es Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George W. Knighton, Chief
Licensing Branch 3
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
Additional Information on Outstanding Issue 115 - Roof Snow Loading

Gentlemen:

Draft Safety Evaluation Report (DSER) Section 2.3.1 identified Outstanding Issue 115 applicable to roof snow loading. Duquesne Light Company (DLC) responded to this by Reference (a) describing why the DLC design was adequate. Last December, DLC became aware that the NRC staff had found this position to be unacceptable. Discussions with your staff at that time indicated that the FSAR was being reviewed to an unpublished 1975 position. DLC then requested that this be reviewed as a backfit (Reference b). In parallel with this, however, DLC proposed a methodology to calculate a Probable Maximum Winter Precipitation as snowfall. In a meeting with the NRC staff on January 15, 1985, DLC presented this methodology and the staff indicated that the approach appeared to be acceptable (pending a full review). Attached to this letter is a detailed description of this methodology. DLC understands that, should this prove to be acceptable, Outstanding Issue 115 would be closed, and from the DLC standpoint, there would be no need to further pursue the backfit issue.

DUQUESNE LIGHT COMPANY

By E. J. Woolever
E. J. Woolever
Vice President

KAT/wjs
Attachment

cc: Mr. B. K. Singh, Project Manager (w/a)
Mr. G. Walton, NRC Resident Inspector (w/a)

References: a) 2NRC-4-112 dated July 30 1984
b) 2NRC-5-008 dated January 16, 1985

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ADDITIONAL INFORMATION ON OUTSTANDING ISSUE 115 OF BVPS-2 DSER

On July 30, 1984 (letter No. 2NRC-4-112), Duquesne Light Company (DLC) responded to Outstanding Issue 115 of the Beaver Valley Power Station Unit No. 2 (BVPS-2) Draft Safety Evaluation Report regarding snow load estimates. This response justified the use of 72 psf as a design snow load for safety- related structures, based on a 48-hour Probable Maximum Winter Precipitation (PMWP load of 71.2 psf, by demonstrating that it complied with published Nuclear Regulatory Commission (NRC) guidance. The NRC did not consider this response adequate in light of a Site Analysis Branch Position dated March 24, 1975, which states that winter precipitation loads should be based on the addition of the weight of the 100-year snowpack to the weight of the 48-hour PMWP. Subsequent conversations with the NRC staff to clarify the branch position led to the approach of calculating a 48-hour PMWP load as a snowfall rather than a rainfall, to be added to the 100-year snowpack load (30 psf). This procedure is discussed in detail in the following paragraphs.

The calculation of the 48-hour PMWP load as a snowfall is based on the principles outlined in Hydrometeorological Report No. 53 (NUREG/CR-1486)[1]. These principles include the following:

- select major storm of record with near-optimum precipitation mechanism
- maximize storm moisture content for time of year
- adjust storm precipitation for transposition to the location of interest

In order to select a controlling storm for the BVPS-2 48-hour PMWP snowfall calculation, the 1982 Local Climatological Data Annual Summaries[2] were scanned for record 24-hour snowfalls for the northeast quadrant of the U.S., ranging from Maine in the northeast, to Minnesota in the northwest, to Missouri in the southwest, and to North Carolina in the southeast. This data scan revealed that the largest 24-hour snowfall within this region was 30.4 inches at Albany, New York in March, 1888. A more detailed investigation of the Albany snowfall revealed that it was caused by the "Blizzard of 88" which is well documented in the Bulletin of the American Meteorological Society[3]. This storm dumped a total of 46.7 inches of snow in Albany and 55 inches in Troy, New York over a period of about 60 hours. Based on its severity and notoriety, this blizzard was chosen as the controlling snowstorm for the 48-hour PMWP analysis.

In order to convert the 24-hour snowfall of 30.4 inches to a 48-hour period, the depth-area-duration curves of Hydromet Report No. 33[4] were examined for the month of March. The largest correction factor in Zone 1 for this month is 1.60 to convert a 200 square mile, 24-hour value to a 10-square mile, 48-hour PMWP. When applied to the record 24-hour snowfall of 30.4 inches at Albany, a 48-hour PMWP snowfall of 48.6 inches was obtained. Although the depth-area-duration curves were developed for rainfalls over drainage basins of varying size, they are applied in a very conservative manner to the water equivalent of the record snowfall. A 48-hour snowfall of 50 inches was conservatively chosen considering the value of the 24-hour snowfall adjusted to 48 hours at Albany (48.6 inches) and 60-hour snowfall of 55 inches at Troy.

The adjustment to this 48-hour snowfall to maximize the moisture content of the storm and to account for the transposition of this storm from the northeast coastal waters with its large supply of moisture to western Pennsylvania was chosen in a very conservative manner from Hydromet Report No. 53. Table 2 of this report indicates that the highest total storm adjustment factor for any storm and for any time of the year is 1.5. Therefore, a conservative total storm adjustment factor of 1.5 was chosen for this analysis, giving a 48-hour PMWP snowfall of 75 inches when applied to the 48-hour snowfall of 50 inches taken from the "Blizzard 88."

The conservatism of this 48-hour PMWP snowfall is further supported by data presented in Ludlum's "Weather Record Book"[5]. Single storm record snowfalls are reported for each state including 50 inches in Morgantown, Pennsylvania, for a 3-day storm; 69 inches in Watertown, New York for a 5-day snowfall; 60 inches in Middletown, Connecticut for a 4-day storm; 47 inches in Peru, Massachusetts for a 4-day storm; and 50 inches in Readsboro, Vermont for a 5- day snowfall. The highest single storm snowfall within the northeast quadrant of the U.S. was 77 inches in Pinkham Notch in the White Mountains of New Hampshire for a 5-day snowfall.

In order to convert the conservatively chosen 48-hour PMWP snowfall of 75 inches to a building roof load, a separate analysis was performed to estimate the snow depth to water equivalent ratio expected to occur at the BVPS-2 site. This was done by examining daily precipitation records for Greater Pittsburgh Airport for 98 "snowy days" during the period 1945-1953, 1963-1965, and 1978-1980. A snowy day was defined as one in which at least 0.10 inch of water equivalent fell in the form of snow, sleet, or ice pellets as indicated by the daily observations. A list of the snow depths and water equivalents for the 98 "snowy days" is shown in Table 1.

This table indicates that the average snow-depth to water equivalent ratio observed at Pittsburgh for 98 "snowy days" is 10 to 1. This compares with a 14 to 1 ratio calculated from measurements at Central Park in New York City for the "Blizzard of 88". Therefore, the conservative 48-hour PMWP snowfall corresponds to approximately 7.5 inches of water. This amount of water produces a load of 39 psf. A summary of the conservatism that entered into the calculation of this value is given below:

- Record New England/New York blizzard with Atlantic moisture source transposed to western Pennsylvania

- Largest possible correction from 24- to 48-hour snowfall used from Hydromet Report No. 33

- 48-hour snowfall of 50 inches chosen compared to highest snowfall of 55 inches in 60 hours

- Highest possible total storm adjustment factor used from Hydromet Report No. 53 for any storm, any time of year

- Snow depth to water ratio of 10 to 1 used compared to 14 to 1 ratio observed in New York City from "Blizzard of 88"

By adding the weight on the ground of the 100-year recurrence interval snow-load of 30 psf from ANSI-A58.1, 1982[6], without correction for roof load, to the weight of the conservative 48-hour PMWP snowfall of 39 psf, a total design snow-load on the ground of 69 psf was obtained. Therefore, the BVPS-2 design snow-load of 72 psf for Category I structures is adequate to support this weight.

References

1. Ho, F. P. and Riedel, J. T. "Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates--United States East of the 105th Meridian," Hydrometeorological Report No. 53. National Weather Service, U.S. National Oceanic and Atmospheric Administration, June 1980.

2. Local Climatological Data, Annual Summaries for 1982. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC, 1982.

3. Kocin, P. J. "An Analysis of the Blizzard of 88". Bulletin of the American Meteorological Society, Vol. 64, No. 11, November 1983.

4. Riedel, J. T., J. F. Appleby, and R. N. Schloemer. "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours: Hydrometeorological Report No. 33. U.S. Department of Commerce, Weather Bureau, April 1956.

5. Ludlum, D. M. "Weather Record Book, United States and Canada." Published by Weatherwise, Inc. Princeton, NJ, 1971.

6. American National Standard Minimum Design Loads for Buildings and Other Structures, ANSI A58.1, American National Standards Institute, Inc., March 10, 1982.

TABLE 1

SNOW DEPTH TO WATER EQUIVALENT RATIOS AT GREATER PITTSBURGH AIRPORT

Day/Year	Snow Depth (inches)	Water Equivalent (inches)	Snow/Water Ratio
January 1, 1945	3.8	0.71	5.4
January 7, 1945	1.6	0.17	9.4
January 15, 1945	2.4	0.24	10.0
January 22-23, 1945	2.7	0.44	6.1
January 28-30, 1945	4.3	0.54	8.0
February 20, 1945	2.0	0.19	10.5
December 13-15, 1945	6.0	0.70	3.6
December 19-20, 1945	4.8	0.45	10.7
December 22, 1945	1.9	0.10	19.0
December 31, 1945	1.5	0.19	7.9
January 20-21, 1945	3.7	0.37	10.0
February 19-20, 1946	3.0	0.50	6.0
February 24, 1946	1.0	0.10	10.0
December 20, 1946	3.6	0.69	5.2
January 1, 1947	1.0	0.13	7.7
January 5-6, 1947	1.9	0.19	10.0
March 1, 1947	1.6	0.21	7.6
March 2, 1947	1.0	0.10	10.0
December 26, 1947	1.3	0.11	11.8
March 11-12, 1948	1.4	0.23	6.1
December 19, 1948	4.7	0.23	20.4
January 31, 1949	2.5	0.33	7.6
November 17, 1949	2.8	0.30	9.3
February 16, 1950	1.9	0.17	11.2
February 19, 1950	1.2	0.15	8.0
March 11, 1950	1.9	0.37	5.1
March 23, 1950	5.2	0.82	6.3
November 24-25, 1950	24.1	2.64	9.1
November 26-29, 1950	7.2	0.69	10.4
January 7, 1951	8.0	0.88	9.1
March 15, 1951	3.0	0.30	10.0
March 16, 1951	1.3	0.13	10.0

Day/Year	Snow Depth (inches)	Water Equivalent (inches)	Snow/Water Ratio
March 21, 1951	1.5	0.15	10.0
April 3-4, 1951	4.2	0.53	7.9
November 2, 1951	2.5	0.30	8.3
November 17, 1951	1.5	0.15	10.0
December 12, 1951	1.1	0.11	10.0
December 14, 1951	5.3	0.69	7.7
December 15, 1951	1.0	0.10	10.0
December 18, 1951	4.0	0.28	14.3
January 10, 1952	1.4	0.14	10.0
January 24, 1952	1.1	0.11	10.0
February 6, 1952	1.1	0.11	10.0
February 11, 1952	2.2	0.27	8.1
March 1, 1952	5.9	0.59	10.0
March 15, 1952	1.0	0.11	9.1
March 29, 1952	1.4	0.14	10.0
April 6-7, 1952	4.7	0.47	10.0
November 29, 1952	1.5	0.12	12.5
December 2, 1952	3.0	0.29	10.3
December 31, 1952	1.8	0.25	7.2
April 18, 1953	3.9	0.54	7.2
November 7, 1953	1.9	0.19	10.0
November 27, 1953	1.1	0.11	10.0
December 15-16, 1953	1.5	0.13	11.5
November 2, 1963	1.4	0.14	10.0
November 29-30, 1963	4.4	0.46	9.6
December 9-10, 1963	2.3	0.29	7.9
December 11, 1963	2.5	0.14	17.9
December 18-19, 1963	3.6	0.19	18.9
December 23-24, 1963	4.1	0.31	13.2
January 1, 1964	3.5	0.39	9.0
January 12-13, 1964	15.6	1.19	13.1
February 18-19, 1964	6.7	0.70	9.6
February 26, 1964	1.5	0.10	15.0
March 12, 1964	2.2	0.20	11.0
March 31, 1964	1.7	0.13	13.1
November 30, 1964	1.2	0.11	10.9

Day/Year	Snow Depth (inches)	Water Equivalent (inches)	Snow/Water Ratio
December 2, 1964	2.6	0.27	9.6
January 1, 1965	1.3	0.17	7.6
January 10, 1965	1.7	0.17	10.0
January 13, 1965	1.0	0.11	9.1
January 16, 1965	2.0	0.14	14.3
February 1, 1965	1.9	0.14	13.6
February 18-19, 1965	2.8	0.16	17.5
February 21, 1965	0.7	0.15	4.7
February 25-26, 1965	4.2	0.42	10.0
March 5-6, 1965	6.0	0.51	11.8
March 20, 1965	2.2	0.21	10.5
November 26-27, 1978	2.2	0.32	6.9
December 9, 1978	1.6	0.13	12.3
January 2, 1979	1.5	0.20	7.5
January 25, 1979	3.8	0.39	9.7
January 28, 1979	3.5	0.33	10.6
January 29, 1979	1.1	0.10	11.0
February 7, 1979	3.0	0.27	11.1
February 12, 1979	3.5	0.39	9.0
February 18-19, 1979	6.1	0.50	12.2
February 26, 1979	1.1	0.10	11.0
January 4, 1980	1.8	0.20	9.0
January 5, 1980	2.1	0.20	10.5
January 23, 1980	1.2	0.11	10.9
January 24, 1980	1.5	0.10	15.0
January 31, 1980	0.8	0.11	7.3
February 27, 1930	1.2	0.10	12.0
March 13, 1980	2.3	0.35	6.6
March 14, 1980	2.5	0.22	11.4
Average	2.8	0.31	10.1