

1 This supplemental testimony is offered in response to the portion
2 of Shirley A. Brand and Mid-Hudson Nuclear Opponents, Stipulated
3 Contention 2, which states:

4 Petitioners contend that the seismic design of the proposed
5 facility is inadequate in that the ground acceleration associated
6 with the Applicant's proposed safe shutdown earthquake (i.e.,
7 0.2g) has been underestimated.

8 and to the following contentions regarding quarrying in the vicinity
9 of the proposed site:

10 Cementon Civic Association, Stipulated Contention I.C.

11 C. The Petitioner contends that the Staff and Applicant
12 have failed to fully assess the geological data and evaluation
13 sufficiently to determine the site's geological stability,
14 particularly with regard to the extensive quarrying operations of
15 the three local contiguous cement plants.

16 Columbia County, Stipulated Contention 6

17 6. The Petitioner contends that there has been an insufficient
18 evaluation of the effects of quarrying and placement of large
19 amounts of earth on the stability of subterranean geologic formations.

20 Basis: Although in the PSAR the Applicant has addressed
21 existing faults and other seismic stresses which may influence
22 site stability, these have not been addressed in respect to
23 the impact that extensive quarrying and earth displacement may
24 have had on these naturally occurring stresses.

John A. Kelleher

1 A recent study done at Wappingers Falls ("Earthquakes
2 Triggered by Surface Quarrying, the Wappingers Falls, New York
3 Sequence" - Paul Pomeroy) has indicated that such major land
4 modifications may have an antagonistic effect on otherwise
5 stable geologic formations.

6 The proposed plant site is located at a point which the
7 Applicant has identified as being .6 miles north of the Alpha
8 Portland Cement Company, .8 miles southeast of the Lehigh Portland
9 Cement Company and 1.2 miles south of the Marquette Cement
10 Manufacturing Company with the nearest quarry located .6 miles
11 from the site.

12 While no information is readily available as to the exact
13 tonnage removed from the quarries to the north, south, and west
14 of the site, the Applicant states that Marquette and Lehigh each
15 use 300,000 pounds of explosives annually. This indicates a
16 substantial amount of material is being removed each year. As
17 the possibility exists that this excavation could lead to a
18 geologic imbalance encouraging seismic activity, the Applicant
19 is negligent in ignoring its impact.

20 Arthur L. Reuter and Columbia County Survival Committee Stipulated
21 Contention 8

22 8. Petitioner contends that the Applicant's PSAR has not
23 adequately considered the susceptibility of the site to earthquakes.

24 Three cement companies have been removing weight from the

1 earth's crust at Cementon for more than a decade. It is
2 submitted that a study should be made to determine whether this
3 removal of stone and sand increases the possibility of earth-
4 quakes at Cementon or would tend to magnify the result of an
5 earthquake otherwise caused.

6 The Petitioners contend that the seismic design of the proposed
7 facility is inadequate in that the ground acceleration associated
8 with the Applicant's proposed Safe Shutdown Earthquake (i.e., 0.2g)
9 has been underestimated. Based upon our review (SER, Section 2.5),
10 we have concluded that the proposed value of 0.2g is adequate when used
11 with the Regulatory Guide 1.60 design spectra. The staff has considered
12 the following factors:

13 1. No capable faults have been identified in the vicinity of the
14 site; thus there is no reason to expect earthquake activity to be
15 localized near the site.

16 2. The tectonic provinces shown by Rodgers (), p. 2) are
17 acceptable as a basis for evaluating the proposed ea. quake design
18 basis.

19 3. The historic seismicity of the site region differs markedly
20 from the southern sector of the tectonic province (Valley and Ridge)
21 within which it is located.

22 4. The effects of quarrying (possible induced seismicity due to
23 loading and unloading of various areas) are well within the proposed
24 design limits.

1 We consider that the Greene County site is located in the Valley
2 and Ridge tectonic province. For present purposes we assume that the
3 boundaries of this province and surrounding provinces correspond to
4 those shown by Rodgers (1970, p. 2). In the vicinity of the site,
5 the Valley and Ridge tectonic province is bounded by the Appalachian
6 Plateau, Central Stable Region (Great Lakes Lowland of Rodgers) and
7 the New England-Piedmont tectonic provinces. The precise location
8 and intersection of these boundaries is not well known. We conclude,
9 however, that the proposed design value of .2g is adequate despite
10 our uncertainties in boundary locations since this value would encompass
11 the occurrence in the site vicinity of the largest known earthquake
12 of the Central Stable Region, the Anna, Ohio, earthquake of intensity
13 VII-VIII, MM. A more detailed description of the reasons for selection
14 of this event as the design earthquake is provided in the Safety
15 Evaluation Report (Section 2.5.6).

16 The ground acceleration value of .2g, to be used as the high
17 frequency anchor for the spectrum of the Regulatory Guide 1.60, was
18 determined by use of the relationships between seismic intensity and
19 peak ground motion developed by Trifunac and Brady (1975). The
20 determination of ground motion in a conservative manner, and, in
21 particular, the use of Trifunac and Brady (1975) is described in the
22 Standard Review Plan (Section 2.5.2).

23 The possibility of minor earthquakes induced by quarrying at
24 Cementon does not constitute a realistic safety hazard. There exists

1 no body of information either in historic data or in the seismic record
2 which indicates that significant earthquakes are commonly associated
3 with surface quarrying. In only a few instances has it ever been
4 hypothesized that seismic events were attributable to surface quarrying.
5 Pomeroy and others (1976) concluded that an earthquake of magnitude
6 3.3 near Wappinger Falls, New York may have been triggered by crustal
7 unloading associated with quarrying operations in the presence of high
8 horizontal compression stress. As Pomeroy points out (p. 695), however,
9 the stress changes involved in the off-loading are small compared to
10 the failure strength of rocks or in relation to the regional stress
11 conditions so that the area must have been in a condition close to
12 failure. Simple stress calculations (see Pomeroy and others, p. 695)
13 indicate that under specialized circumstances off-loading may trigger
14 the release of regional tectonic stress already stored, but that there
15 is not sufficient energy in the off-loading process to cause a
16 significant earthquake. On this basis, the staff concluded that no
17 potential seismic event induced by quarrying would exceed the SSE derived
18 from consideration of regional tectonics. There is, therefore, no
19 information which justifies an extensive study of quarrying-induced
20 seismicity near the Cementon site.

21
22
23
24

JOHN KELLEHER
SEISMOLOGIST
GEOSCIENCES BRANCH
DIVISION OF SITE SAFETY AND ENVIRONMENTAL ANALYSIS
U. S. NUCLEAR REGULATORY COMMISSION

My name is John Kelleher. I presently reside at 1000 Water St., S.W., Washington, D. C. I am employed as a Seismologist in the Geosciences Branch, Division of Site Safety and Environmental Analysis, Office of Nuclear Reactor Regulation, Washington, D. C. 20555.

PROFESSIONAL QUALIFICATIONS

I received a Bachelor of Science degree majoring in physics from Boston College in 1958, and a Master of Science degree in 1964 from the Department of Pure and Applied Mathematics of Boston University.

I was awarded a Ph.D. in seismology from Lamont-Doherty Geological Observatory of Columbia University in 1972. My dissertation is entitled "Criteria for Predicting Earthquake Locations and Their Application to Major Plate Boundaries of the Pacific and the Caribbean." Following completion of doctoral requirements, I was employed by Columbia University as a Research Associate until July 1976, at which time I accepted a position with the Nuclear Regulatory Commission.

My research career has dealt exclusively with the problem of seismic hazard, and I have published numerous papers on this subject in the leading professional journals. My research has attempted to develop an understanding of the size, location and frequency of large earthquakes that may occur within a given tectonic setting.