The MINERνA Operations Report
All Experimenters Meeting

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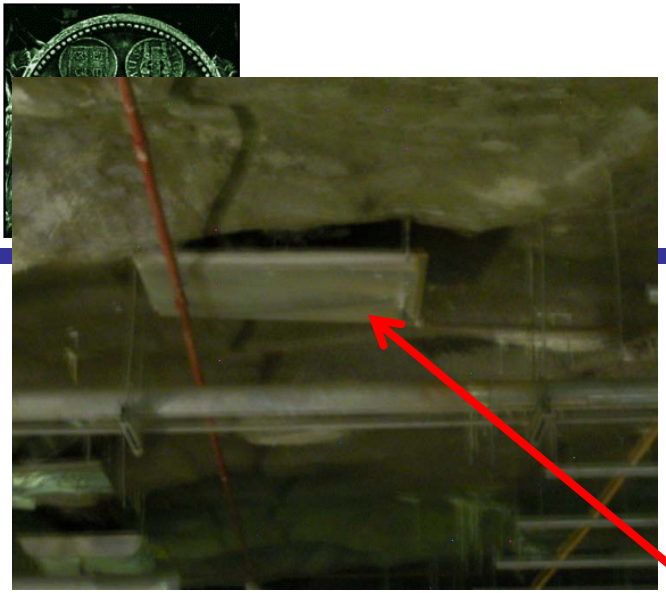
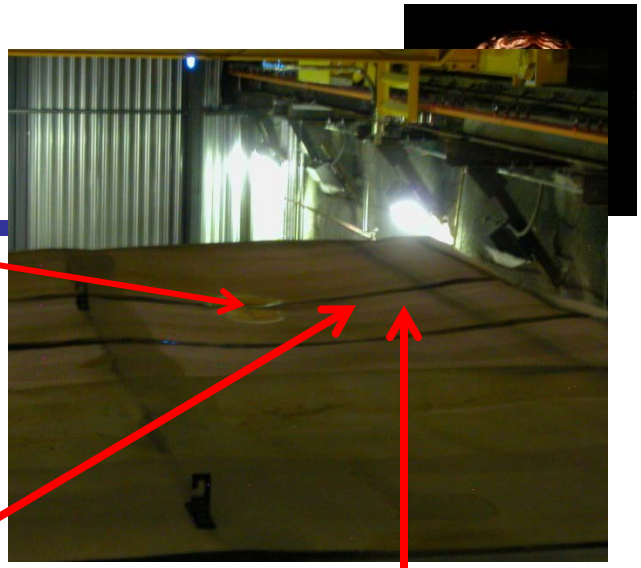
Nov 05 2012

MINERvA Detector

- Detector came up with no problem after Kautz Rd. power outage
  - All boards operating
  - We moved a computer from spares rack to DAQ rack as the computer was used in taking data
- Running shifts starting 5:30PM weekdays for about 1½ hours
  - We are leaving HV off except for shifts
  - Run PEDs and Light Injection to determine if there has been any change in the detector.
    - There appears to be no change in the detector or PMTs
  - Shifter posts plots of vibration sensors

Water Leak





Almost all water removed from roof

Indentation for puddle

- On Oct 30, water leaking on roof from drip pan and water leaking through the seam of the roof, onto veto panels & a little bit on veto PMTs
- Problem is herculite which is supported by unistrut causes the water to form puddles
- Bill Moorhouse and John Chyllo drained the pan
  - The pans were check on Oct 4 2012
  - Speculation - loose debris from cleaning drain or debris falling into pan caused problem, rather than deposits building up in the drain pipe
  - This makes time between water leaks unpredictable
  - Thank Bill Moorhouse, John Chyllo, Aria Soha, & Steve Hahn

Vibration studies thanks

- Vibrations from geophones
- We would like to thank Todd Johnson (AD) and Linda Bagby (PPD) for their work on this
- This used Todd's work from vibration studies he did for AD
- Thank MCR for taking the FFTs
- Jim Volk for the seismometers

Vibrations from excavation

Expectations from FESS presentation

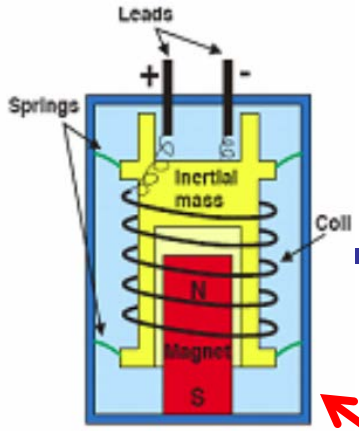
The frequency of the ground vibration associated with road headers is normally in the range 10-50 Hz. Vibration levels associated with road headers are very low in comparison to other excavation methods.

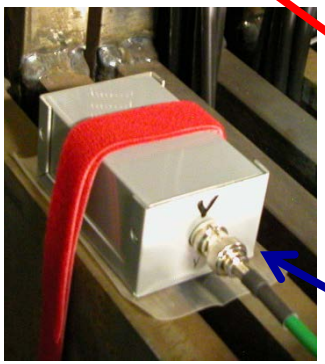
Detector to wall is about 9 m so
Detector is roughly 13 m to excavation so vibration ~ 0.07 mm/sec

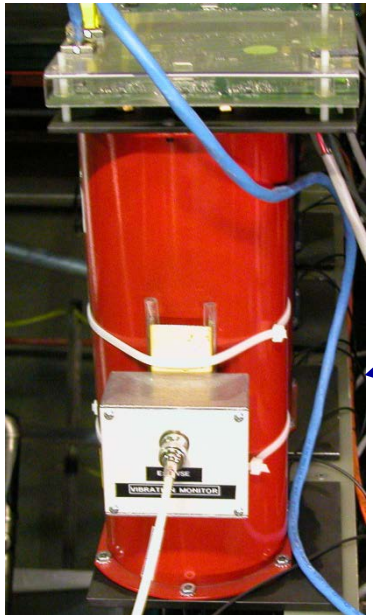
	Peak Vibration Levels (mm/s) Versus Distance					
	5m	10m	20m	30m	40m	50m
12m hard rock TBM	35	10	3	1.5	0.8	0.5
Heavy Rockbreaking	4.5	1.3	0.4	0.2	0.14	0.1
Heavy Roadheading	0.5	0.13	0.04	0.02	0.01	0.01
Blasting - ICI tunnelling formula						
5 kg Maximum Instantaneous Charge	168	55	18	10	6	4
1 kg Maximum Instantaneous Charge	46	15	5	2.6	1.7	1.2
0.2 kg Maximum Instantaneous Charge	13	4.2	1.4	0.7	0.5	0.3

Ref: SKM/Connell Wagner Northern Link – Phase 2 – Detailed Feasibility Study – Chapter 9 Noise and Vibration – Sep. 2008

Vibration at MINERvA Detector

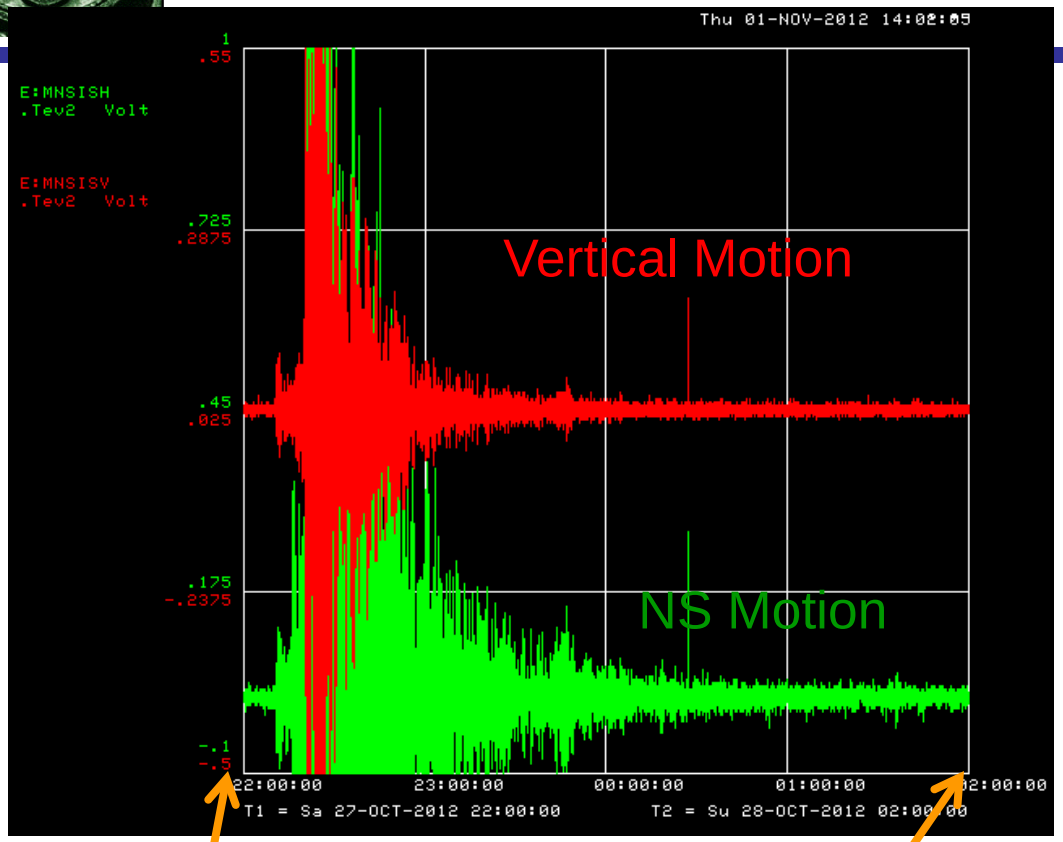






- Hamamatsu indicates that vibrations 500-1500 Hz might damage the PMTs with HV on by setting up a resonance. They indicated the PMTs are probably OK if the acceleration < 0.2 g.
  - Information not real clear on this, but this sets our goal
- Horizontal and vertical measuring seismometers downstream end of MINOS hall
  - From Jim Volk
- Installed 4 geophones on the MINERvA PMTs
  - 1 vertical & 3 horizontal, 2 NS & 1 EW
    - NS & EW on PMTs, vertical on steel near PMTs
  - When geophone case is moved, the coil moves wrt the fixed magnet & this generates a voltage.
    - Measures velocity

Seismometers



10 PM Oct 27

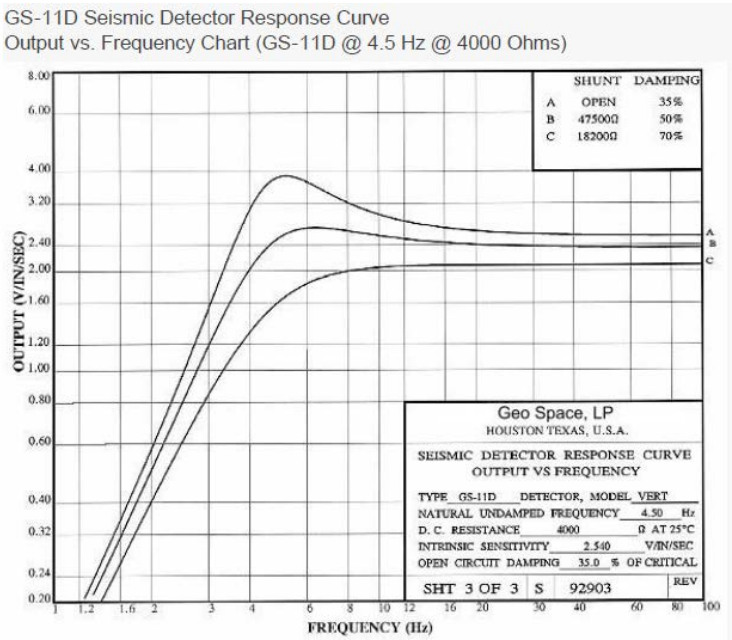
2 AM Oct 28

Oct 27 2012 7.7 Magnitude Earthquake Off Canadian Islands, Haida Gwaii, in the Pacific

- Coil moving in magnetic field
- In ACNET value for the seismometers is velocity
  - Roughly 1 volt= 0.5 microns/second
- Working frequency is 0.05 to 200 Hz
  - Designed at Institute of Nuclear Physics in Russia
  - Seismometer much more sensitive, but not at MINERvA & response < 200 Hz
- Used to tell when there is excavation

Geophone response function

Volts/velocity, v/in/sec

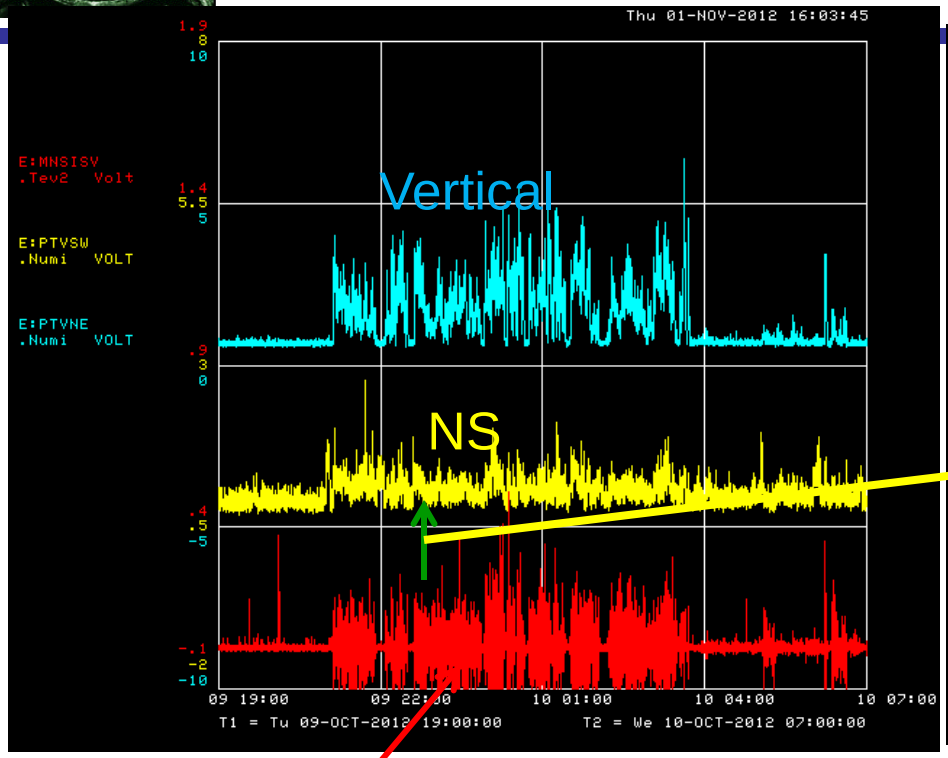


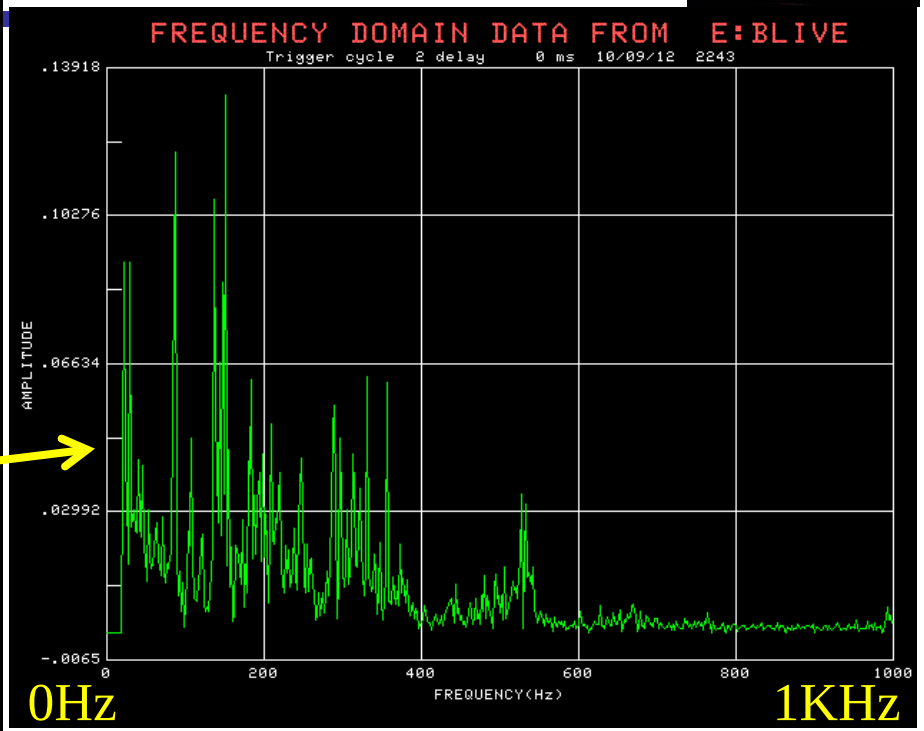
Frequency

Response is about 2.3 volt/(in/sec) above about 4 Hz

- Geophones put out voltage linear wrt velocity from 4 Hz up. The company states the response fall off above 750 Hz
  - Used by AD
- The AD circuit is peak sensing to measure maximal displacement
  - ∫ circuit on velocity = displacement
  - Modified circuit by cutting the cap to measure velocity - × 1400 amp
- Peak sensing of velocity → MADC
- Output × 1400 → MADC
  - Use FFT to look at spectral response of vibrations
  - But we have direct out on only 1 geophone

Horizontal Geophones





7 PM

Vertical Seismometer

7AM

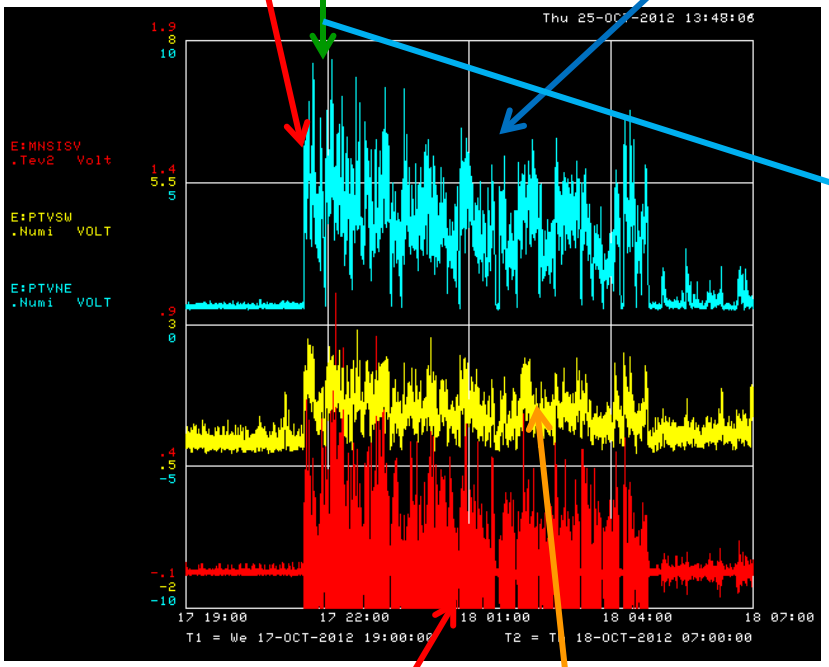
FFT, Fast Fourier transform, of NS measuring geophone

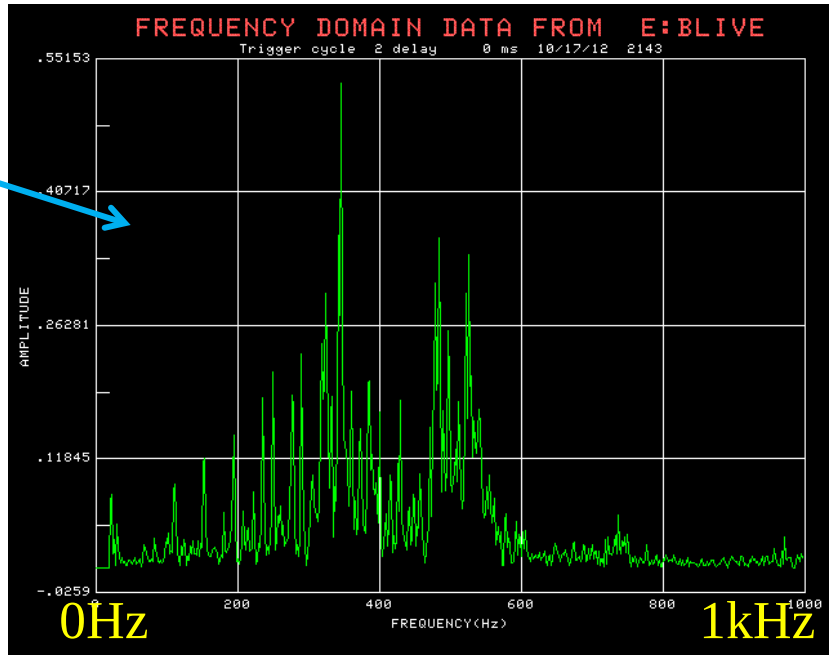
- Geophone full scale,10 v in ACNET
  - 0.07 mm/sec – From page 2, expect roughly 0.07 mm/sec
  - If all vibrations at 500 Hz acceleration is ~ 0.2g
- Horizontal and Vertical Seismometer look similar

Vertical geophone

Start of excavation

Vertical geophone (here max ~ 9v)





7PM

7AM

FFT vertical geophone

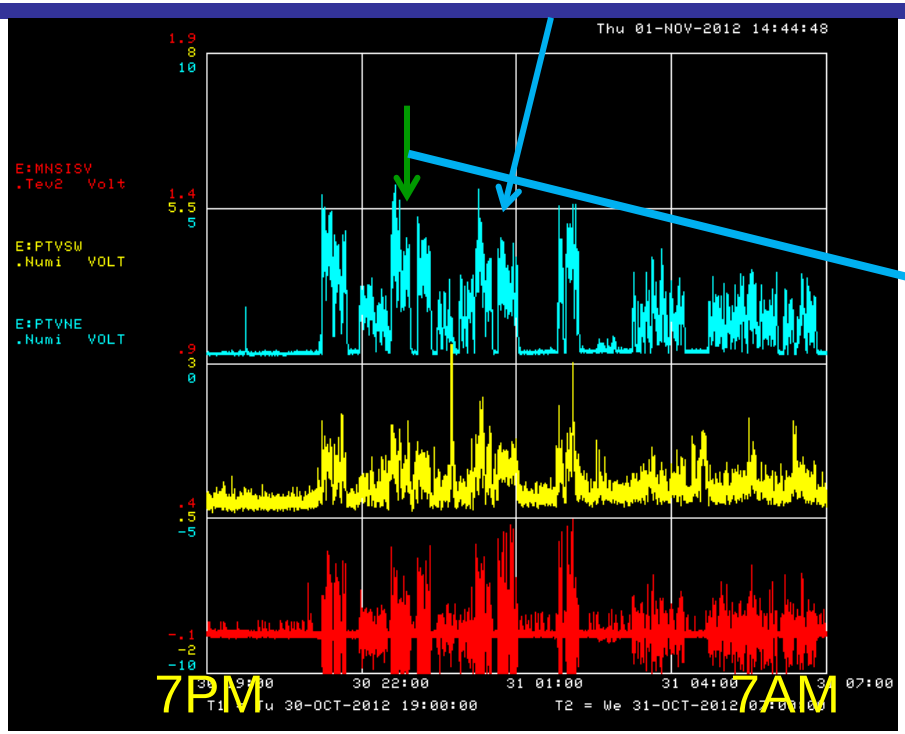
Vertical Seismometer

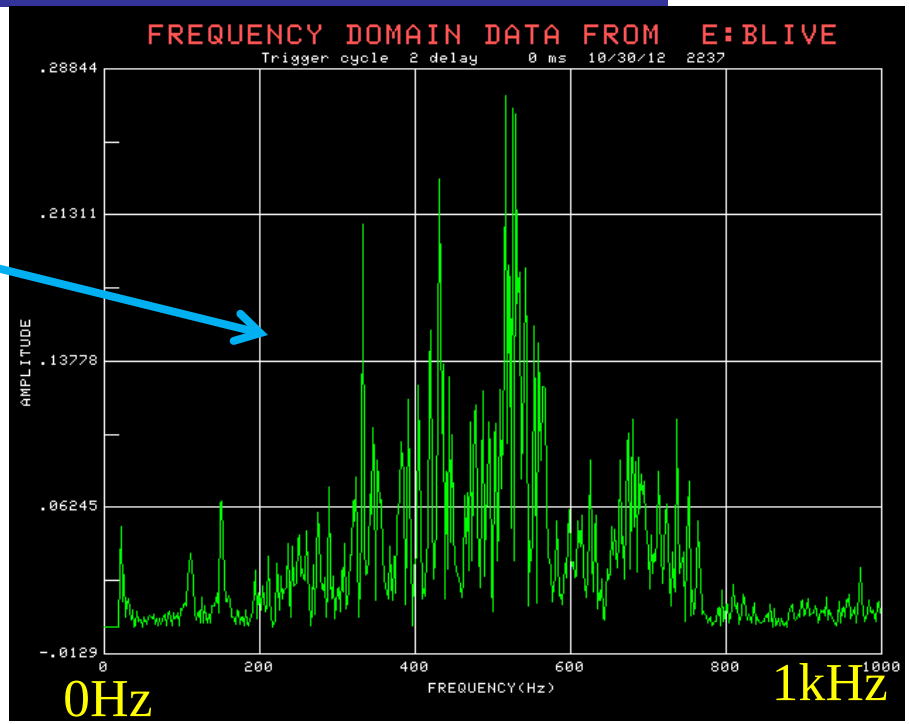
Horizontal geophone

- The vertical motions seems to have different frequency shape
  - Note that we only had one FFT channel, moved to vertical

Vertical geophones

Maximum on vertical geophone is 5 volts





FFT on vertical geophone

- The gain for the vertical geophone was reduced by ½ as it was saturating the MADC so now full scale (10 v) is ~ 0.14 mm/sec
  - Vibrations going out to ~ 800Hz, not much at low frequency 10–50 Hz
  - Max deviation on vertical geophones during excavation
    - 7 volts – 0.1 mm/sec – at 500 Hz – 0.3 g

Summary

- Vibration frequencies are higher than we expected.
  - Both vertical and horizontal frequencies disagree with expected 10–50 Hz
  - The vertical geophones see higher frequency vibrations than the horizontal geophones
  - The horizontal geophones are mounted on the PMTs
  - The vertical geophone was mounted on the steel at the level of the PMTs, not actually on the PMT.
  - Vibrations at ground level might be different as the steel structure and PMT mount could change the vibrations might expect them to reduce the high frequency components
- If all vibrations at 500 Hz, we have about 0.2-0.3 g of maximal vertical vibration.
  - By making a differentiation front end we could have the geophone measure acceleration
- Maximal velocity ~ 0.07 – 0.1 mm/sec are close to what we expect

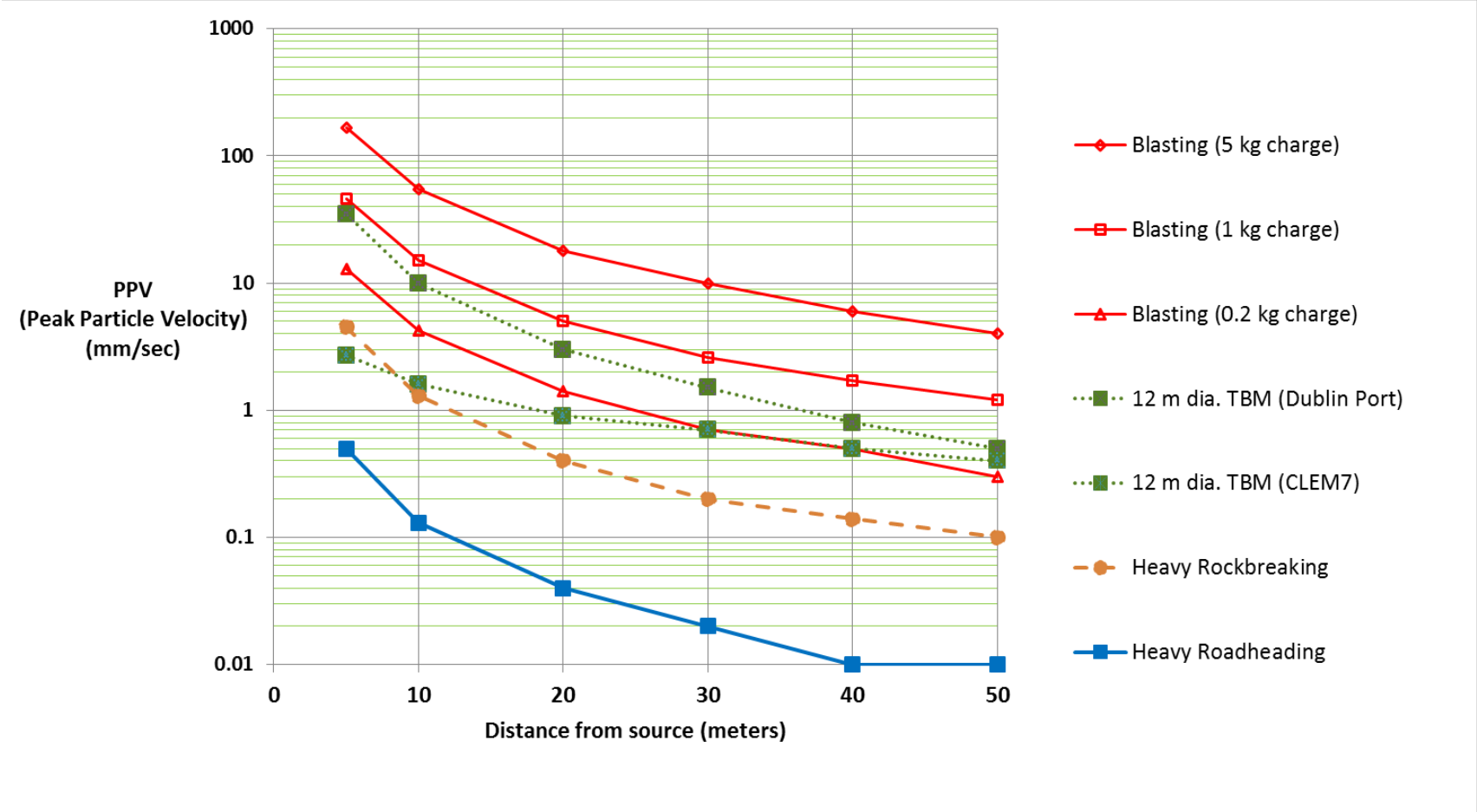
Summary

- As a result of these measurements we will most definitely NOT be turning on our PMTs until we are sure the vibration levels are much below what they currently are.

Backup Slides

Mitigation Measures - Excavation

Vibration



Mitigation Measures – Excavation

Vibration

Typical Maximum Levels for Sensitive Equipment:

Equipment Type	Maximum Vibration Levels
Precision balances	0.5mm/s to 2mm/s
Some optical microscopes	0.5mm/s
Large computer disk drives Sensitive electronic instrumentation	1mm/s to 5mm/s

Typical Maximum Levels for Sensitive Buildings:

Type of Building or Structure	Ground Vibration Limit (peak particle velocity)
Historical buildings, monuments or ruin	2 mm/s
Visibly damaged or cracked buildings or structures	10 mm/s
Structurally sound buildings or structures	20 mm/s
Reinforced concrete or steel buildings or structures	50 mm/s

Ref: SKM/Connell Wagner Northern Link – Phase 2 – Detailed Feasibility Study – Chapter 9 Noise and Vibration – Sep. 2008

Mitigation Measures - Excavation

Vibration

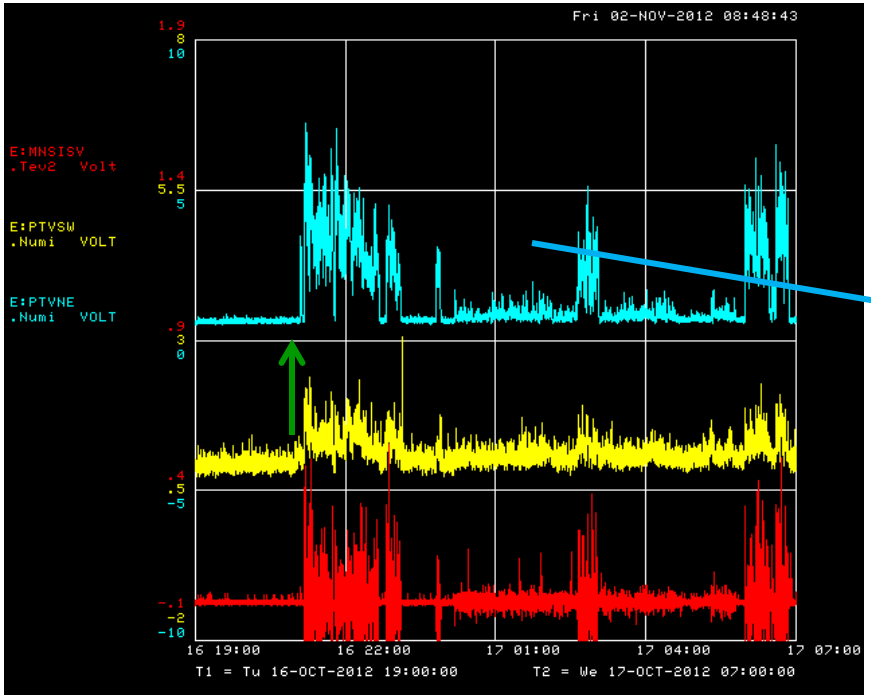
Vibration propagating from the roadheader is expected to be low outside the limits of construction.

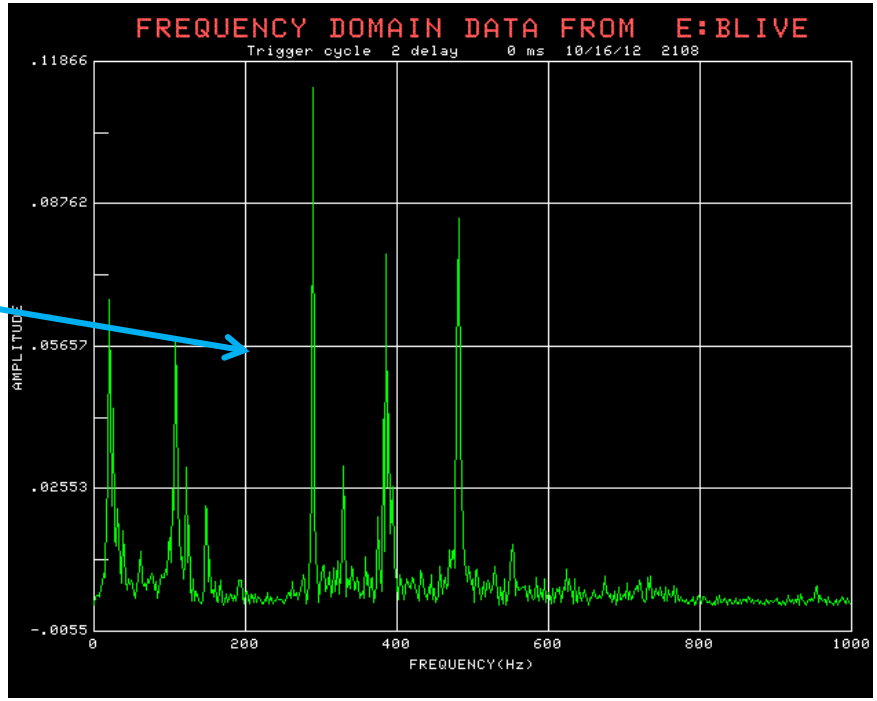
Effects on surrounding area will be monitored.

Vibration Levels and Human Perception of Motion

Approximate Vibration Level	Degree of Perception
0.10mm/s	Not felt
0.15mm/s	Threshold of perception
0.35mm/s	Barely noticeable
1mm/s	Noticeable
2.2mm/s	Easily noticeable
6mm/s	Strongly noticeable
14mm/s	Very strongly noticeable

Geophones, pedestal



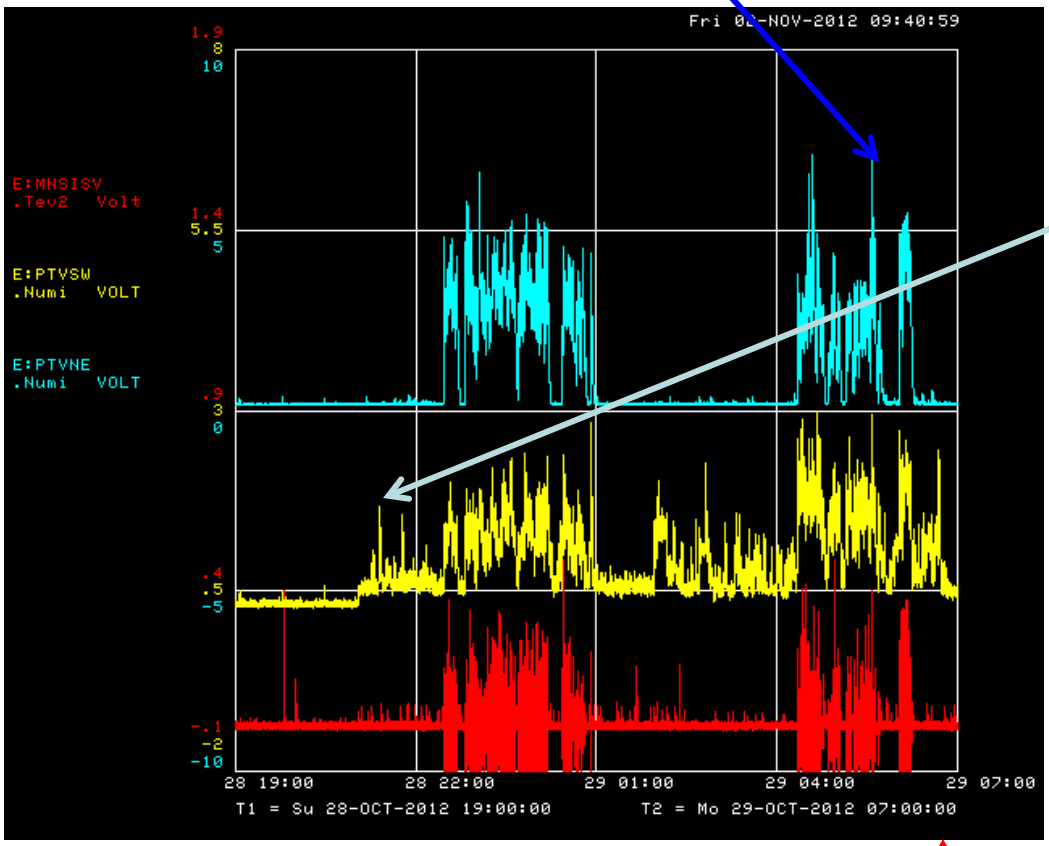


FFT no activity

- No excavation activity
- I could not seem to find a no activity for the NS geophone

Geophones see the exhaust Fan

Note maximal value is about 7 volts



- NS geophone sees the turning on of the exhaust fan for the contractors in the Hall
- The vertical geophones does not see it
- Turned off 5:30 Friday

7 PM Sun

7 PM Mon