From: <Joseph_Hegner@dom.com>
To: <bxs2@nrc.gov>
Date: Tue, Aug 2, 2005 4:40 PM
Subject: Follow-up from July 26, 2005 Conference Call

Belkys,

On a July 26, 2005 conference call, certain aspects of Dominion's July 25, 2005 letter involving seismic v/h ratios were discussed. During the call we offered to provide clarification and respond by e-mail to your comments and questions.

The attachment to this e-mail contains the information we agreed to provide.

Joe H.

(See attached file: Responses to 7-26-05 NRC Questions-080205.pdf)

CC: <Marvin_Smith@dom.com>, <sdrouth@bechtel.com>

Mail Envelope Properties (42EFDA2F.BFC : 14 : 7164)

Subject: Follow-up from July 26, 2005 Conference Call
Creation Date: Tue, Aug 2, 2005 4:39 PM
From: <Joseph_Hegner@dom.com>

Created By: Joseph_Hegner@dom.com

Recipients
nrc.gov
owf4_po.OWFN_DO
BXS2 (Belkys Sosa)

bechtel.com
sdrouth CC

dom.com
Marvin_Smith CC

Post Office	**Route**
owf4_po.OWFN_DO	nrc.gov
	bechtel.com
	dom.com

Files	**Size**	**Date & Time**
MESSAGE	1198	Tuesday, August 2, 2005 4:39 PM
Responses to 7-26-05 NRC Questions-080205.pdf	66562	
Mime.822	93804	

Options

Expiration Date:	None
Priority:	Standard
Reply Requested:	No
Return Notification:	None
Concealed Subject:	No
Security:	Standard

Responses to NRC Questions of July 26, 2005 Conference Call

On July 26, 2005, a conference call was held between the NRC Staff and Dominion to discuss Dominion's July 25, 2005 letter, Serial No. 05-457 (Reference 1). During the conference call, the NRC asked several questions on the site-specific analysis that was performed to confirm the appropriateness of the V/H ratios used in the ESP Site Safety Analysis Report (SSAR) to establish the vertical safe shutdown earthquake (SSE) spectrum for the Zone III-IV hypothetical rock outcrop control point. Responses to the NRC's questions are provided on the following pages.

Question 1 (7/26/05 Conference Call)

> How were Poisson's ratios for Model 2 developed for depths greater than 15m?

Response

Model 2 comprises three linear segments. The first segment [from 0 to ~15m] is the result of a least-squares fit to the available Poisson's ratio data from boring B-802. No S-wave data are available for this boring at greater depths. The end of the deepest [third] segment is constrained to have a Poisson's ratio of 0.25, appropriate for rock at the top of the Mid-Continent crust [EPRI (1993), Reference 2].

The second and third segments of Model 2 are defined to give a simple Poisson's ratio model bounded by two constraints: 1) the model should not cross the Model 1 representation of Poisson's ratio [as a simple two-segment model would], and 2) the corresponding P-wave velocity should not significantly exceed a value of 4,900 m/sec [the P-wave velocity of the rock at the top of the Mid-Continent crust] for depths shallower than 41.0 meters.

If Model 2 had been defined by a single straight line segment from the end of the fit to available data at 15m to the Poisson's ratio value of 0.25 at 41m depth this model would have intersected, and at places, dropped below Model 1. Defined in this manner, Models 1 and 2 would have differed negligibly from depths of ~30m to 41m. Because it was of interest to consider the full range of epistemic uncertainty in the development of the V/H ratios, this convergence of Models 1 and 2 was assessed to be undesirable, establishing a lower bound for the Poisson's ratios of Model 2.

An upper bound to Poisson's ratio Model 2 was defined by the values of Poisson's ratio resulting from fixing the P-wave velocity to have a constant value of 4,900 m/s near the end of the B-802 data at ~15m to the depth of 41m. A shallower slope model of Poisson's ratio would then imply P-wave velocities greater within the rock column than at its bottom.

Figure 1 shows Model 2 Poisson's ratios and the upper and lower bounding constraints specified.

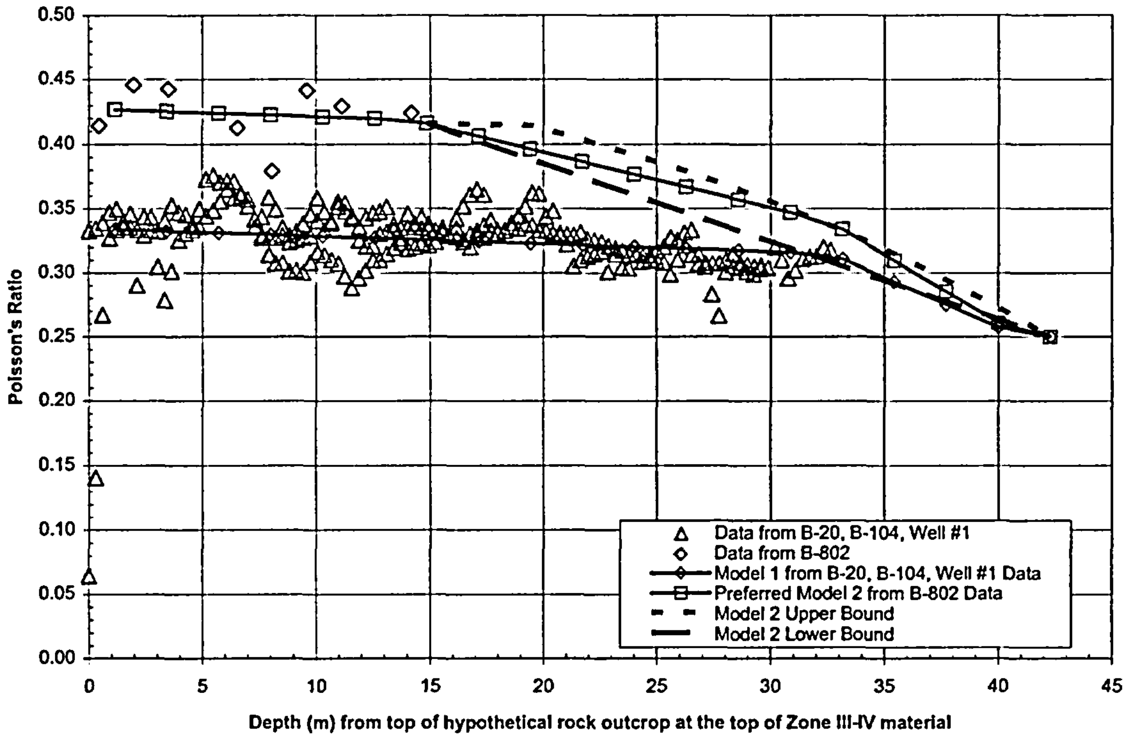

Figure 1. Poisson's ratio models with upper and lower bound constraints for Model 2.

Question 2 (7/26/05 Conference Call)

Why are the Poisson's ratio values so different between the old data set [borings B-20, B-104, and Well #1] and the newer data [boring B-802]?

Response

The shear wave (S-wave) velocity profile for the site was developed using data from four boreholes—three (boreholes B-20 and B-104, and Well #1 (W-1)) from the 1968 subsurface exploration for the existing Units 1 and 2, and the fourth (B-802) from the subsurface investigation performed for the ESP site characterization.

The measurements of the S-wave and P- wave velocities in the Units 1 and 2 borings (used to develop the Poisson's ratios of Model 1) and the ESP boring (used to develop the Poisson's ratios of Model 2) show a large variation of values throughout the borehole depths, although the overall trend is an increase with increasing depth, as would be expected. This variation is reflected in the compressive strength of the Zone IV rock as measured by laboratory tests for the ESP investigation – 15 rock core samples from six borings ranged in strength from 4.4 to 28.4 ksi.

Although there is a wide variation in the S- and P-wave values (and in rock strengths), the consistently higher Poisson's ratio in B-802 indicates a higher ratio of P-wave velocity to S-wave velocity than was determined in the older borings. Examination of the data shows that the S-wave velocity in B-802 is generally below the best-fit line at shallower depths, and above the best fit line at greater depths. The P-wave velocities in B-802 are consistently higher than the values in the older borings.

The reason for the differences observed is likely in the equipment and testing methods. The B-802 wave velocities were measured in a down-hole test, i.e., the S-waves and P-waves were traveling vertically through the rock from a wave source at the ground surface. The Birdwell 3-D Velocity Recorder used to measure the S- and P-wave velocities in the older borings (drilled in 1968) emits and receives signals at a series of test depths within the borehole itself. The differences in equipment and measurement methods may account for the computed differences in wave velocities for the rock.

It was determined that the differences between the older and more recent data should be recognized and considered in alternative models to properly capture epistemic uncertainty.

Question 3 (7/26/05 Conference Call)

Why are the new Poisson's ratio data of boring B-802 so high, compared to more expected values of 0.25 to 0.30?

Response

It is agreed that a value of 0.43 is higher than would be expected for hard rock. For the ESP investigation, in addition to field geophysical tests, laboratory unconfined compression tests with strain gages to measure both axial and lateral strain, and thus Poisson's ratio, were run on 5 samples of Zone IV rock core from four different borings. The Poisson's ratios computed from the laboratory tests ranged from 0.24 to 0.43. Thus, the median Poisson's ratio computed from the field geophysical tests was the same as the upper bound Poisson's ratio computed from the laboratory tests. Experience has shown that Poisson's ratio measurements from laboratory tests are less reliable due to microfractures and other imperfections in the rock. Therefore, 0.43 was used for the Poisson's ratio of the rock strata.

Question 4a (7/26/05 Conference Call)

What are the effects on the resultant V/H ratios of considering different weights between Model 1 and Model 2?

Response

Figure 2 shows the resulting V/H ratios for the mean and various fractile results where the weights of 0.25 and 0.75 have been considered for P-wave Models 1 and 2, respectively. A graphical measure of the sensitivity of V/H ratios to the weights assigned to Poisson's ratio Models 1 and 2 is provided in several additional plots. In Figure 3, Model 1 has been given a weight of 1.0 and Model 2 a weight of 0.0, putting complete confidence in the older, original site geotechnical investigation data. In Figure 4, Model 2 has been given a weight of 1.0 and Model 1 a weight of 0.0, putting complete confidence in the recent ESP subsurface investigation data. Finally, both models have been given equal weight in Figure 5.

While the 0.25 Model 1and 0.75 Model 2 weight distribution is preferred, the effect on V/H ratios is modest over the entire range of possibility and does not affect the fundamental conclusion that the V/H ratios given in NUREG/CR-6728 for hard rock and used in SSAR Table 2.5-27A for development of the vertical SSE spectrum are appropriate.

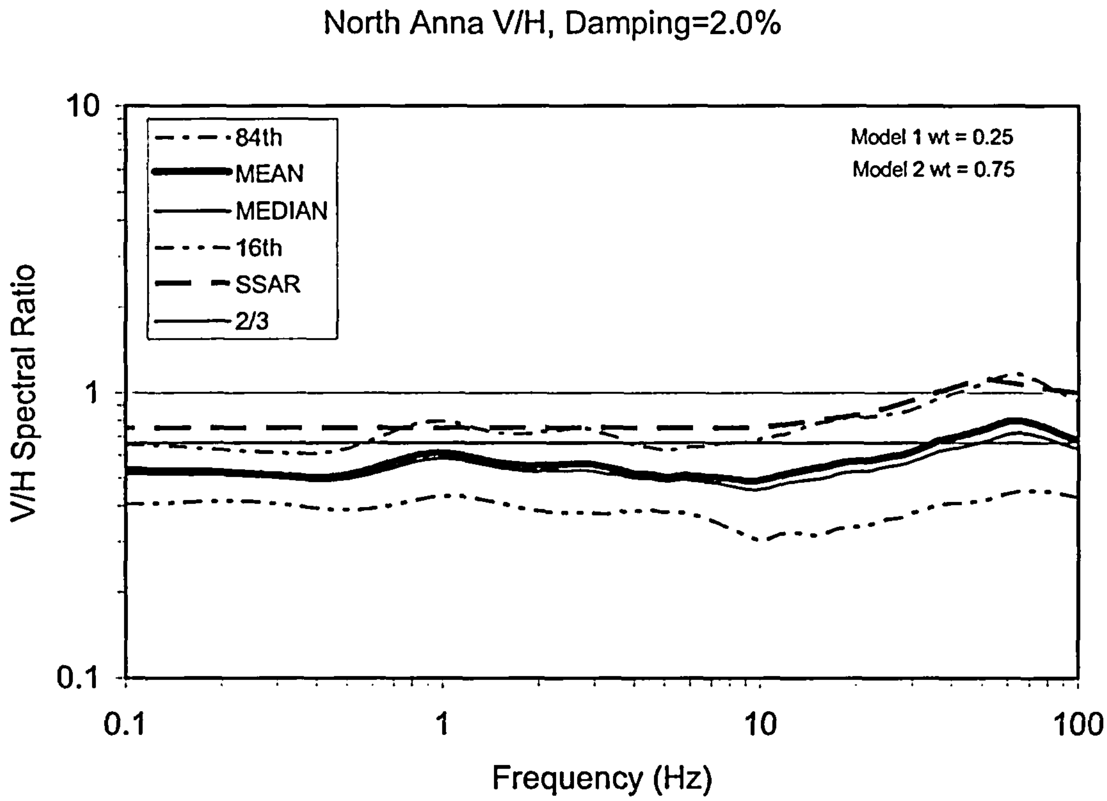

Figure 2. Preferred V/H mean and fractiles ratios, using weights of 0.25 and 0.75 for Poisson's ratio Models 1 and 2.

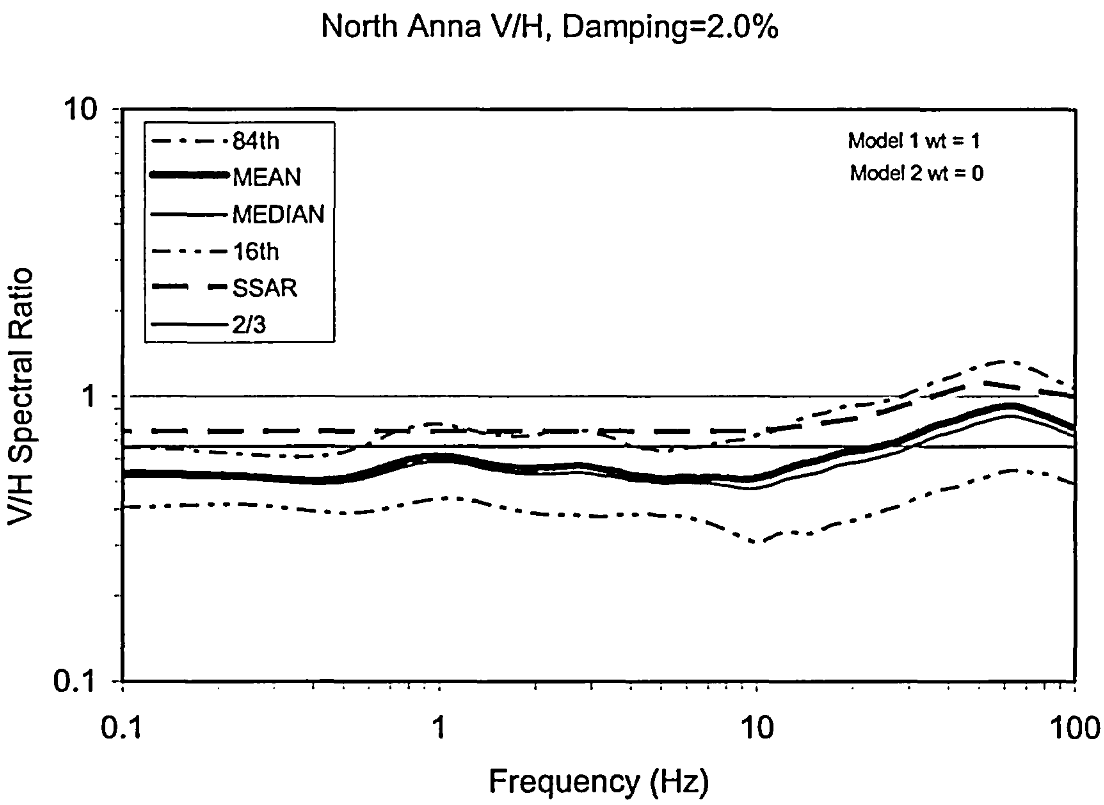

Figure 3. V/H mean and fractiles ratios, using weights of 1.0 and 0.0 for Poisson's ratio Models 1 and 2, respectively.

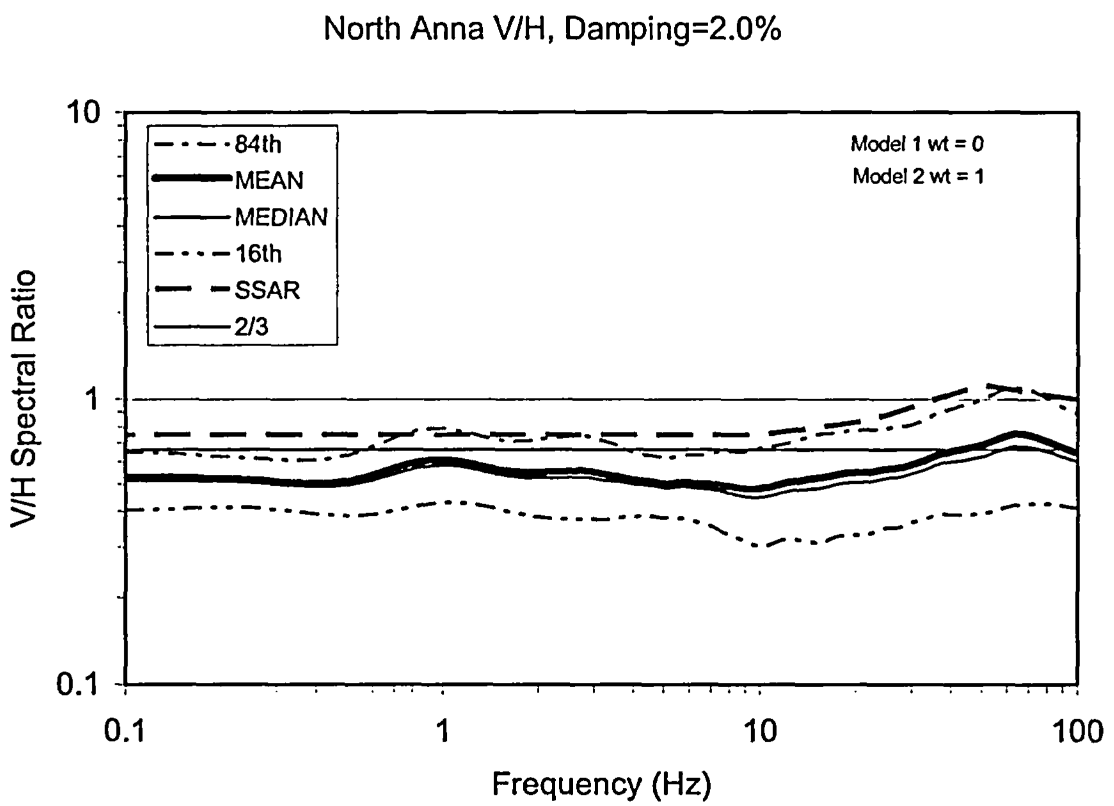

Figure 4. **V/H mean and fractiles ratios, using weights of 0.0 and 1.0 for Poisson's ratio Models 1 and 2, respectively.**

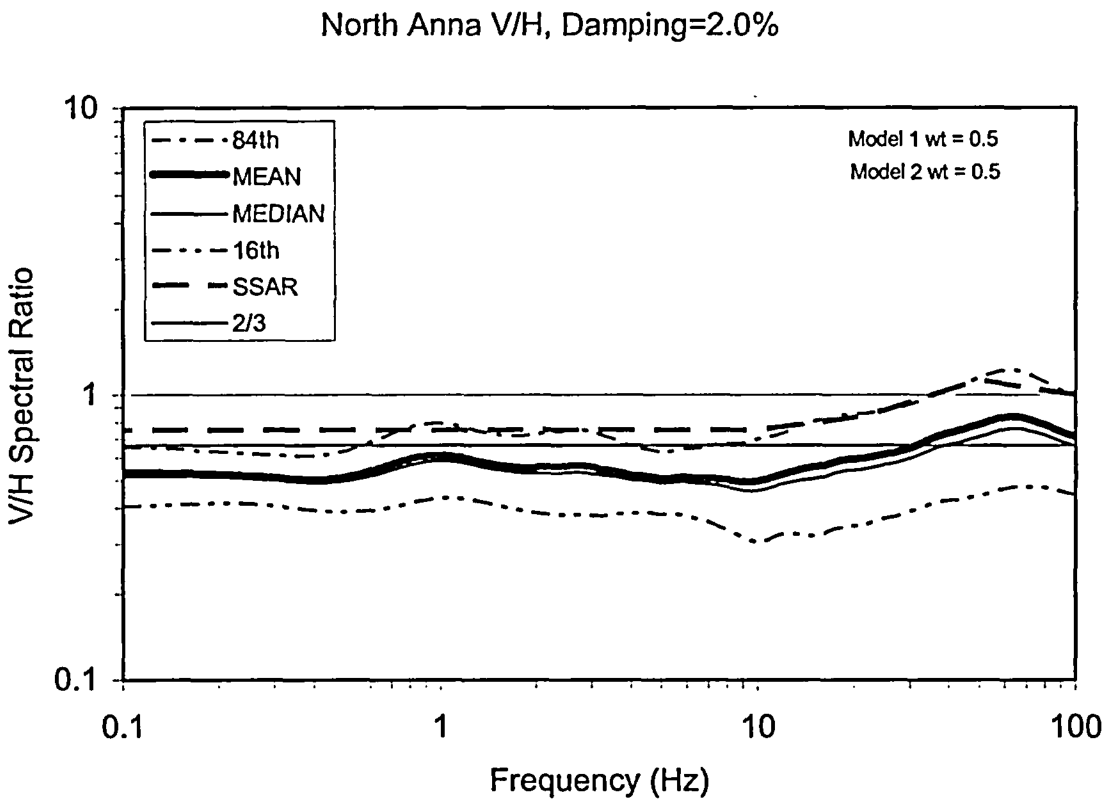

Figure 5. V/H mean and fractiles ratios, using equal weights for Poisson's ratio Models 1 and 2.

Question 4b (7/26/05 Conference Call)

What is the rationale for using weights of 0.25 and 0.75 for Models 1 and 2, respectively?

Response

This judgment to rely more on recent rather than old data was made on the basis of experience and recognition that the basis for the ESP data was better known. Discussions of appropriate weights proposed values for Model 2 from 0.65 to 0.9 with Model 1 being assigned complementary values of from 0.35 to 0.1. The values selected were approximately in the middle of this range.

References

1. July 25, 2005 Letter from Eugene S. Grecheck, Vice President-Nuclear Support Services, Dominion to U.S. Nuclear Regulatory Commission, Document Control Desk, "Dominion Nuclear North Anna, LLC, North Anna Early Site Permit Application, Final Safety Evaluation Report Review Items and Revision 5 to the North Anna ESP Application," Serial No. 05-457.

2. Electric Power Research Institute (1993). "Quantification of Crustal Path Effects" in Guidelines for Determining Design Basis Ground Motions, Volume 1: Method and Guidelines for Estimating Earthquake Ground Motion in Eastern North America, EPRI TR-102293, Electric Power Research Institute, Palo Alto, California, p. 5-1 to 5-98.