Minimizing Risk from Blasting

Stuart Brashear

QUARRY ACADEMY

Improving Processes. Instilling Expertise.

DYNO
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SCHOOL OF MINES
1874
COLORADO

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Path Forward

- Proactive vs Reactive
- Community Relations
- Blast Optimization Basics
- Electronic Initiation Solutions
  - ✓ Precision
  - ✓ Timing
  - ✓ SHA
- Complaint Response

Basics

- Risk from blasting can be minimized in two ways
- Proactive – long term reward
  - ✓ Reduced damage claims
  - ✓ Reduced objections to expansion/permit renewal
- Reactive – short term damage control
  - ✓ Minimize cost of claims
  - ✓ Minimize costs for permitting
  - ✓ Reduce pressure for additional limitations

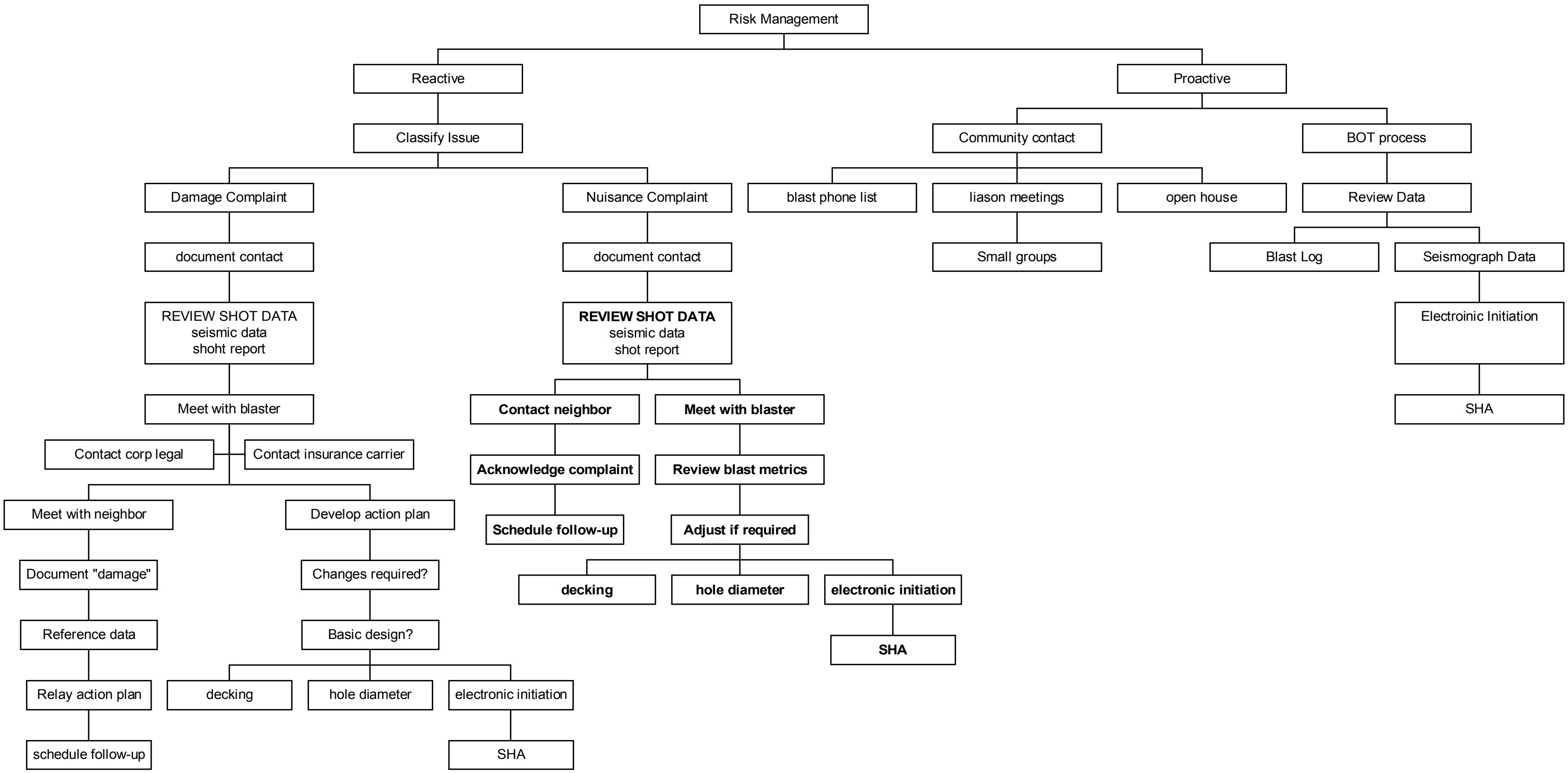
Must Optimize Both Processes

- **Proactive**
  - ✓ Status in community
  - ✓ Change in local government
  - ✓ Changes in demographics
  - ✓ Development of pit
  - ✓ Production increases

- **Reactive**
  - ✓ Complaints of damage
  - ✓ Complaints of nuisance
  - ✓ Flyrock
  - ✓ Media target
  - ✓ Environmental attacks
  - ✓ Regulatory changes

Must Optimize Both Processes

- Both processes require blast optimization to work!!!
  - ✓ Minimize complaints
  - ✓ Show “good neighbor” policy is real
  - ✓ Essential for litigation defense



Risk Management
Reactive
Proactive
Classify Issue
Community contact
BOT process
Damage Complaint
Nuisance Complaint
blast phone list
liason meetings
open house
Review Data
document contact
document contact
Small groups
Blast Log
Seismograph Data
REVIEW SHOT DATA
seismic data
shoht report
REVIEW SHOT DATA
seismic data
shot report
Electroinic Initiation
Meet with blaster
Contact neighbor
Meet with blaster
SHA
Contact corp legal
Contact insurance carrier
Acknowledge complaint
Review blast metrics
Meet with neighbor
Develop action plan
Schedule follow-up
Adjust if required
Document "damage"
Changes required?
decking
hole diameter
electronic initiation
Reference data
Basic design?
SHA
Relay action plan
decking
hole diameter
electronic initiation
schedule follow-up
SHA

Proactive Measures

- Must have a formalized approach
- Can be part of BOT process
- Communication key with neighbors
  - ✓ Website
  - ✓ Brochures
  - ✓ Liasion meetings
  - ✓ Open house events
- Does not always have to be expensive
  - ✓ Mentoring
  - ✓ School visits

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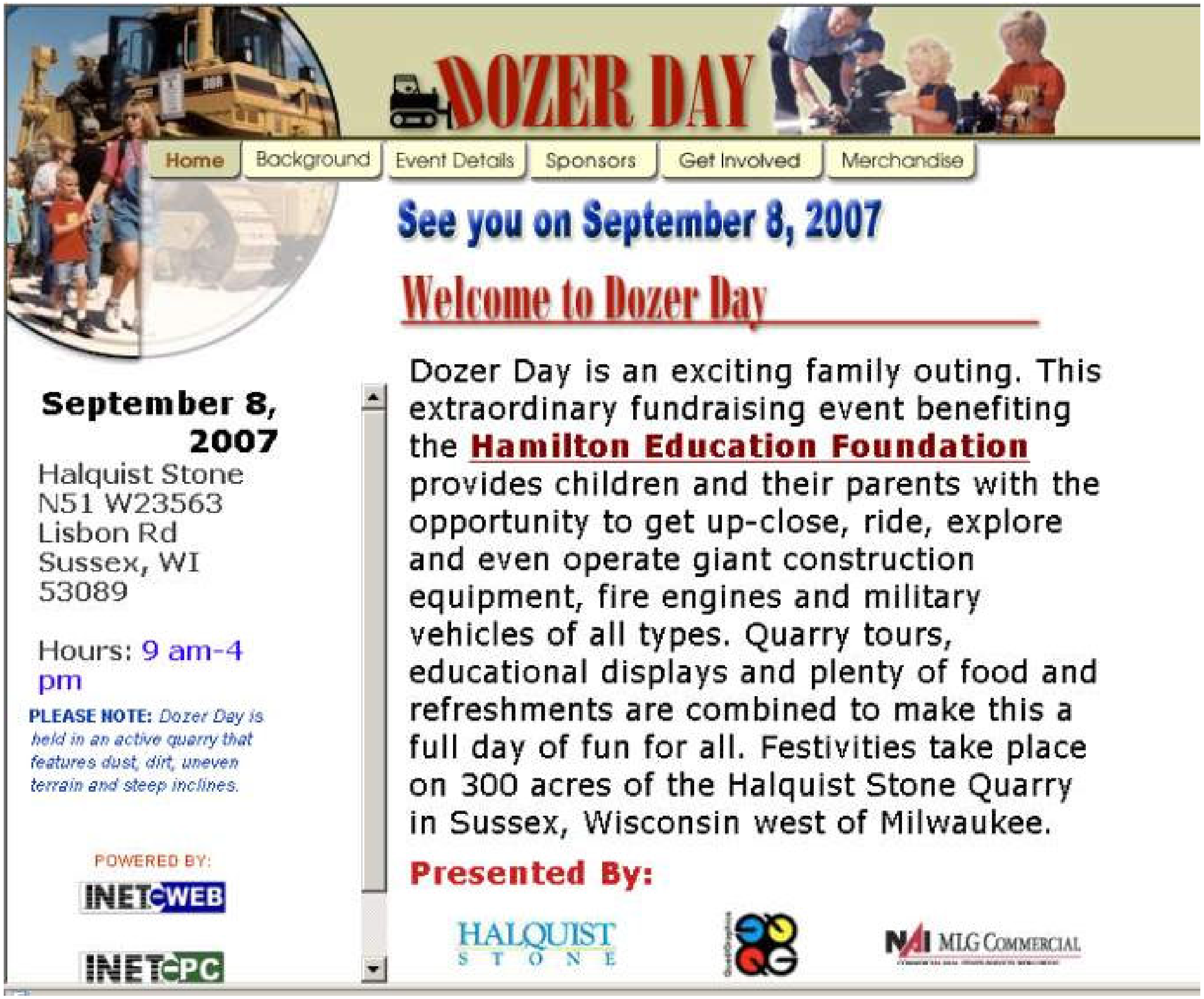
Quick Launch

- PRODUCT CALCULATOR
- DISCLAIMER
- SITE MAP

 This site is best viewed in 1024 x 768 (or higher).



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MAPS & GUIDES EMAIL SUBSCRIPTIONS CONTACT US FALL COLOR RE

- **ACCOMMODATIONS**
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  - AMUSEMENT PARKS
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  - TOURS
  - WATERPARKS & POOLS
  - ZOOS
- **FOOD & DRINK**
- **THE GREAT OUTDOORS**
- **DESTINATIONS**
- **EVENTS CALENDAR**

OVERVIEW EVENTS

Dozer Day

Back to Event Listings

Sussex

Dozer Day is a unique, exciting family outing and fundraising event benefiting the Hamilton Education Foundation. The Halquist Stone Company opens its Town of Lisbon quarry to the public for tours and an opportunity to learn more about the quarry, military and heavy construction equipment.Kids of all ages are able to participate in a wide variety of activities

SUBMITT

WDT

WEB SITE

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Doozy of a Dozer Day

Love of rock 'n' roar expected to draw thousands to fund-raiser

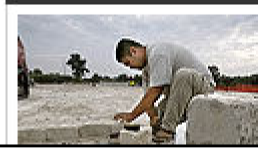
By ERIN RICHARDS
erichards@journalsentinel.com

Posted: Sept. 6, 2007

Lisbon - With temperatures in the 70s predicted, organizers of Dozer Day at Halquist Stone Co. expect to welcome 15,000 to 20,000 people to a real rumbling, roaring rock quarry on Saturday.

Dozer Day, which is from 9 a.m. to 4 p.m., began as annual event in 1997. Since 2003, it has been held every other year.

Dozer Day



QUARRY ACADEMY


QUARRY QUEST
Digging For A Decade
2008
An Earth Moving Experience!
Home
Background
Event Details
Activities
Sponsors
Tickets
Store
See you Sept 13, 2008!
Welcome
Quarry Quest is an exciting family outing and fundraiser held in Michels Materials limestone quarry in Neenah, Wisconsin.
The event gives visitors a one-of-a-kind opportunity to tour a working quarry, ride and explore giant excavation machinery, and participate in a host of fun, hands-on educational activities such as "prospecting" for fool's gold or mixing up a batch of concrete "cake".
Click on Event Details for directions and map
Volunteers
QUARRY QUEST
It's a BLAST!
ONE GRAND PRIZE WINNER
will receive an
EXCLUSIVE VIP PASS
For the Entire Day
(Click for Details)

QUARRY QUEST

Digging For A Decade 2008

An Earth Moving Experience!

Home | Background | Event Details | Activities | Sponsors | Tickets | Store

See you Sept 13, 2008!

Background

Quarry Quest was created by a team of community-minded organizations in 1999 to help provide a better understanding of the construction and mining industries while also raising much needed funds for local charitable organizations.

The event has grown to be the pride of the community involving over 250 businesses and nearly 1,000 volunteers. In nine years, the event has attracted 150,000 people and raised over $650,000 for the Fox Cities Field Trip Fund, Weis Earth Science museum, Bay Lakes Boy Scouts Council and other local charities. Following the devastation of Hurricane Katrina, the American Red Cross was selected as an additional beneficiary of 2005 proceeds to support relief efforts.

The combination of heavy equipment "rides", hands-on learning and unique family fun have visitors saying that Quarry Quest is "the best family outing ever attended!" Come and see for yourself!

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Eastern View High School Rocks Out

Craig Dennis, Eastern View High School chemistry teacher, directs the bulldozer driver last week to the rock's future location.

Contributed Photo

6

Manual
Auto
back
next
Jump to image:
6

Culpeper Star-Exponent
and the Culpeper News

Concert in the Quarry 2006

Presented on May 6, 2006 at the
Martin Marietta Materials Forsyth Quarry
in the John's Creek Community of Suwanee, Georgia.

Start Slideshow

QUARRY ACADEMY

concert in
the **quarry**®

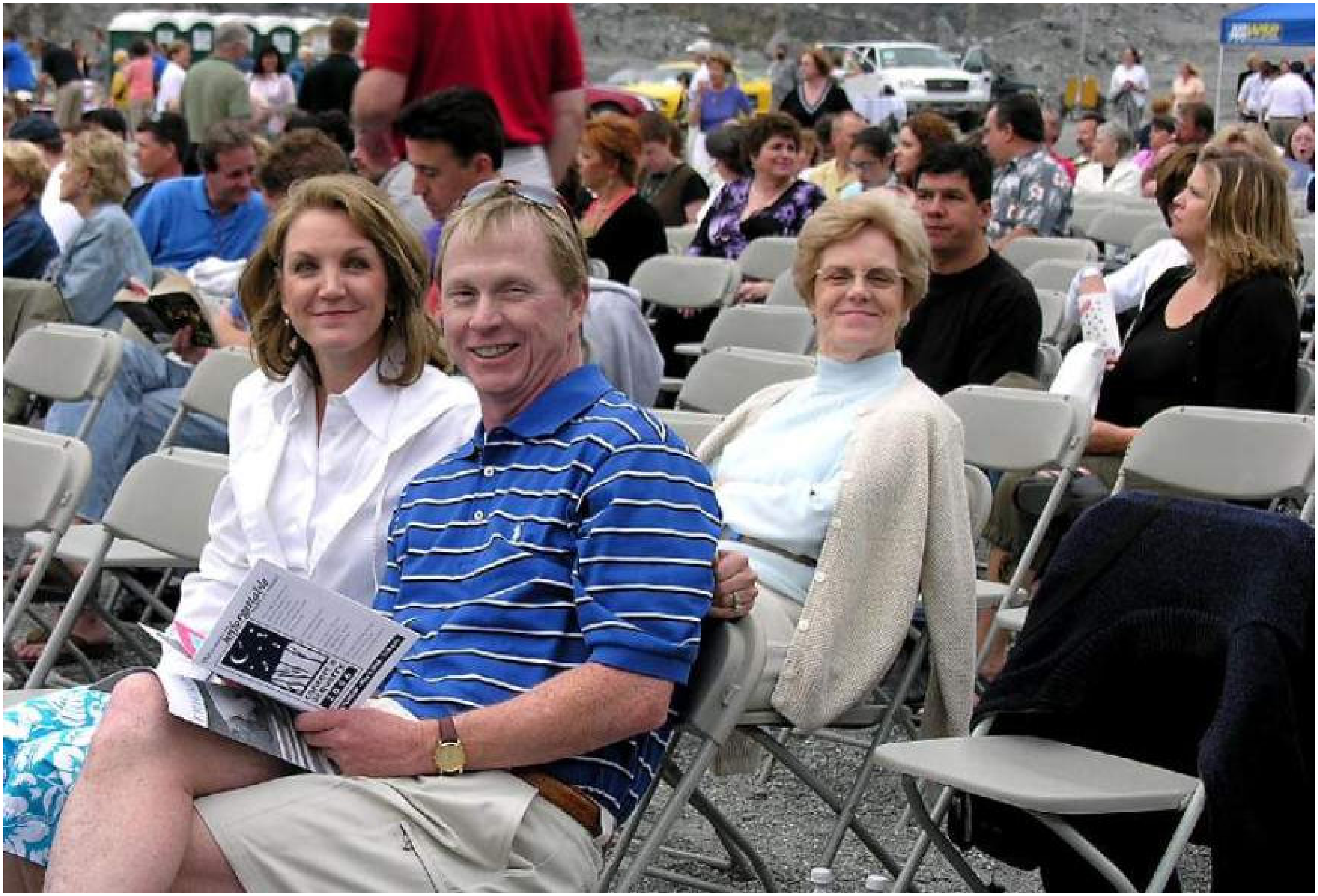
Saturday May 31st, 2008 at 7:30 PM

Presented By:

Northside Hospital Forsyth

Featuring:

QUARRY ACADEMY



QUARRY
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« KBDJ to help improve FM 967

KBDJ wins MSHA's Sentinels of Safety award »

Students' seeding project coming along nicely

Published September 8, 2008 Uncategorized

In May, more than 125 fourth graders from Highland Park Elementary School planted wildflower seeds on a one acre plot near KBDJ's limestone quarry. The seed mix, which was recommended by the Hill Country Conservancy, contained twelve different types of plants and grasses native to the region. As you can see from the recent photograph, the plants and grasses are filling in nicely. Thanks again to all of the students who helped make this project happen.

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But we still need to optimize!

- Understand how energy is utilized in blast
- For any given blast…….
  - ✓ Specific volume of rock to be blasted
  - ✓ Specific amount of energy released in shot
  - ✓ All energy will be utilized in one of four ways
    - Fragmentation
    - Heave
    - Vibration
    - Overpressure
- Proper use of explosive energy can minimize transient vibration

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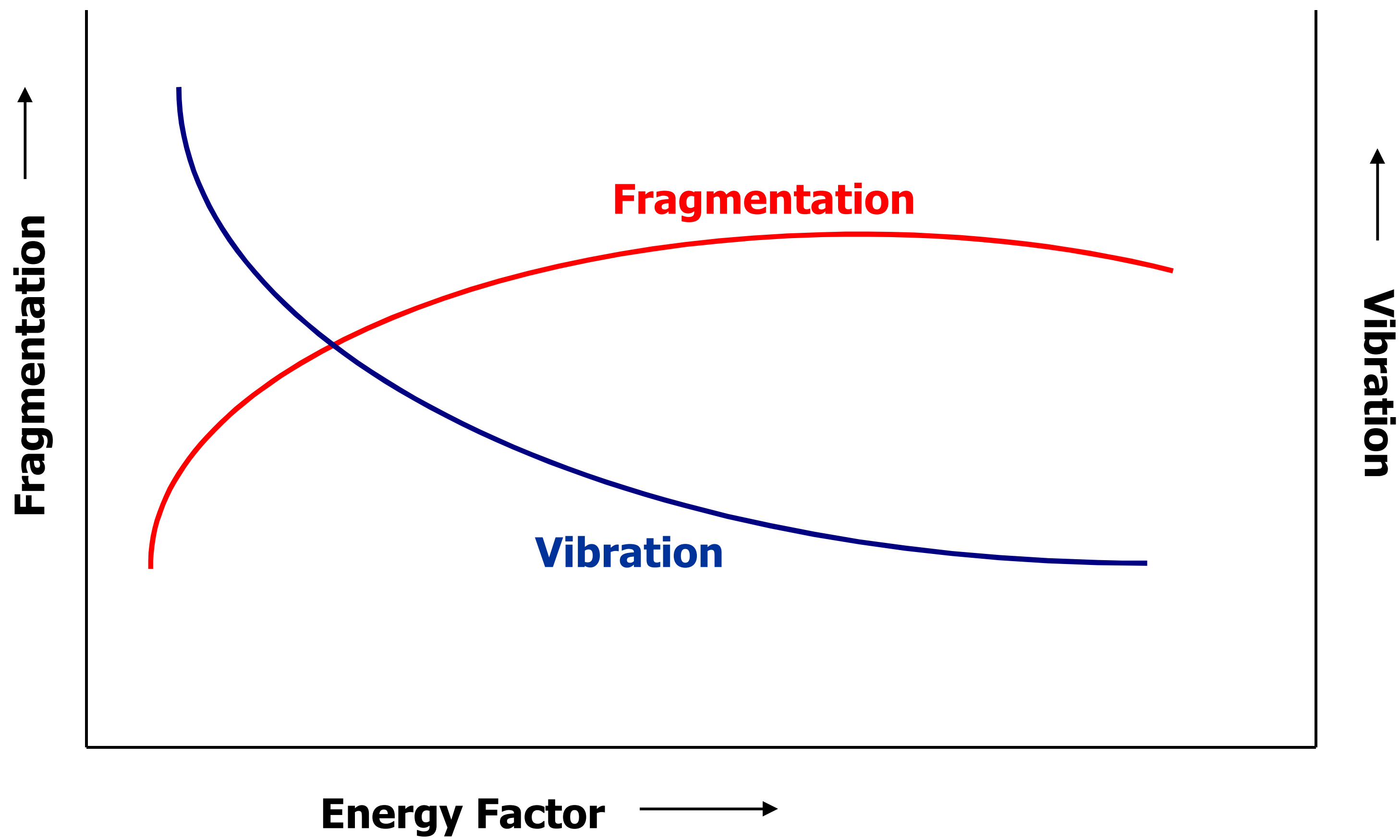
Optimizing Blasting Operations



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Optimizing Blasting Operations

- Proper energy factors
- Minimize subdrill
- Accurate face data
  - ✓ Burden
  - ✓ Bench height
- Proper energy distribution in front row
- Proper explosive application for conditions
  - ✓ Water
  - ✓ Rock type
- Utilize timing/precision detonators to control off site effects

Electronic Detonators

- Radically increases efficiency of waveform analysis
  - ✓ Precision firing at desired delay intervals
  - ✓ Increases number of possible solutions
- Effectiveness widely reported
- Sometimes critical to be using latest technology for community perception of operation
  - ✓ Public relations
  - ✓ Litigation plus

Signature Hole Analysis

- Based on concept of linear superpositioning
- Each hole creates similar seismic waves
- The overall vibration event created by blast is determined by interaction of waves from each hole in blast
- The sequencing of holes can radically impact transient vibration effects in the community

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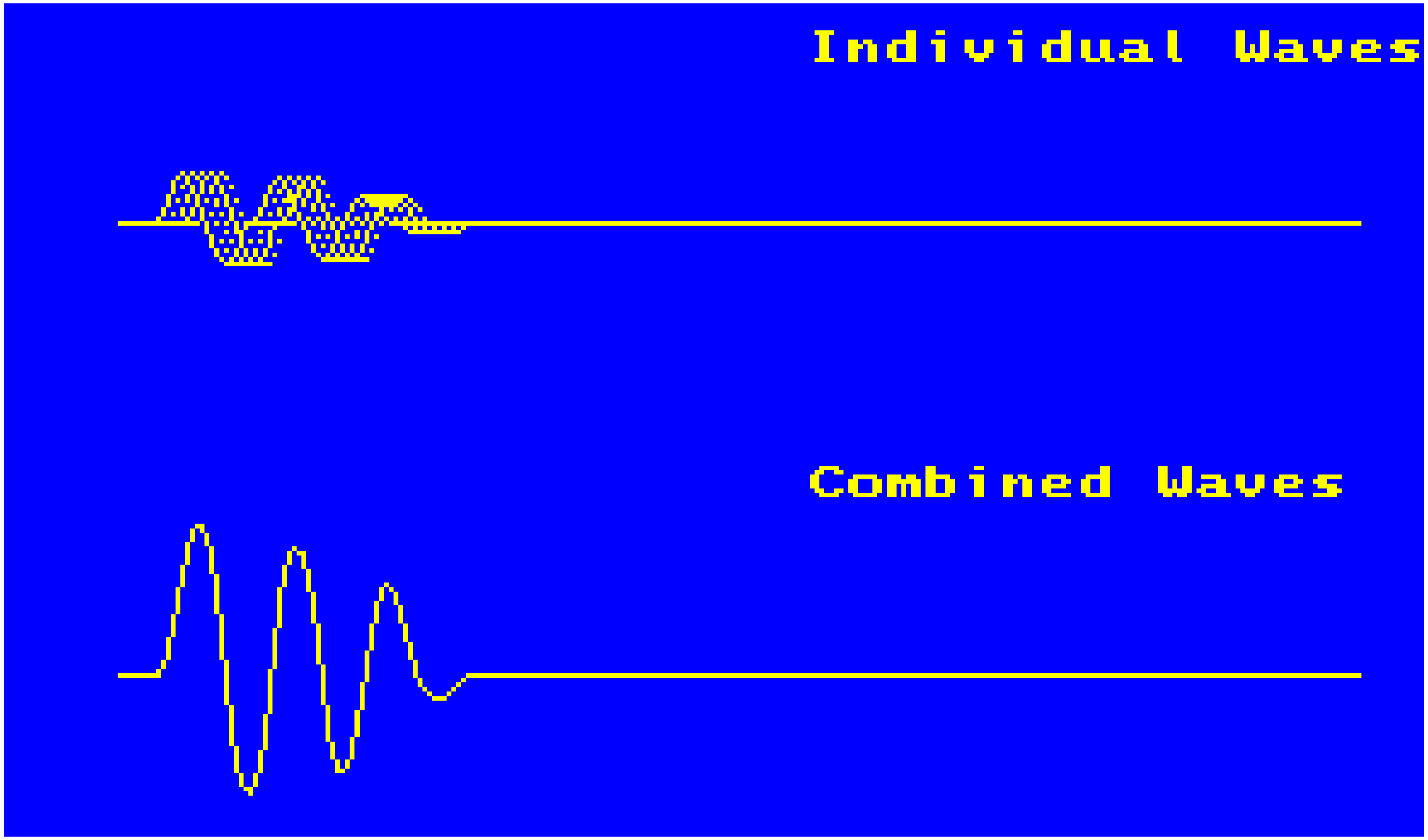

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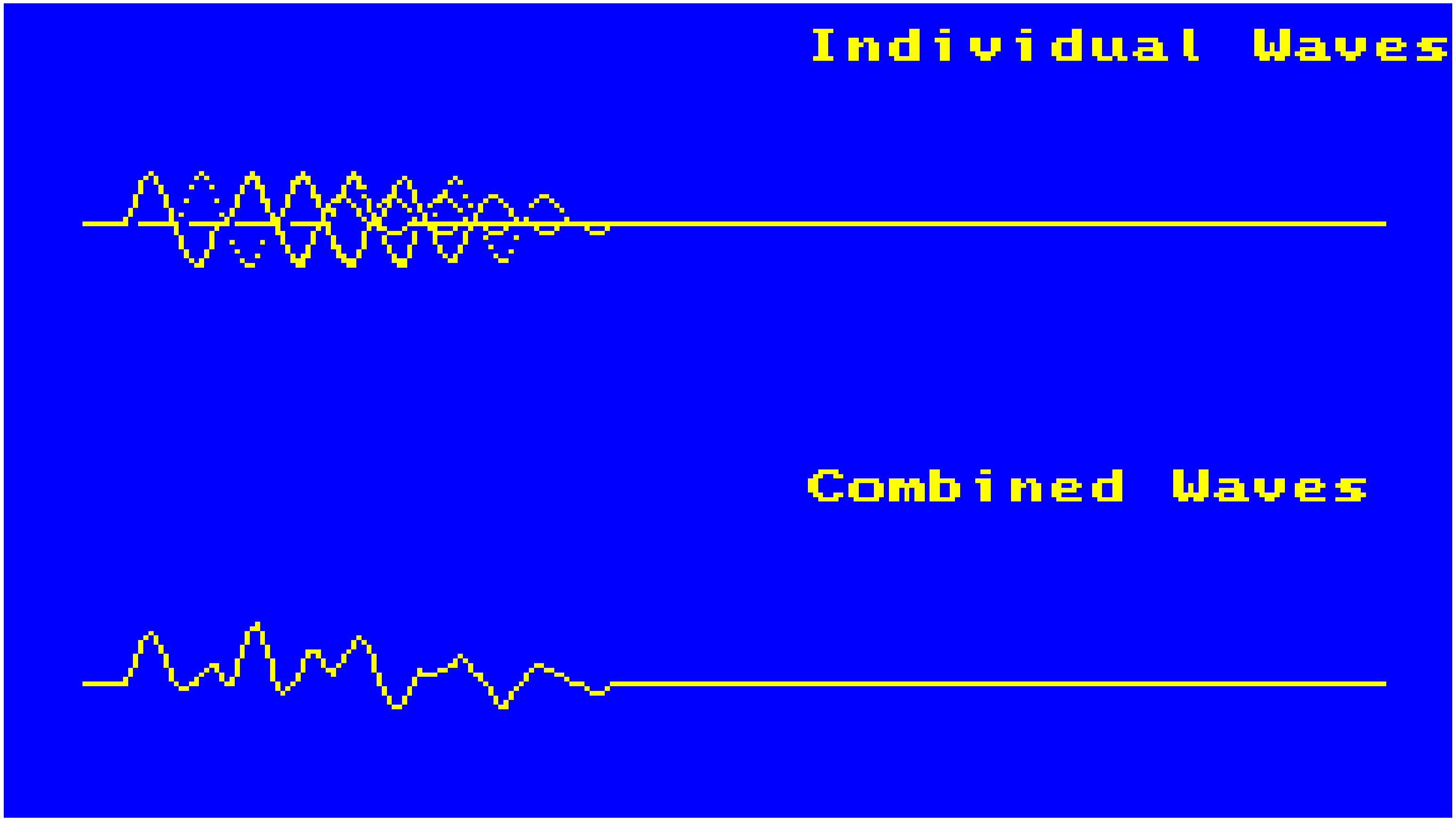
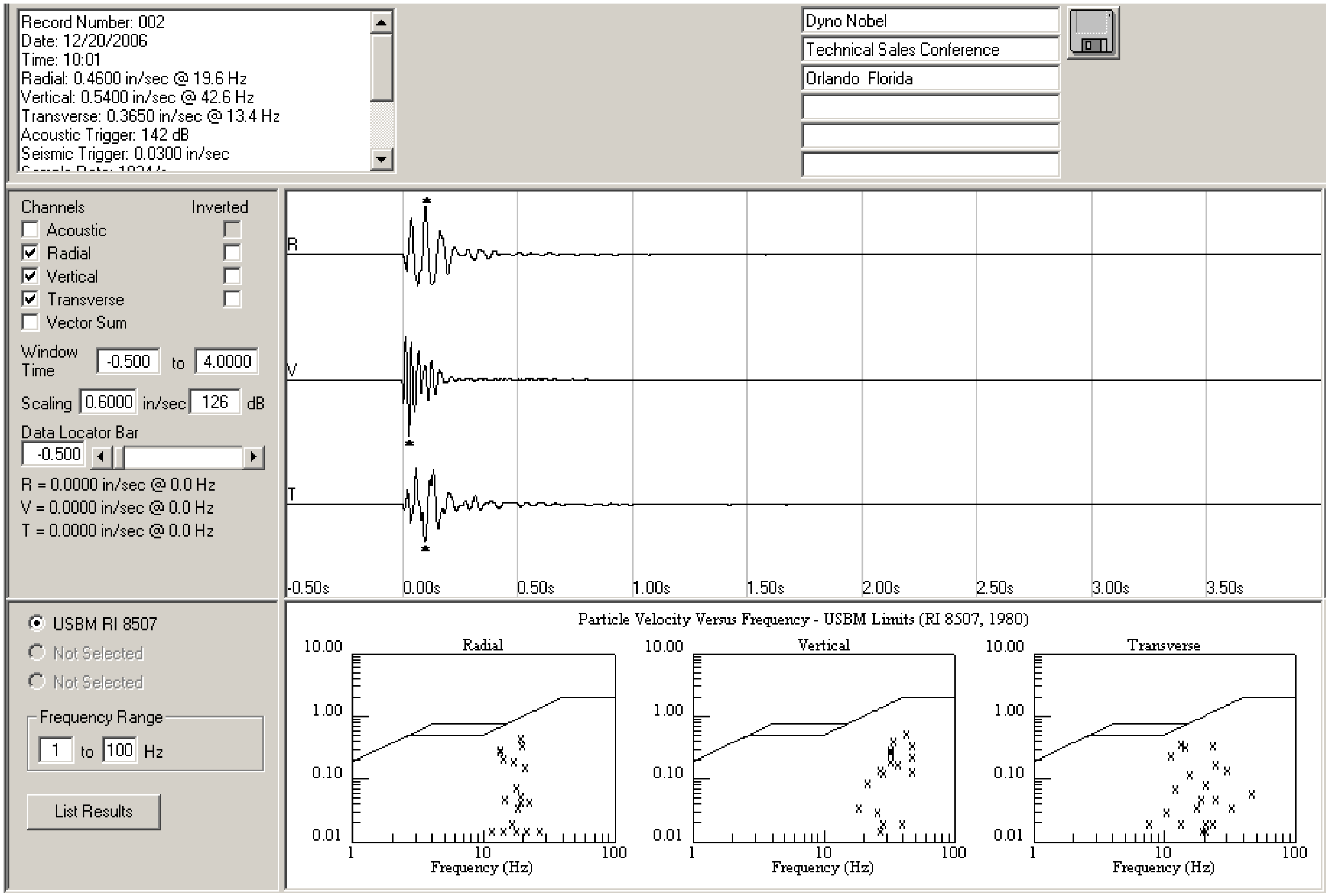

Individual Waves
Combined Waves



Single Hole Seismogram

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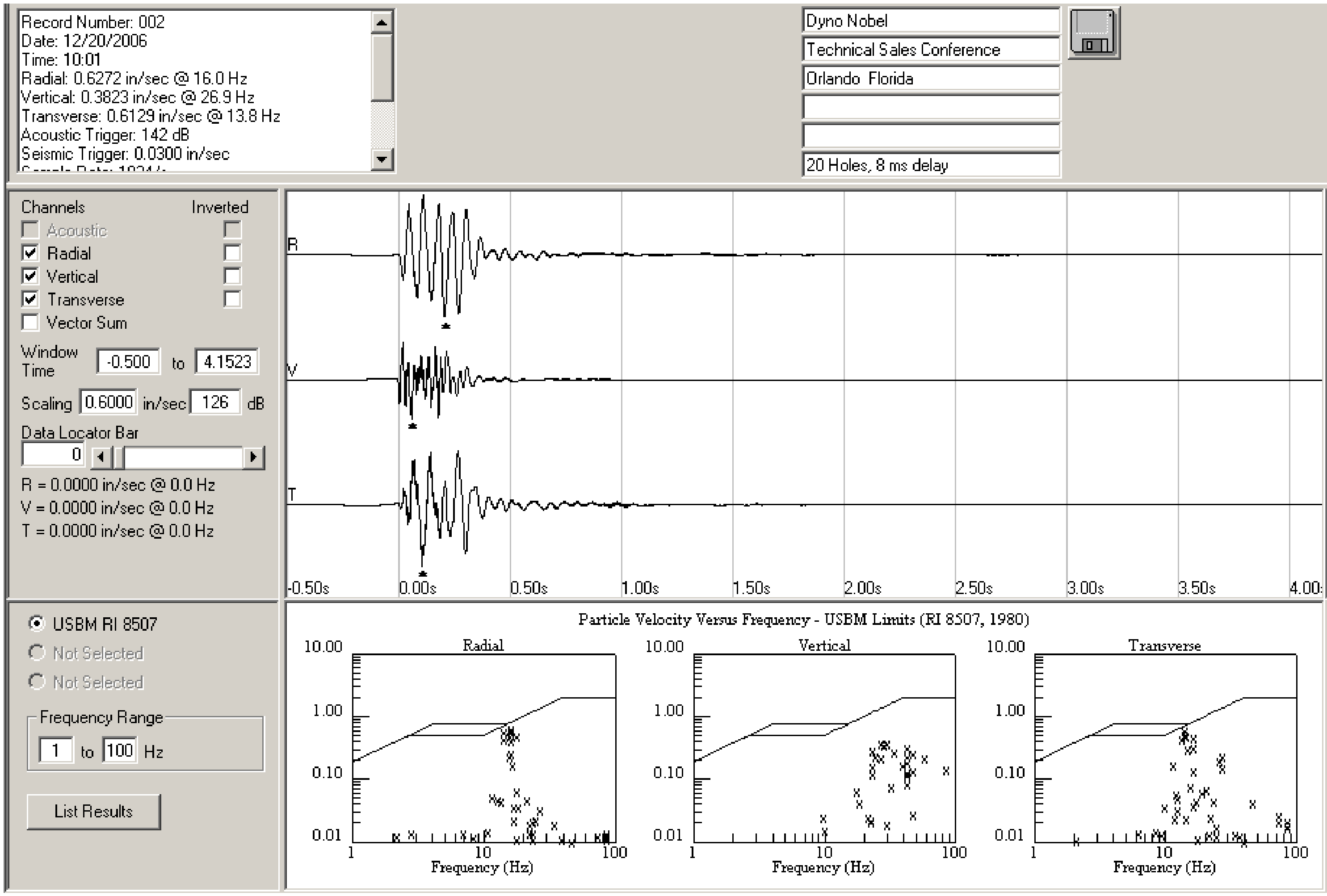
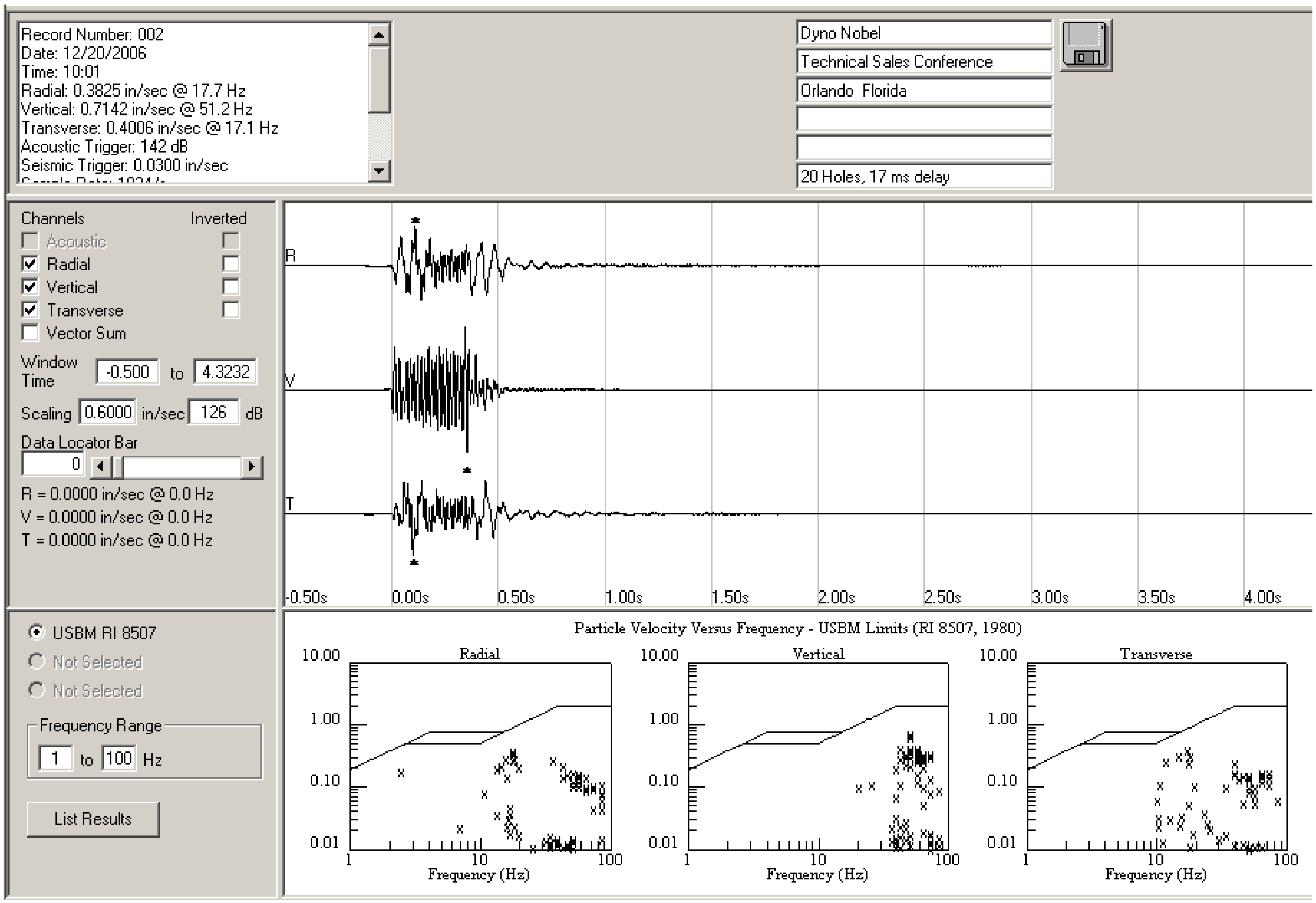


20 Holes, 9ms delay



20 Holes, 17ms Delay

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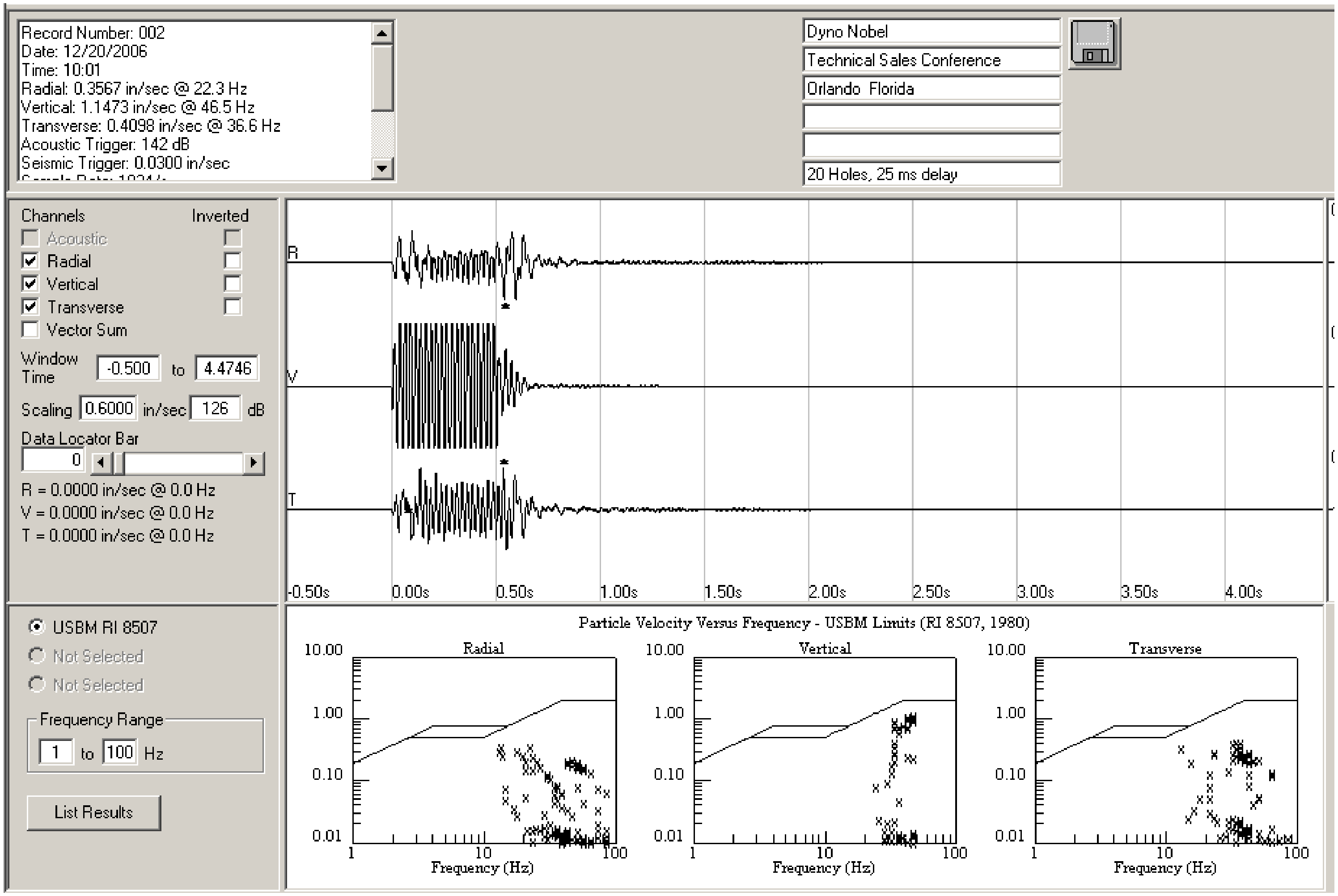

20 Holes – 25ms Delay

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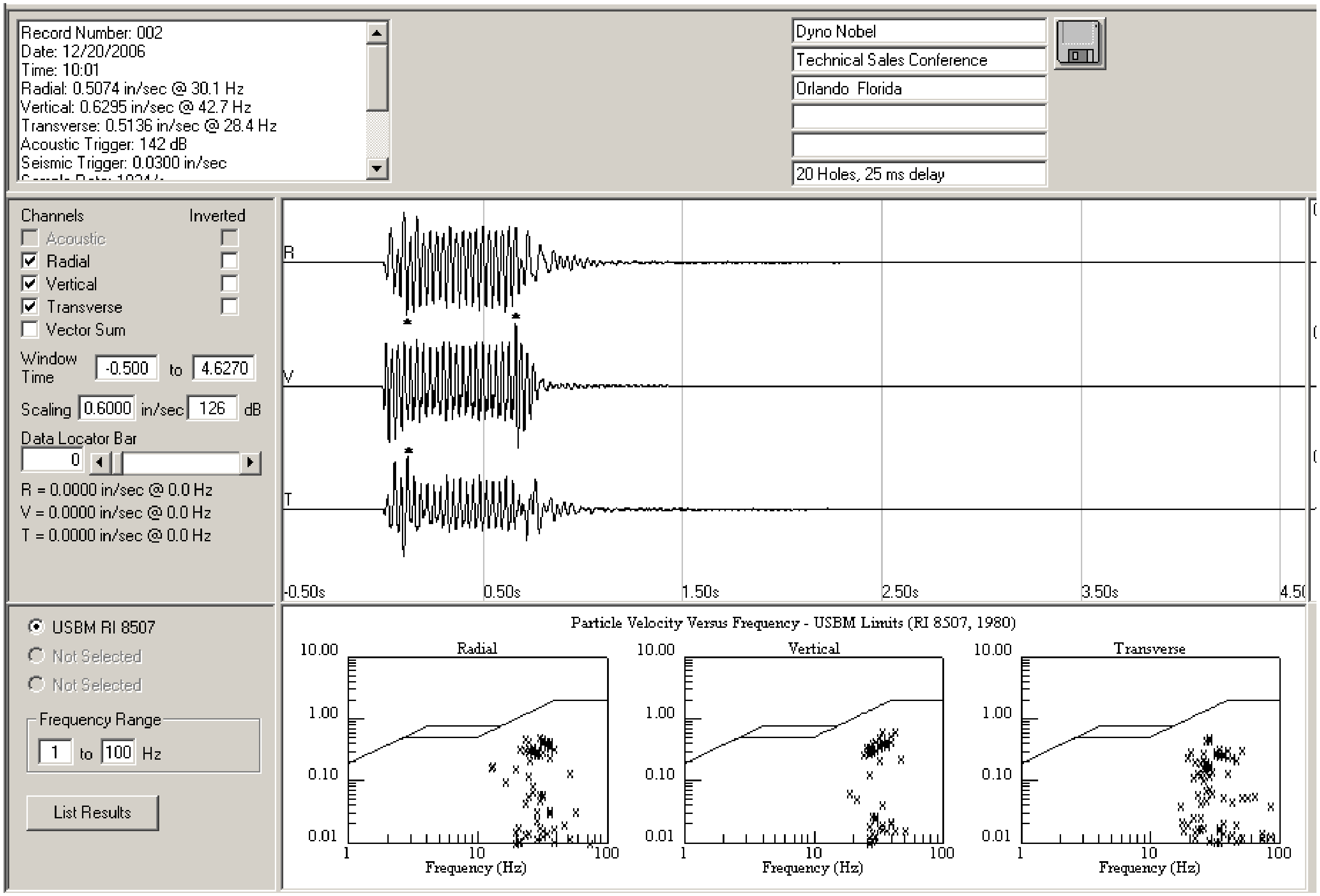

20 Holes – 33 ms Delay

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Vibration Control

- How does blaster determine good from bad??
- No intuitive way
- If you simply use EDD's with current timing
  - ✓ Vibration can get worse (get this stuff out of here!)
  - ✓ Vibration can get better (ok, that's more like it!)
  - ✓ Vibration can remain where it was (why am I paying more for the same results?)
- That's a 33% chance of success
- Do you like those odds???

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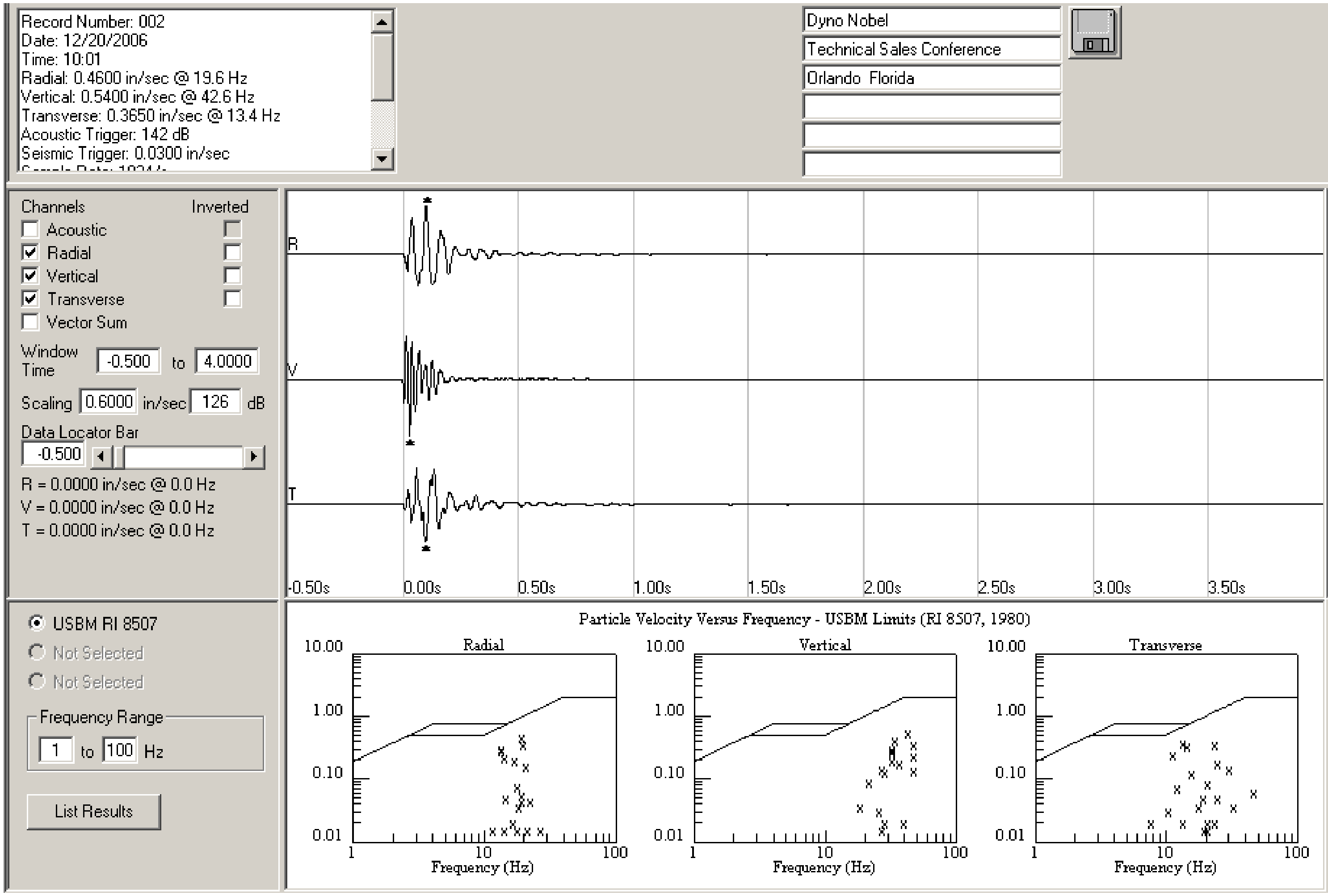
Vibration Control

- **How can we increase the odds of success???**
  - ✓ **Seismic modeling of customer site**
    - Single hole test shots
    - Monitored at critical sites
  - ✓ **Develop alternative timing sequence for each initial shot design**
  - ✓ **Continually update model as blast geometry changes**

QUARRY ACADEMY



Single Hole Seismogram

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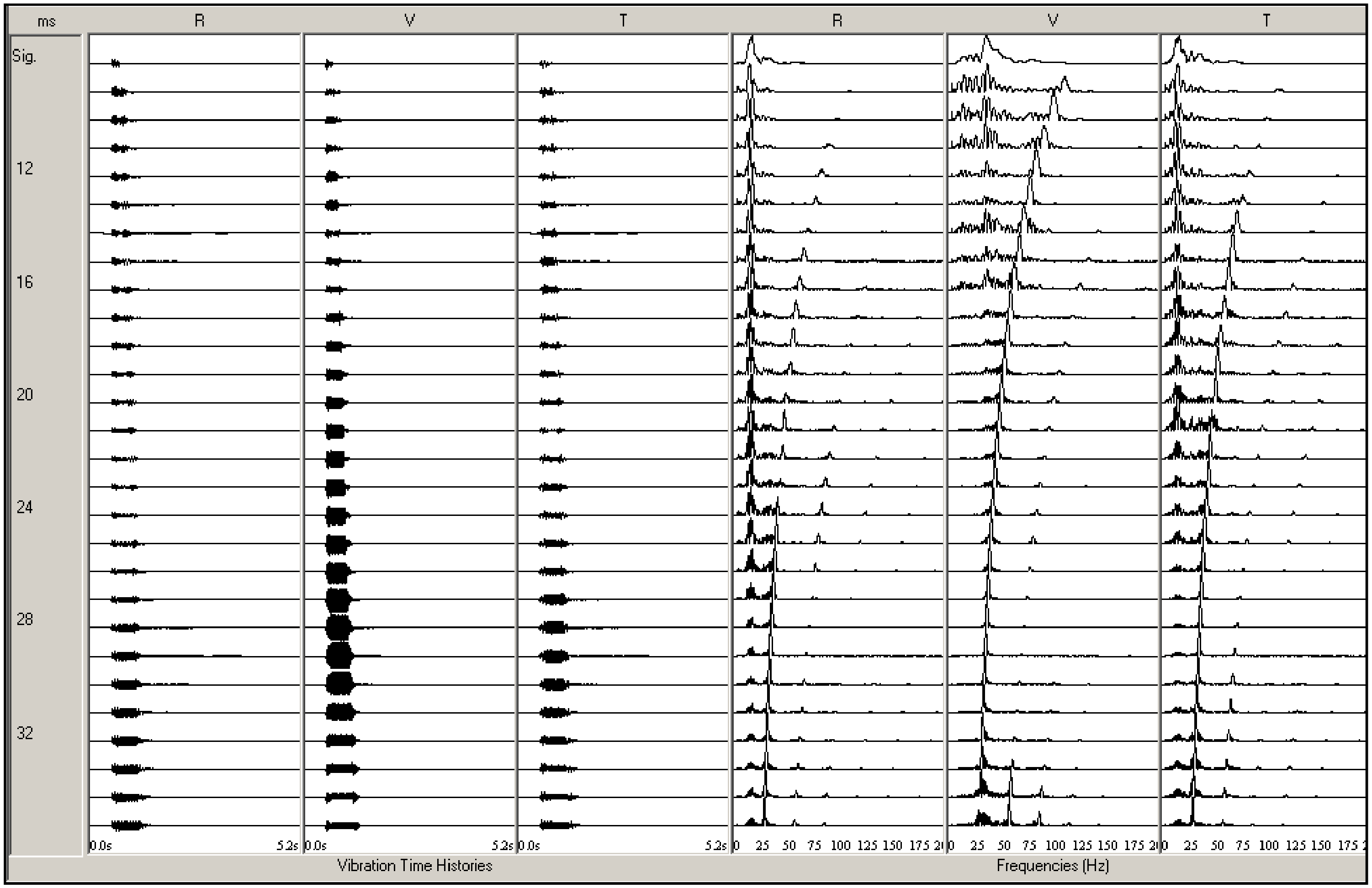

20 hole analysis – 9ms to 35 ms

QUARRY ACADEMY

Fixed Delay Effect
Dyno Nobel
Technical Sales Conference
Orlando Florida

File Name: 45320061220002.dtb
Number: 002
Date: 12/20/2006
Time: 10:01
Serial Number: 453
Seismic Trigger: 0.0300 in/sec
Acoustic Trigger: 142 dB
Sample Rate: 1024
Duration: 4.0 Seconds
Pre-Trigger: 0.50 Seconds
Gain: 2x
Voltage: 6.3

20 Holes

Analysis Range: 9ms to 35ms in steps of 1ms over 20 holes

	Peak Simulated Amplitudes			Dominant Frequencies and High/Low Ratios		
	Radial	Vertical	Transverse	Radial (Ratio)	Vertical (Ratio)	Transverse (Ratio)
Sig.	0.4600	0.5400	0.3650	16.5 Hz (35.76)	34.5 Hz (57.55)	15.1 Hz (15.04)
9ms	0.5031	0.3807	0.5325	14.1 Hz (9.42)	36.0 Hz (14.11)	14.3 Hz (4.83)
10ms	0.4576	0.3649	0.4463	16.9 Hz (11.53)	99.5 Hz (21.22)	12.6 Hz (6.33)
11ms	0.4338	0.4653	0.4388	16.0 Hz (12.63)	34.3 Hz (30.36)	11.4 Hz (7.31)
12ms	0.4321	0.5336	0.4132	14.9 Hz (13.55)	82.8 Hz (35.57)	14.8 Hz (6.92)
13ms	0.3650	0.5486	0.4072	16.9 Hz (13.51)	77.5 Hz (33.32)	12.9 Hz (6.64)
14ms	0.3785	0.4298	0.4784	16.1 Hz (13.94)	71.0 Hz (28.48)	12.6 Hz (8.75)
15ms	0.4033	0.4674	0.4912	15.1 Hz (15.84)	67.0 Hz (36.07)	66.8 Hz (12.39)
16ms	0.4185	0.4929	0.4784	17.0 Hz (18.18)	61.5 Hz (41.68)	62.9 Hz (12.74)
17ms	0.3825	0.7142	0.4006	16.3 Hz (18.22)	58.5 Hz (51.77)	12.9 Hz (10.72)
18ms	0.3358	0.5203	0.3715	15.3 Hz (19.21)	55.8 Hz (53.09)	12.5 Hz (9.90)
19ms	0.2974	0.6348	0.4180	14.6 Hz (18.69)	52.6 Hz (59.24)	52.4 Hz (10.86)
20ms	0.2957	0.7778	0.4062	16.3 Hz (18.82)	49.6 Hz (72.81)	50.5 Hz (11.84)
21ms	0.3060	0.8637	0.3313	15.5 Hz (20.82)	47.3 Hz (98.24)	12.9 Hz (11.88)
22ms	0.3222	0.9690	0.3720	14.9 Hz (20.62)	45.5 Hz (107.71)	45.0 Hz (14.30)
23ms	0.2937	1.0430	0.3848	16.4 Hz (20.83)	43.5 Hz (114.18)	43.8 Hz (15.75)
24ms	0.3077	1.0733	0.4351	15.6 Hz (22.50)	41.6 Hz (124.58)	41.5 Hz (15.93)
25ms	0.3567	1.1473	0.4098	39.9 Hz (27.53)	39.9 Hz (148.38)	39.9 Hz (18.54)
26ms	0.3623	1.2319	0.5439	38.4 Hz (28.55)	38.4 Hz (161.34)	38.3 Hz (21.41)
27ms	0.3793	1.2678	0.6122	36.6 Hz (29.92)	37.0 Hz (156.93)	36.9 Hz (24.30)
28ms	0.4369	1.2565	0.6311	35.4 Hz (34.43)	35.6 Hz (153.64)	35.6 Hz (27.69)
29ms	0.4493	1.3640	0.6071	34.3 Hz (39.04)	34.5 Hz (146.63)	34.5 Hz (28.22)
30ms	0.4771	1.2217	0.5965	33.4 Hz (46.27)	33.5 Hz (160.10)	33.5 Hz (31.80)
31ms	0.5027	0.8991	0.5593	32.3 Hz (48.06)	32.5 Hz (146.38)	32.5 Hz (29.58)
32ms	0.5151	0.7042	0.5369	31.1 Hz (49.01)	31.5 Hz (122.28)	31.3 Hz (25.15)
33ms	0.5074	0.6295	0.5136	30.4 Hz (48.73)	30.6 Hz (107.31)	30.8 Hz (22.50)
34ms	0.5293	0.5400	0.4734	29.5 Hz (48.58)	30.0 Hz (103.18)	29.0 Hz (22.48)
35ms	0.5218	0.5401	0.4854	28.4 Hz (51.31)	57.1 Hz (103.35)	28.4 Hz (25.56)

The High/Low ratio is an arbitrary ratio of the amount of frequency content above 10 hertz to that at and below 10 hertz.
In general, the higher the ratio, the better the frequency content.

QUARRY ACADEMY

Vibration Control

- **Now we have technically-based alternatives**
- **Best fit depends on customer goal**
  - ✓ **Reduce vibration levels for regulatory compliance**
    - Find sequence with lowest predicted ppv
  - ✓ **Minimize community perception of blasting**
    - Find sequences with HZ above 20 on horizontal planes
    - Find sequence with lowest predicted ppv on horizontal planes

QUARRY ACADEMY

Fixed Delay Effect
Dyno Nobel
Technical Sales Conference
Orlando Florida

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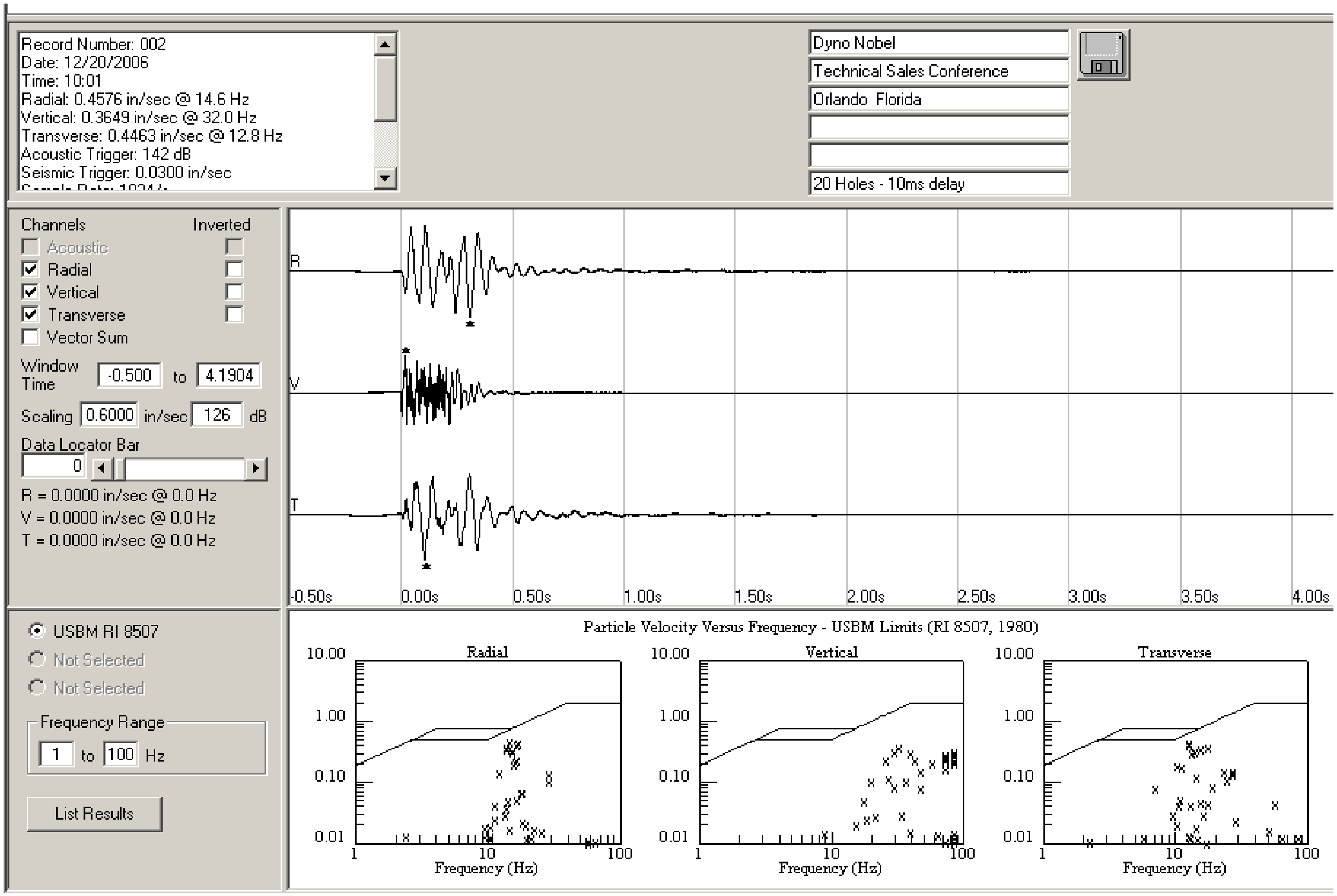

20 Holes – 10 ms Delay

Vibration Control

- What if 10ms is too fast for pattern !!!
- Communicate results with local DNNA staff
  - ✓ Review data
  - ✓ Find delay that provides the best fit within range of acceptable sequences for shot.

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Voltage: 6.3

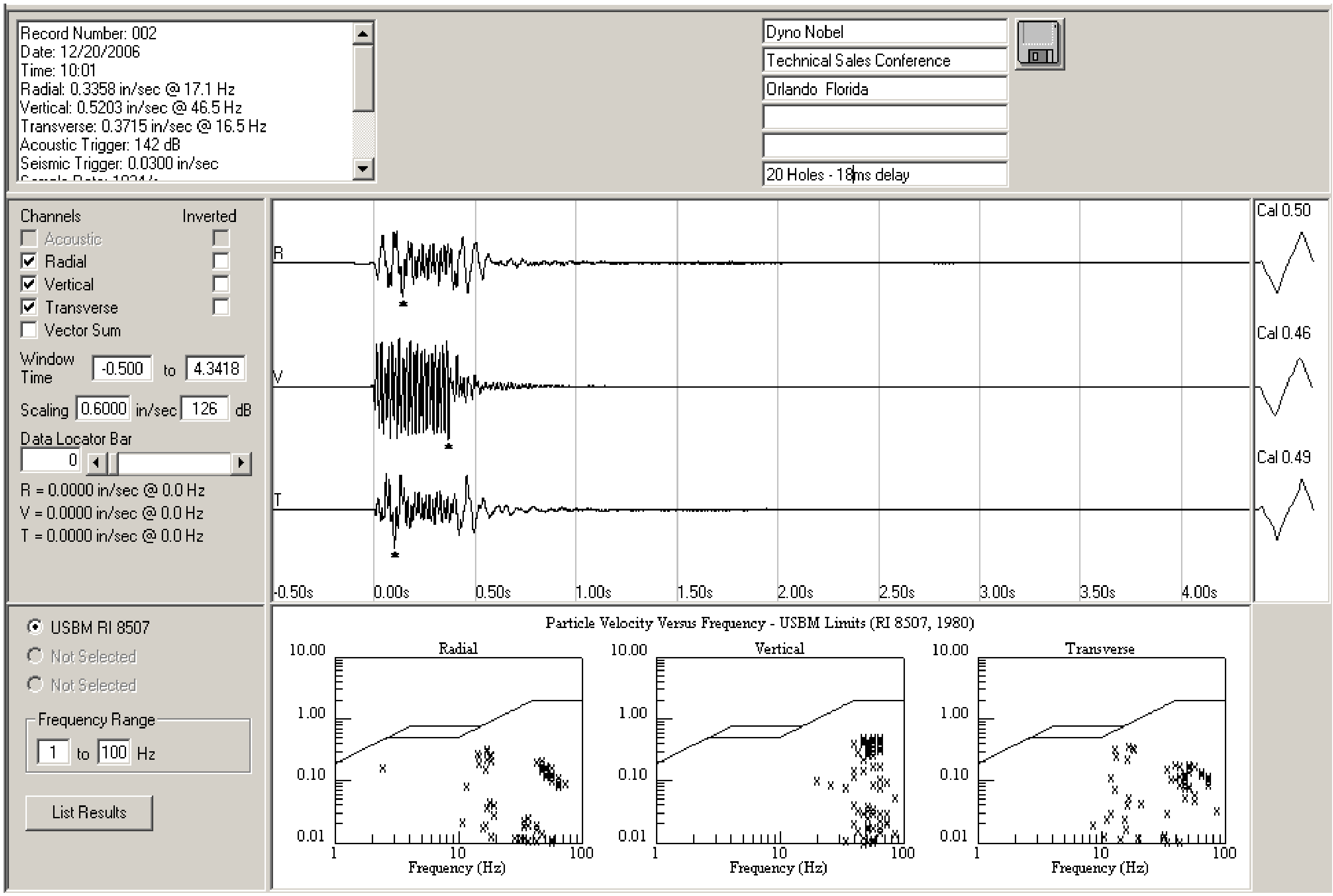
20 Holes

Analysis Range: 9ms to 35ms in steps of 1ms over 20 holes

	Peak Simulated Amplitudes			Dominant Frequencies and High/Low Ratios		
	Radial	Vertical	Transverse	Radial (Ratio)	Vertical (Ratio)	Transverse (Ratio)
Sig.	0.4600	0.5400	0.3650	16.5 Hz (35.76)	34.5 Hz (57.55)	15.1 Hz (15.04)
9ms	0.5031	0.3807	0.5325	14.1 Hz (9.42)	36.0 Hz (14.11)	14.3 Hz (4.83)
10ms	0.4576	0.3649	0.4463	16.9 Hz (11.53)	99.5 Hz (21.22)	12.6 Hz (6.33)
11ms	0.4338	0.4653	0.4388	16.0 Hz (12.63)	34.3 Hz (30.36)	11.4 Hz (7.31)
12ms	0.4321	0.5336	0.4132	14.9 Hz (13.55)	82.8 Hz (35.57)	14.8 Hz (6.92)
13ms	0.3650	0.5486	0.4072	16.9 Hz (13.51)	77.5 Hz (33.32)	12.9 Hz (6.64)
14ms	0.3785	0.4298	0.4784	16.1 Hz (13.94)	71.0 Hz (28.48)	12.6 Hz (8.75)
15ms	0.4033	0.4674	0.4912	15.1 Hz (15.84)	67.0 Hz (36.07)	66.8 Hz (12.39)
16ms	0.4185	0.4929	0.4784	17.0 Hz (18.18)	61.5 Hz (41.68)	62.9 Hz (12.74)
17ms	0.3825	0.7142	0.4006	16.3 Hz (18.22)	58.5 Hz (51.77)	12.9 Hz (10.72)
18ms	0.3358	0.5203	0.3715	15.3 Hz (19.21)	55.8 Hz (53.09)	12.5 Hz (9.90)
19ms	0.2974	0.6348	0.4180	14.6 Hz (18.69)	52.6 Hz (59.24)	52.4 Hz (10.86)
20ms	0.2957	0.7778	0.4062	16.3 Hz (18.82)	49.6 Hz (72.81)	50.5 Hz (11.84)
21ms	0.3060	0.8637	0.3313	15.5 Hz (20.82)	47.3 Hz (98.24)	12.9 Hz (11.88)
22ms	0.3222	0.9690	0.3720	14.9 Hz (20.62)	45.5 Hz (107.71)	45.0 Hz (14.30)
23ms	0.2937	1.0430	0.3848	16.4 Hz (20.83)	43.5 Hz (114.18)	43.8 Hz (15.75)
24ms	0.3077	1.0733	0.4351	15.6 Hz (22.50)	41.6 Hz (124.58)	41.5 Hz (15.93)
25ms	0.3567	1.1473	0.4098	39.9 Hz (27.53)	39.9 Hz (148.38)	39.9 Hz (18.54)
26ms	0.3623	1.2319	0.5439	38.4 Hz (28.55)	38.4 Hz (161.34)	38.3 Hz (21.41)
27ms	0.3793	1.2678	0.6122	36.6 Hz (29.92)	37.0 Hz (156.93)	36.9 Hz (24.30)
28ms	0.4369	1.2565	0.6311	35.4 Hz (34.43)	35.6 Hz (153.64)	35.6 Hz (27.69)
29ms	0.4493	1.3640	0.6071	34.3 Hz (39.04)	34.5 Hz (146.63)	34.5 Hz (28.22)
30ms	0.4771	1.2217	0.5965	33.4 Hz (46.27)	33.5 Hz (160.10)	33.5 Hz (31.80)
31ms	0.5027	0.8991	0.5593	32.3 Hz (48.06)	32.5 Hz (146.38)	32.5 Hz (29.58)
32ms	0.5151	0.7042	0.5369	31.1 Hz (49.01)	31.5 Hz (122.28)	31.3 Hz (25.15)
33ms	0.5074	0.6295	0.5136	30.4 Hz (48.73)	30.6 Hz (107.31)	30.8 Hz (22.50)
34ms	0.5293	0.5400	0.4734	29.5 Hz (48.58)	30.0 Hz (103.18)	29.0 Hz (22.48)
35ms	0.5218	0.5401	0.4854	28.4 Hz (51.31)	57.1 Hz (103.35)	28.4 Hz (25.56)

The High/Low ratio is an arbitrary ratio of the amount of frequency content above 10 hertz to that at and below 10 hertz.
In general, the higher the ratio, the better the frequency content.

QUARRY ACADEMY



20 Holes – 18ms Delay

If perception/frequency is critical…

- Look for sequences predicting Hz > 20
- Prioritize based on lowest predicted ppv on two horizontal planes

QUARRY ACADEMY

Fixed Delay Effect
Dyno Nobel
Technical Sales Conference
Orlando Florida

File Name: 45320061220002.dtb
Number: 002
Date: 12/20/2006
Time: 10:01
Serial Number: 453
Seismic Trigger: 0.0300 in/sec
Acoustic Trigger: 142 dB
Sample Rate: 1024
Duration: 4.0 Seconds
Pre-Trigger: 0.50 Seconds
Gain: 2x
Voltage: 6.3

20 Holes

Analysis Range: 9ms to 35ms in steps of 1ms over 20 holes

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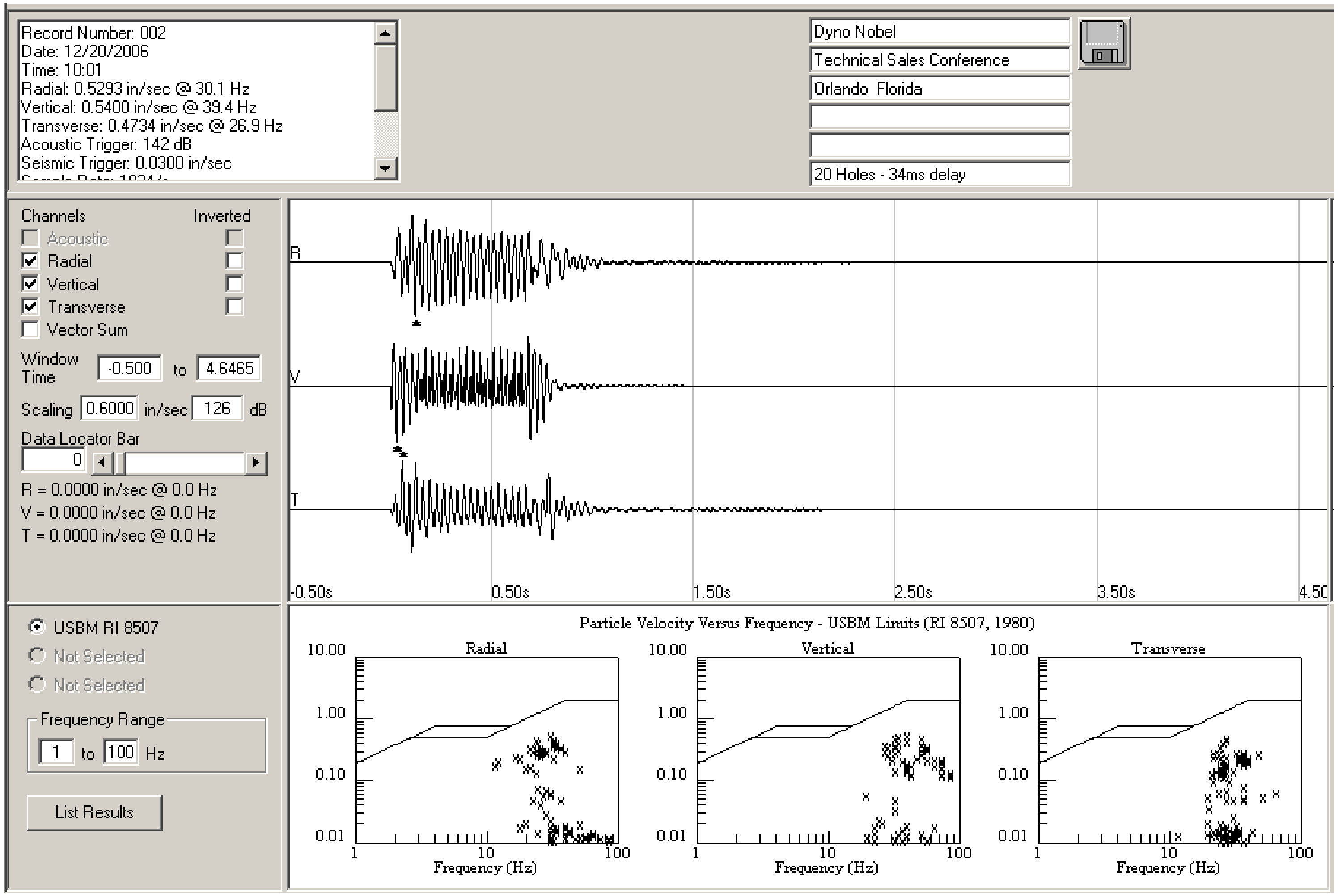

20 Holes – 34ms Delay

QUARRY ACADEMY

Insure Proper Documentation

- **Insure seismic data collection for EVERY shot**
- **Closest non-company owned structure**
  - ✓ **Definition varies by state**
    - Inhabited structure
    - Road, bridge highway or structure
    - Any type of non-company owned building
- **Make sure data is correct**
  - ✓ **Date/Time**
  - ✓ **Location/Distance**
- **Many monitoring systems available**

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GREENLEE

Immediate Response to Community Concerns

- **First Response is critical**
- **Sense of being ignored always creates heightened tension**
- **Follow up often required**
- **All actions must be documented**

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Blast Complaint Response Form

Date ________ Time ________

Complaint Received By ____________________

Complaint Received From ____________________

Address ____________________

Phone Number ____________________

Nature of Complaint ____________________

____

____

____

First Response By ____________________

Date ________ Time ________

Type of Response phone ☐ visit ☐

Summary of Communication ____________________

____

____

Further Actions to be Taken ____________________

____

____

Complaint Closed yes ☐ no ☐

Date ________

QUARRY ACADEMY

Immediate Response to Community Concerns

- **Alternative monitoring methods can provide remediation to complaints**
  - ✓ **Split cable monitoring**
  - ✓ **Long term monitoring**
  - ✓ **Autonomous crack monitoring**
- **Aids in perception of response to community concerns**
- **Adds to documentation of blasting non-effect on structure**

Maintain Communication….

- Proactive approach
- Once complaints begin, reaching a consensus with community becomes difficult
  - ✓ Emotionally charged communication
  - ✓ Lack of trust
  - ✓ All responses will be viewed as means of pacifying community
- Time spent on the front side will always pay benefits

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Maintain Communication….

- Adopt a school
  - ✓ Employee mentoring/tutoring
  - ✓ Sponsor a science room
  - ✓ Assist with athletic field development
- Open door policy with neighbors
- Invite to view blast
- Sponsor Open House

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Putting It All together

- **With increased scrutiny in many communities, just doing it right is not enough.**
- **Liability risks from blasting can be a company killer, shortcuts cannot be tolerated on the bench.**
- **Accuracy in documentation is often the difference in winning lawsuits or deflecting potential litigation.**
- **We can no longer hide behind the berm. A commitment to be active in the community will always pay dividends far beyond the cost of proactive programs.**

Developing a Liability Protection Program

- Know your own risk!!!!
- Know the law
- Use your training
- Ask questions
- Never assume anything!!!

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