Status of Voluntary Consensus Standard ANS-2.31, "Determining Design Basis On-Site Flooding Caused by Precipitation at Nuclear Facility Sites"

ANS-2.31 Status

- New ANS VCS.
- Portion of 1992 ANS-2.8 VCS that addressed all potential flooding insults to nuclear power plant sites.
- Reason for separating ANS-2.31 from revision to ANS-2.8: Make it applicable to all sites, even “dry sites” where facility grade is well above any external flood level.

ANS-2.31 Status

- Revision 1 comments were resolved at 6 December 12 WG meeting in Las Vegas leading to Revision 2.
- Revision 3 under preparation to resolve outstanding WG meeting items and additional NRC comments on Revision 1 received after WG meeting.
- Targeting NFSC SC-25 review this Spring.

Basic Concepts Used

- ANS-2.31 based on probabilistically-defined on-site precipitation.
- Mean return period in years or mean probability of exceedence/year.
- Ground level snow load and rain or combination of snow followed by rain within a 48-hr period.
- 48-hr period selected as longest period before mitigation action should be taken.

APPROACHES

Two different approaches are defined:

- REGIONAL APPROACH
- LOCAL APPROACH

Regional Approach

- Snow loads: Use existing CONUS maps for 50-yr mean return period where ground snow load defined (ASCE 7-10[1] Fig. 7.1).

- Rain loads: Use existing CONUS maps for 50-yr mean return period preceded by 48-hr antecedent rain (Technical Paper 49 Fig. 16 US Dept of Commercial Weather Bureau[2])

References

1. ASCE 7-10, “Minimum Design Loads for Buildings and Other Structures,” American Society of Civil Engineers, 2010.

2. Technical Paper No. 49, US Dept of Commerce Weather Bureau, “Two to 10 day Precipitation for Return Periods of 2 to 100 Years in the Contiguous U.S.,” 1964.

Extending Precipitation Data to Longer Return Periods

Need: Extend 50-yr mean return period (or mean $2x10^{-2}$/yr probability of exceedence) to 100,000-yr mean return period (or mean 10^{-5}/year probability of exceedence) for a range of return periods

Extending Precipitation Data to Longer Return Periods

- Approach: Use NOAA Atlas 14, Vol. 2 Appendix 9 500-yr and 1,000-yr mean return period predictions and increase parameters for 48-hr periods of precipitation for 86 homogenous regions of Central and Eastern US.
- Data sampled to develop a multiplication factor as a function of doubling of return period.
- Applying multiplication factors: ANS-2.31 Table 5-1 presents a 0.22 increase for each return period doubling from 50-400 yr and a 0.16 increase from 400-100,000 yr.

Local Approach

- Issue: There are geographical areas of US where regional ground snow load contours do not exist where local precipitation measurement station data can be used.
- Resolution: NOAA Atlas 14, Vol. 2 Appendix A-6 identifies such measuring stations and their locations for Central and Eastern US.
- This data is assembled into 86 homogenous regions as shown in NOAA Atlas 14, Vol. 2 Appendix A-9.

Table 7-1:

Return Period (years) for Design Basis Flooding Caused by Precipitation - from DOE Std. 1020-2012 Categories PDC-1 and PDC-2 are based on the ASCE 7-10 Standard Requirements.

SSC Category	PDC-3	PDC-4	PDC-5
Return Period (Years)	10,000	25,000	*

Table 7-2:

Return Period (Years) for Design Precipitation Structural Loads – from DOE Std. 1020-2012

SSC Category	PDC-3	PDC-4	PDC-5
Return Period (Years)	2,500	6,250	*

*Use return periods the same as those used by the NRC for commercial nuclear power plant design.

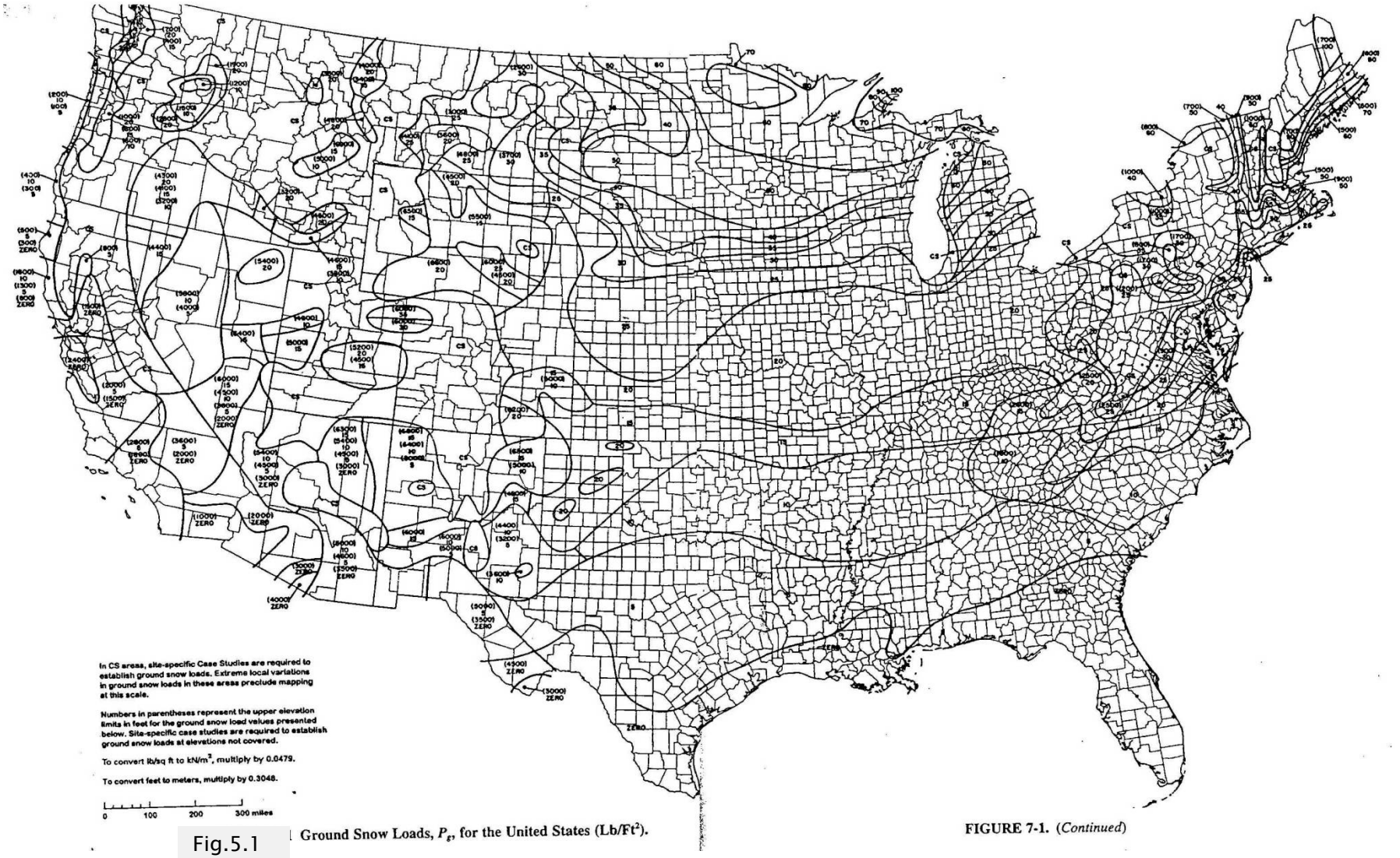
Table 5-1 of Draft ANS 2.31

Multiplication Factor to be Applied to Design Basis Ground Precipitation Load[(2)] as a Function of Mean Return Period

Mean Return Period (Years)	Multiplication Factor[(1)]
50	1.0
100	1.22
200	1.44
400	1.66
800	1.82
1600	1.98
3200	2.14
6400	2.30
12800	2.46
25600	2.62
51200	2.78
102400	2.94

[(1)] Multiplication factors to be applied to Figures 5.1 and 5.2 50-year mean return period snow or rain loads.

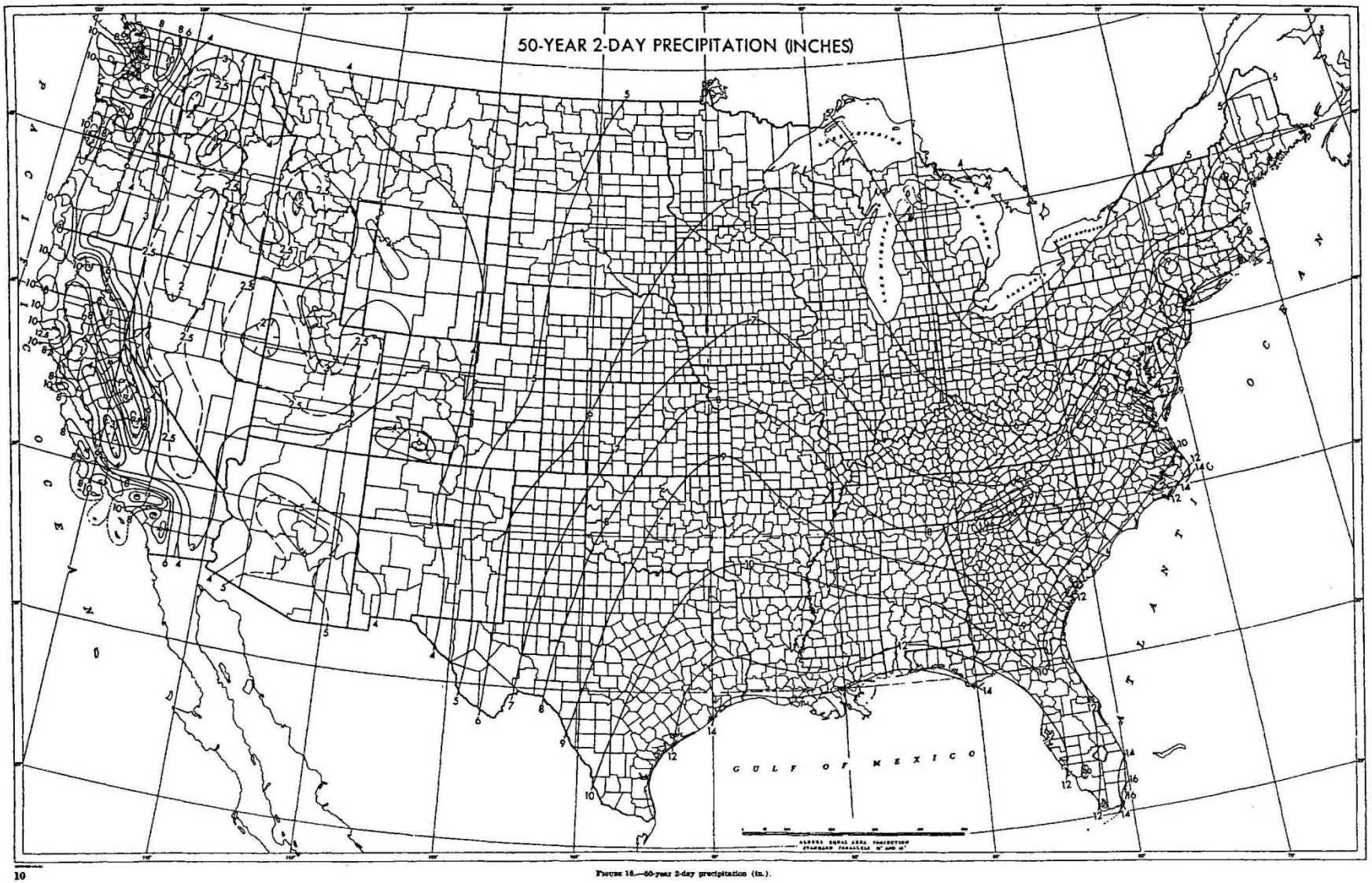
[(2)] The factor of 0.22 increase in load for every doubling of the return period up to the 400 years based on ASCE 7-10 Standard. Slope of the hazard thereafter is increased to a factor of 0.16 based on the Appendix 9 data from NOAA Atlas 14, Vol. 2.



Ground Snow Loads, P_g, for the United States (Lb/Ft^2).

FIGURE 7-1. (*Continued*)

Fig.5.1



10

FIGURE 14.—50-year 2-day precipitation (in.).

Fig. 5.2 Rain Loading