COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

COMMENT AND RESPONSE DOCUMENT (FOR PUBLIC COMMENTS)

DRAFT AIR QUALITY PLAN APPROVAL

ADELPHIA GATEWAY, LLC
QUAKERTOWN COMPRESSOR STATION & METERING STATIONS
PLAN APPROVAL NO. 09-0242

April 18, 2019

PUBLIC COMMENTATORS

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25	John Polier	Schukraft Road, Quakertown, PA 18951

[1] Ms. Murphy stated at the public hearing on the draft Air Quality Plan Approval that she would submit written comments to DEP, mostly regarding health and environmental issues, in lieu of providing oral testimony. However, DEP never received any written comments from her.

[2] At the public hearing on the draft Air Quality Plan Approval, Mr. Devan played the opening to "For the Love of Money" by the O'Jays and shouted "Shame, shame, shame!," but did not provide substantive oral testimony.

No.	Name (Title & Organization)	Home and/or E-mail Address(es)
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[3] An hour after the public hearing concluded, Mr. O'Connor sent an e-mail to DEP's resource account stating that: "We were unaware that there was a meeting taking place. To say this would have no effect on our community is an understatement!" On December 7, 2018, Mr. James D. Rebarchak, Air Quality Program Manager, DEP Southeast Region, replied to Mr. O'Connor's e-mail stating that: "I am sorry that you were unaware of our public hearing that was held on Tuesday, Dec. 4. We are still accepting comments on the application for the proposed compressor station until December 14. You can send those comments to me at this email address." However, DEP never received any follow-up comments from him.

[4] On December 5, 2018, Mr. Stranere sent an e-mail to Virginia Cain, Environmental Community Relations Specialist, DEP Southeast Region, stating that: "I attended meeting last night. This was too much for me to copy. I emailed this yesterday....please confirm receipt and make sure and add into the public comments. This is a health/safety study that MUST be added to this file." Attached to the e-mail were a technical report, entitled "Health Effects Associated with Stack Chemical Emissions from NYS Natural Gas Compressor Stations: 2008–2014," and a "Shale Gas & Oil Health Impact Assessment Template for Compressor Station" from the Southwest Pennsylvania Environmental Health Project. DEP acknowledges receipt of the documents and has added them to the public file. However, as Mr. Stranere did not provide

The Department of Environmental Protection (DEP) has prepared these responses to public comments on the draft Air Quality Plan Approval (No. 09-0242) for Adelphia Gateway, LLC[5] (Adelphia) for its proposed Quakertown compressor station and metering stations facility (hereinafter referred to as "the facility").[6]

DEP published notice of the public comment period in the *Pennsylvania Bulletin* on November 3, 2018. Adelphia published notice of the public comment period in *The Intelligencer* on November 9 and 11–12, 2018. DEP held a public hearing on the draft Air Quality Plan Approval on December 4, 2018, at the West Rockhill Elementary School, 1000 Washington Avenue, Sellersville, PA 18960.

DEP appreciates all the comments submitted and the concerns expressed. However, with one justified exception, DEP responses are limited to comments received on or before the close of the public comment period on December 14, 2018.

The comments are organized by topic, with the number(s) in brackets at the end of each topic corresponding to the respective public commentator(s). For certain topics, more specific comments and/or associated condition requests (in periwinkle) are indicated under the topic. In cases where multiple public commentators had either the same or complementary comments, to provide sufficient context for certain comments, or to make certain comments more concise, DEP has listed general comments instead of direct quotes. Responses that reference conditions from the draft Air Quality Plan Approval are consistent with the section designations and condition numbering contained therein.

General Concerns

1. Assurance that the public has a chance to review "plans" for the proposed compressor station [1]

Response: In general, the public is always welcome to contact the Records Management Section of DEP at 484.250.5910 to make an appointment for an informal file review of any non-confidential DEP records, including those associated with the draft Air Quality Plan Approval for the proposed facility. However, due to the substantial public interest concerning the proposed project and Air Quality Plan Approval, DEP created a webpage (accessible at https://www.dep.pa.gov/About/Regional/SoutheastRegion/Community%20Information/Pages/Adelphia-Gateway-.aspx) to house and share materials and updates relating to the project, including links to the Federal Energy Regulatory Commission (FERC) docket and Adelphia project page, and electronic versions of the Air Quality Plan Approval applications, draft Air Quality Plan Approvals, associated technical review memos, and public hearing transcripts for the facility and the Marcus Hook compressor station facility.

2. Assurance that all comments from the public are taken into consideration and responded to [1, 2]

Response: This Comment and Response Document compiles all public comments on the draft Air Quality Plan Approval and contains responses to each topic/comment from DEP.

3. The lack of buffering around the proposed site of the compressor station/the site is too small for the proposed compressor building [1, 3–6, 26, 28–31, 33]

Comment A.: A FERC landowner pamphlet, titled "*An Interstate Natural Gas Facility on My Land? What Do I need to Know?*," says that 10–40 acres are usually purchased by natural gas companies, with about 5 acres being

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any specific comments associating information contained in the documents with potential concerns regarding the draft Air Quality Plan Approval, DEP cannot offer any response relating to the documents.

[5] The application was originally submitted with the company name as "Adelphia Pipeline Company, LLC." However, in its comments on the draft Air Quality Plan Approval, Adelphia indicated that the company name should be revised to "Adelphia Gateway, LLC."

[6] The company comments and DEP responses appear in a separate Comment and Response Document.

used for construction. However, the total area of the site is 1.5 acres, with 0.5 acres being wetlands, 0.5 acres with existing equipment, and only 0.5 acres for new construction.

Comment B.: Adelphia justifies the limited size of the property by noting that existing neighboring structures are located at a distance from the compressor station. However, the property immediately surrounding the small Adelphia property is owned by others and is zoned to allow additional structures. Thus, DEP should evaluate the proposed project based on the proposed site, not any properties owned by others.

Response A.–B.: Except as discussed in DEP's response to Comments E.–F., below, concerns regarding the siting or size of the proposed facility are addressed in FERC's Environmental Assessment (EA) (page 28 [last two paragraphs]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment C.: There is no area around the proposed site to serve as a buffer for noise or to absorb air emissions, such that homeowner properties end up serving as the buffer.

Response C.: There are no Air Quality regulatory requirements that give DEP the authority to determine, or to provide for a buffer around, the physical location of a source(s) of air contaminant emissions on a site. Concerns regarding potential health effects of living near the proposed compressor station and potential odors resulting from blowdowns are addressed in DEP's responses to General Concern 4 (under Comments A.–G. and H.–K./ Condition Request #1, respectively). Concerns regarding noise from the proposed compressor station are addressed in DEP's response to General Concern 6.

Comment D.: Adelphia cannot meet the setback or buffering requirements of the local zoning ordinance (West Rockhill Township) for the proposed compressor station at the site.

Response D.: Concerns regarding siting authority for the proposed facility are addressed in FERC's EA (page 28 [last full sentence]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment E.: "Adelphia should pick a site where they have enough land to implant safety requirements and not be encroaching on other people's property."

Comment F.: Adelphia would not be able to control a fire at the proposed site, and any fire could spread to nearby properties, including a hayfield on an abutting property located only a few feet from proposed compressor building. The proposed site would be too small for emergency vehicles to freely move around the compressor building.

Response E.–F.: Safety concerns regarding the siting of the proposed compressor building and potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18.

4. Effects of living near the proposed compressor station on air quality and the health, safety, and welfare of the community [1, 3–4, 6–8, 10, 12–13, 15–18, 25–26, 28–29, 33]

Comment A.: Many toxic, carcinogenic, and/or neurotoxic chemicals (carbon monoxide [CO], particulate matter [PM], PM less than 2.5 μm in aerodynamic diameter [$PM_{2.5}$], nitrogen oxides [NO_x], sulfur oxides [SO_x], volatile organic compounds [VOCs], benzene, ethylbenzene, formaldehyde, acetaldehyde, acrolein, hydrogen sulfide [H_2S], methane, toluene, xylenes, radon) are emitted from compressor stations.

Comment B.: "[T]his compressor station will be operating 24 hrs a day, 7 days a week, forcing the surrounding community to be exposed to these noxious elements without any respite from them."

Comment C.: People living 50 feet to 2 miles from compressor stations are exposed to chemicals in large amounts.

Comment D.: Children, older people, and those with pre-existing conditions are especially adversely affected (i.e., increased risk of heart disease, lung cancer, asthma attacks, and premature death from particle pollution even when levels of short-term particle pollution met the current national standards).

Comment E.: "It has been noted on record by citizens' groups that thousands of residents throughout Pennsylvania who live within a thousand feet from these types of facilities have experienced many health issues, such as skin rashes, throat and eye irritations, as well as stomach and intestinal problems."

Comment F.: A correlation between proximity to gas facilities and prevalence of health symptoms such as asthma, cancer, high blood pressure, and other respiratory, cardiovascular, kidney, pulmonary, and thyroid conditions.

Comment G.: "[The proposed compressor station] would cause psychological trauma, stress, and depression, as well as ill health effects."

Response A.–G.: There are several other compressor stations located at major facilities within the Southeast Pennsylvania air basin. Citizen complaints to DEP regarding the operation of these facilities have been minimal and sporadic, with none received in the past 2 years. In addition, no health impacts relating to these facilities have been reported to DEP.

While the pollutants specified in Comment A. would be emitted as combustion gases from the proposed compressor engines, engine of the proposed Cummins emergency generator set, and engine of the existing Generac emergency generator set at the site; and/or as fugitive emissions from other compressor station equipment, DEP has determined that the potentials to emit these pollutants from the proposed facility do not exceed any of the major facility thresholds for the Southeast Pennsylvania air basin.

Moreover, as indicated in FERC's EA (pages 111 [last paragraph], 112 [first paragraph], 128–130 [first paragraph], 132 [first full paragraph], and 169 [third full paragraph]), the results of air quality modeling analyses Adelphia performed for the proposed project indicate that the combined total of background and project-related emissions do not cause or contribute to a violation of the National Ambient Air Quality Standards (NAAQS), as incorporated by reference into Pennsylvania's regulations at 25 Pa. Code § 131.2, or result in significant impacts on air quality or human health. [Primary and secondary NAAQS are defined in section 109(b)(1)–(2) of the Clean Air Act (CAA), respectively. The primary NAAQS is designed to protect public health and includes consideration of sensitive populations. The secondary NAAQS is designed to protect public welfare, including "effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate."]

DEP's authority is limited to ensuring that companies comply with all applicable federal and state regulations and requirements for proposed or actual sources of air contaminant emissions. Anything beyond this, including the siting or size of a facility, as previously stated in DEP's response to General Concern 3 (under Comments A.–B.), is beyond DEP's Air Quality purview.

Comment H.: Nearby residents will not be able to keep their windows open during blowdowns.

Comment I.: Residents are "afraid to put their children—what if they're asleep at night and a gas emission goes off or a pipe erupts, nobody knows, and they're breathing that stuff in."

Comment J.: Residents will be "living in the resulting stink of the toxins from blow-offs and any accidents."

Comment K.: "What will this operation do to the health, safety, and welfare of our community and who will be responsible for those issues that may arise from our lack of air quality or the effects of what this may cause?"

Condition Request #1: West Rockhill Township requests that the Air Quality Plan Approval include future accountability to township residents so that there is recourse when the operation of the compressor station adversely affects their health, safety, and welfare.

Response H.–K./Condition Request #1: Concerns regarding potential odors resulting from blowdowns are addressed in the Air Quality Plan Approval application (page 9 [section 3.3.4]), and Conditions # 013 and 016, Section C, of the draft Air Quality Plan Approval. These conditions require Adelphia to monitor the facility for objectionable odors and address any deviations from the requirements of 25 Pa. Code § 123.31 (i.e., malodors are

detectable outside of Adelphia's property), respectively, and have appropriate corrective action(s) taken to abate the situation and prevent future occurrences.

Concerns regarding the air quality and health effects of blowdowns are addressed in FERC's EA (pages 127 [first full paragraph] and 130 [second paragraph]). On a related note, on April 11, 2019, Adelphia sent an e-mail to DEP indicating that the natural gas volumes and corresponding emissions estimates for blowdowns, as specified in the Air Quality Plan Approval application (Table B-5), are conservative, with "[s]ome of the events, such as an ESD [emergency shutdown], ... expected to occur at most once a year and more likely once every few years." Additionally, in the same e-mail, Adelphia has confirmed that it will "implement recycling of the blowdown volumes where possible such as recycling the gas into fuel gas. However, there are innumerable operational scenarios in which this recycling will not be possible; a primary example of which would be if the compressor engines are not running." [Note: See DEP's response to General Concern 29 for further discussion on the recycling of blowdowns.]

Safety concerns regarding the siting of the proposed compressor building and potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18. In addition, concerns regarding pipeline integrity for the proposed project are addressed in DEP's response to General Concern 21. While any adverse events occurring at/effects resulting from the compressor station would ostensibly be Adelphia's responsibility, placing the requested condition in the Air Quality Plan Approval is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Therefore, the Air Quality Plan Approval will not include the requested condition.

5. No emergency response plan (and associated training program) developed, reviewed, or discussed with the community (by Adelphia, FERC, or DEP) [1, 4, 10, 27–28, 30]

Comment A.: "What would be the staffing? What would constitute an emergency? How would residents be informed? What are specific remedies if there is an emergency?"

Comment B.: No residents have been educated on emergency procedures, hazard mitigation programs, or provided educational information should an "EVENT" occur near their properties.

Condition Request #2: West Rockhill Township contends that the Air Quality Plan Approval should require that Adelphia meet with and address the concerns of the emergency service providers, such as local fire companies, so that the issues of those organizations may be addressed.

Work Practice Request #1: Springfield Township strongly urges DEP to mandate that Adelphia have a comprehensive, well-articulated, and thorough emergency management plan to serve it and other municipalities that the pipeline traverses.

Work Practice Request #2: Springfield Township strongly urges DEP to require that Adelphia provide yearly emergency training to local emergency responders, so they are well prepared in case of an "event."

Response: This concern is addressed in FERC's EA (pages 105 [last full paragraph] and 147–148 [Section B.9.6]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Therefore, the Air Quality Plan Approval will not include the requested condition or work practices.

The above notwithstanding, at DEP's request, on February 19, 2019, Adelphia sent an e-mail to DEP with records of its outreach regarding the proposed project to agencies, public officials, and affected stakeholders (see *Attachments #1a–1d*). This outreach included a meeting with representatives of West Rockhill Township and local emergency services personnel on December 17, 2018, to discuss emergency plans.

6. Noise and vibrations from the proposed compressor station [1, 5–7, 11, 13, 16, 18, 24–25, 28, 33]

Comment A.: Will result in continuous disturbance to surrounding properties

Comment B.: How will noise be monitored and controlled?

Comment C.: Houses may be within the 55 dB level, but not the properties themselves.

Comment D.: Compressors will run at a higher sound level than 60 dB day/55 dB night.

Comment E.: What will the peak decibel level will be, and how long will it last?

Comment F.: The compressor station imposes on residents' "quiet, country lifestyle."

Comment G.: "I enjoy the birds, the deer, the rabbits, and the other wildlife, and they will disappear from this noise."

Comment H.: The aforementioned FERC landowner pamphlet says that the vibrations are "similar to what happens when noise from a speaker causes the floor to shake or when a helicopter flying overhead causes the windows to rattle."

Comment I.: "[T]o the Adelphia employees, would you be willing to play outside with your kids while there's a constant 'dishwasher' sound going on? … [W]ould you want to wake up in the middle of night to what people compare to a jet engine taking off?"

Comment J.: "[I]f there's going to be vibrations constantly, is that really 55 decibels?"

Condition Request #3: West Rockhill Township requests that the Air Quality Plan Approval include a condition requiring that noise and vibration from the compressor station be attenuated so that the peaceful enjoyment of the neighbors' property is not adversely affected.

Response: This concern is addressed in FERC's EA (pages 92, 111 [last sentence]–112 [first paragraph], 133 [last sentence]–134 [first paragraph and second full paragraph], 137 [second and third paragraphs], 139–140 [first paragraph], 141 [last two paragraphs]–142 [first paragraph], 173 [first paragraph], and 201 [mitigation measure 25]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Therefore, the Air Quality Plan Approval will not include the requested condition.

7. Soil/well water/waterways and wetlands contamination resulting from the proposed project [1, 5, 12–13, 15, 17, 24, 27, 32]

Comment A.: "[Pollutants] will go out and settle on his soil, then eventually into his private well. Adelphia is not even obligated to come over and test his water well. We ask the DEP, should Adelphia have enough acres of land around this facility to prevent this? And, are the regulations going to be put into place by the DEP to monitor this?"

Comment B.: "Farmers … have enough to compete with now we need to worry about the effects of these emissions and long term effects to our soil."

Comment C.: "[W]e are concerned about the concentration of emission that will build up over time in our wells, ground which has a lot of clay, that will be tilled for our crops and feed to our livestock. … Can you guarantee our safety now and the future of our families from these toxin (*sic*) accumulating over time? How will [DEP] hold this company accountable for monitoring these levels that are claimed to be safe under 'normal conditions'? What effects will this have on our livestock and crops[?]"

Comment D.: "Our well is not more than 100 feet deep. … What about how many times it's going to fall into my ground and it's going to rain and over time the concentration of those emissions are going to go in my well."

Comment E.: "Wetlands should be … protected … at all costs because that affects our drinking water, everything, wells. And if these toxins come out of this plant and they go into soil and then they kind of, like, go into the water and then where does that water go? Well, it's going to flow downwards. And it's going to flow down into West Rockhill and pollute all these wonderful streams."

Response A.–E.: As discussed in DEP's response to General Concern 4 (under Comments A.–G.), DEP has determined that the potentials to emit any pollutants from the proposed facility would not exceed any of the major facility thresholds for the Southeast Pennsylvania air basin, cause or contribute to a violation of the NAAQS, or

result in significant impacts on air quality. Thus, DEP has determined that no pollutants would be emitted into the air in sufficient quantities to pose an atmospheric deposition concern.

Concerns regarding the impact of construction activities at the proposed site on nearby drinking water wells and wetlands are addressed in FERC's EA (pages 56 [first full paragraph] and 165–166 [section B.10.4]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment F.: The historic installation of pipelines in Pennsylvania and Ohio caused 800 violations, and Energy Transfer Partners was fined $15 million by Ohio EPA for spilling over 2 million gallons of drilling fluids into wetlands and ruining them.

Response A.–E.: No natural gas drilling or hydraulic fracturing will occur as part of the proposed project. Concerns regarding the impact of construction activities on wetlands at/adjacent to the proposed site are addressed in FERC's EA (pages 22 [last full paragraph] and 62–67 [section B.2.3], and Appendix C), and are beyond the scope of the Air Quality Plan Approval.

Comment G.: "How will wetlands and the Cook's Creek exceptional value watershed be protected when doing vegetation maintenance ([i.e., with] 2-4D, Round-Up, and other herbicide use)?"

Response G.: Concerns regarding herbicide use are addressed in FERC's EA (pages 71 [last sentence]–72 [first full sentence]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

8. The proposed compressor station threatens the community, its way of life, and residents' enjoyment of property [1, 6–7, 10, 12–13, 15, 17]

Comment A.: "[The proposed compressor station] would cause psychological trauma, stress, and depression."

Comment B.: "[H]ow are we going to control [noise] and give these people the quality of life they deserve? They bought property out here because they're in the country. They didn't buy property out here so they could have a 50-foot building next to them."

Comment C.: "[Adelphia's] going to make a ton of money on this, and it shouldn't be to our expense of our way of life."

Comment D.: "[T]he thought of this [compressor station] going in makes me want to cry. [W]e care about this township. It's a wonderful township, and [Adelphia is] really invading a very beautiful space."

Comment E.: "I've lived in this area my entire life. I was born and raised here with the clean land, the clean water. … [T]here's going to be many toxic chemicals emitted by [the compressor station] that threaten our way of life and threaten our health."

Comment F.: "I lived in my home for 55 years or more. I like the freedom to live a lifestyle of my choosing. We live in a democracy, not a dictatorship. It seems like Adelphia wants to come in and dictate how I have to live."

Comment G.: "We bought this farm to have a better life for our children, so they can play outside, learn what it's like to work hard, and enjoy the benefits of this community."

Comment H.: "[My] dad designed the house, built it, had it brought up and everything. We built a barn on our property. We're building an addition. We built this on our property because we want to live on this property forever."

Comment I.: "My family has lived in this house for six generations! We do not want to be forced to move. This is our home."

Response: As stated in DEP's response to General Concern 4 (under Comments A.–G.), "DEP's authority is limited to ensuring that companies comply with all applicable federal and state regulations and requirements for proposed or actual sources of air contaminant emissions." DEP would like to emphasize that, as discussed in

DEP's responses to General Concerns 4 (under Comments A.–G.) and 7 (under Comments A.–E.), it has determined that the emissions from the project do not result in significant impacts on air, soil, or water quality.

In addition, concerns regarding noise and visual impacts from the proposed compressor station are discussed in DEP's responses to General Concerns 6 and 17, respectively.

9. The information forwarded by Adelphia provides little information on the equipment that the proposed compressor station will be comprised of, where it will be located, and what it does [2]

Response: This concern is addressed in Adelphia's applications for Certificate of Public Convenience and Necessity (Certificate) to FERC and Air Quality Plan Approval to DEP, both of which are accessible through DEP's webpage for the proposed project specified in DEP's response to General Concern 1.

10. Adelphia will ignore the local community and will not comply with local laws and ordinances/Adelphia must respect local ordinances and respect and preserve local values [2, 29]

Response: This concern is addressed in FERC's EA (pages 28 [last paragraph] and 134 [second full paragraph]) and DEP's response to General Concern 8 (under Comments A.–I.).

11. Adelphia refuses to engage in dialogue with residents/residents do not trust Adelphia and want better communication and honesty with intentions for the proposed project [2–3, 8, 13, 17–18, 25, 28–29, 32]

Comment A.: Some residents only found out about the proposed project a few months (or even weeks) before the public hearing and/or from neighbors or a website opposing the project.

Response A.: Concerns regarding residents not receiving notice of Adelphia's application for Certificate for the proposed project are partially addressed in FERC's EA (page 26 [last paragraph]: "with few exceptions, the mailing list was comprehensive and included contacts for parcels within 0.5 mile of the [Quakertown] compressor station.").

Regarding the Air Quality Plan Approval application, DEP published notice of the public comment period in the *Pennsylvania Bulletin,* as indicated in the second paragraph on page 4 of this Comment and Response document. These are the minimum notification requirements for Adelphia's applications for Certificate and Air Quality Plan Approval pursuant to 18 C.F.R. § 157.203(d)(1)–(2) and 25 Pa. Code § 127.44(a), respectively.

However, due to the substantial public interest in the proposed project:

- Adelphia published notice of the public comment period in *The Intelligencer*, pursuant to 25 Pa. Code § 127.44(b)(5).
- DEP held a public hearing on the draft Air Quality Plan Approval, as indicated in the second paragraph on page 4 of this Comment and Response document.
- DEP created a webpage to house and share materials and updates relating to the proposed project, as indicated in DEP's response to General Concern 1.

In addition, as indicated in DEP's response to General Concern 5, Adelphia performed outreach regarding the proposed project to agencies, public officials, and affected stakeholders. While DEP cannot speak to the level of detail in its notifications to the public, DEP does not have a concern that Adelphia at least provided sufficient notification of the proposed project itself.

Comment B.: Adelphia is not being transparent about their potential end use customers, with concern that the proposed project is not intended to serve local or even domestic energy needs.

Response B.: Concerns regarding the purpose of the proposed project are addressed in FERC's EA (pages 2 [section A.2] and 178 [first paragraph]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment C.: "Adelphia was very sneaky in how it informed the community about what was going to be happening here."

Comment D.: "From the beginning we feel Adelphia has not been very transparent about this compressor station from the way we were notified to the way they acted and what little they shared with our zoning committee."

Comment E.: "I also find it a little ironic that Adelphia isn't really here today to show what their plans are."

Comment F.: Other than an initial planning commission meeting in March 2018 (with no plan available prior to the meeting), Adelphia has refused to meet with residents, other than on a one-to-one basis. Repeated requests for a public meeting have been denied.

Condition Request #4: West Rockhill Township requests that the Air Quality Plan Approval include a condition requiring Adelphia to attend public meetings, either at the local planning commission or governing body, to hear and respond to the concerns of the neighboring property owners

Response C.–F./Condition Request #4: Outside of what is indicated in DEP's response to Comment A., above, concerns regarding Adelphia's level of communication with residents are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Therefore, the Air Quality Plan Approval will not include the requested condition.

12. Periodic air quality monitoring for the proposed compressor station and pipeline [3, 27–28]

Comment A: "How often are you going to test the air quality and provide reports once this [proposed compressor] building is built and if it is built?"

Comment B: Increasing the frequency of testing and monitoring of the gas in the pipeline and that being processed by the compressor, especially during construction and the first year after the facility becomes 100% operational

Condition Request #5: Springfield Township strongly urges DEP to require Adelphia to perform close and regular monitoring of the air quality along and near impact zones of the pipeline. [27]

Response: As a point of clarification, DEP has interpreted the comment to mean: **"How often will DEP require Adelphia to test the air quality and provide reports…?"**, as the facility owners generally bear the cost associated with source testing of affected sources.

DEP included various **periodic stack testing and monitoring requirements** for the proposed facility in the draft Air Quality Plan Approval, as discussed below.

Because the proposed compressor engines and engine of the proposed Cummins emergency generator set are non-certified engines, pursuant to the provisions of 40 C.F.R. Part 60, Subpart JJJJ, and as incorporated from the best available technology (BAT) requirements of DEP's General Plan Approval and/or General Operating Permit BAQ-GPA/GP-5 (GP-5), Adelphia is required to perform **stack tests for the engines within 180 days after commencement of operation, and every 3 years or 8,760 hours of total operating time thereafter (whichever comes first)**. Adelphia is also required to submit a complete test report, including the results and all operating conditions, for each stack test to DEP within 60 days after the respective stack test. These requirements are specified in Condition # 006, Section E (under the Compressor Engine & Oxidation Catalyst source group), of the draft Air Quality Plan Approval, and Condition # 003, Section D (under Source ID 600), of the draft Air Quality Plan Approval, respectively.

In addition, as incorporated from the BAT requirements of DEP's GP-5, Adelphia is required to perform **periodic monitoring for the proposed compressor engines, using a portable gas analyzer, every 2,500 hours of total operating time**. Adelphia is also required to maintain records of the results of all periodic monitoring. These requirements are specified/indicated in Conditions # 007 and 012, Section E (under the Compressor Engine & Oxidation Catalyst source group), of the draft Air Quality Plan Approval, respectively.

The results of the stack testing and periodic monitoring are to demonstrate compliance with the applicable pollutant emission restrictions for the proposed compressor engines and engine of the proposed Cummins emergency generator set indicated in Condition # 001, Sections E (under the Compressor Engine & Oxidation Catalyst source group) and D (under Source ID 600), of the draft Air Quality Plan Approval, respectively. If the results of the stack testing or periodic monitoring do not demonstrate compliance with the applicable emission restrictions for any of the proposed engines, then Adelphia is required to implement measures to reduce the air contaminant emissions to within the restrictions and perform another stack test for the affected engine(s).

Regarding leak detection and repair (LDAR) requirements **for fugitive emissions components**, as incorporated from the BAT requirements of DEP's GP-5, Adelphia is required to conduct **audible, visual, and olfactory (AVO) inspections within 30 days after commencement of operation, and at least monthly thereafter**. Also, pursuant to the provisions of 40 C.F.R. Part 60, Subpart OOOOa, and as incorporated from the BAT requirements of DEP's GP-5, Adelphia is required to conduct **monitoring surveys within 60 days after commencement of operation, and quarterly thereafter**, as well as attempt and complete repairs of any leaks. These requirements are indicated/ specified in Conditions # 008–010, Section D (under Source ID 400), of the draft Air Quality Plan Approval, respectively.

Finally, pursuant to Condition # 011, Section C, of the draft Air Quality Plan Approval, DEP may require additional testing if it "has cause to believe that air contaminant emissions from any source(s) listed in [the] plan approval may be in excess of [any applicable] restrictions."

13. The potential decrease in property values due to the proposed compressor station [3, 10, 26, 33]

Comment A.: "What part does Adelphia share in the decrease in property values of the surrounding properties when no one wants to buy a house or the property owners that, currently, under our current zoning, can subdivide and sell houses, will not be able to do this once this—if this [proposed compressor station] building gets built?"

Comment B.: "These people own this land. It has a value emotionally as well as financially and you're destroying all of that."

Comment C.: "The noise and pollution caused by the compressor station, as well as the station's size and unsightliness, will diminish the quality of life for nearby residents and depress the value of their properties. FERC says property owners must be compensated by Adelphia Gateway for easements that the company takes on their land. We believe these property owners should be compensated for the loss of property value as well."

Response: This concern is addressed in FERC's EA (pages 106–107 [section B.6.5]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. In addition, regarding Comment A., the aforementioned FERC landowner pamphlet states that, "[i]f you own property adjacent to the site, you may build on it."

14. A 220-home development proposed on nearby site should also be considered, especially since it was proposed prior to the compressor station [3, 28, 31, 33]

Response: This concern is addressed in FERC's EA (page 92 [last full paragraph]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

15. Residents and the community never received communication regarding alternative sites recommended by FERC, and these alternative sites were turned down by Adelphia [4]

Response: This concern is addressed in FERC's EA (page 183 [second half of first paragraph–second paragraph]) and, as previously stated in DEP's response to General Concern 3, is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. [Note: Discussion of alternative sites proposed by Adelphia are addressed in DEP's response to General Concern 30. Discussion of layout alternatives for the proposed site are addressed in FERC's EA (page 186 [section B.6.2]).]

16. Pigging operations at the proposed compressor station/methane emissions from the compressor station and natural gas production [4–5, 9–10]

Comment A.: Possibly 200 *tons/yr* of methane could be emitted from pigging operations.

Response A.: In the draft Air Quality Plan Approval, DEP incorporated the emission restrictions for pigging operations (below which no additional emission control device is required to be installed) from its GP-5. However, in the Air Quality Plan Approval application (Tables B-5, B-8, and B-10), Adelphia had estimated the combined methane emissions from the pigging operations for the proposed compression station, and proposed and existing metering stations, respectively, to be 3.18 *tons/yr*. Moreover, on January 25, 2019, Adelphia sent an e-mail to DEP stating that "[t]he finalized design does not call for additional pigging at the meter station[s]," such that the total methane emissions from the pigging operations would be those from the proposed compression station (0.33 *tons/yr*). To allay the appearance of the methane emissions from pigging operations approaching 200 *tons/yr*, DEP has removed the methane emission restriction, as incorporated from DEP's GP-5, from the Air Quality Plan Approval. In its place, DEP has added a work practice requirement to the Air Quality Plan Approval limiting the number of pigging operations at the facility to three per year, which will ensure that the total methane emissions from pigging operations are less than 1 *ton/yr*.

Comment B.: "According to Adelphia['s Plan Approval] application, they would do this process [pigging] once a year, yet they will conduct the pipeline [integrity] inspections only once every 5–7 years."

Response B.: Concerns regarding the frequency of pigging operations and pipeline integrity are addressed in DEP's response to General Concern 21.

Comment C.: "Given the urgency of addressing climate change concerns highlighted by the recent Intergovernmental Panel on Climate Change report at the Fourth National Climate Assessment, all efforts should be made to reduce methane emissions associated with gas-powered compressor stations."

Comment D.: "Natural gas production results in an increase in emissions of methane, which has been identified by the EPA as the second-most prevalent greenhouse gas (GHG) emitted in U.S. from human activity."

Response C.–D.: This concern is addressed in FERC's EA (pages 119 [first full paragraph], 122 [first full paragraph], 127 [last paragraph], 132 [first paragraph and second full paragraph], and 171 [last two paragraphs]–172 [first paragraph]).

17. The proposed compressor building would dwarf the neighboring residences and be an eyesore [4, 10, 28, 33]

Comment A.: A depiction of the proposed compressor building provided by Adelphia looks "like a large Target store," and "they thought this was really nice because they painted it barn red, okay, so it would fit in with our barn."

Comment B.: The proposed compressor building "will also provide an unsightly backdrop to a residential community which has several historical home sites in the immediate vicinity of the proposed compressor station."

Comment C.: Buffering vegetation would be needed to obscure the proposed compressor building.

Comment D.: West Rockhill Township appreciates Adelphia's revision to the compressor station plans to limit the height of the proposed compressor building to 35 feet, the maximum height allowed in the local zoning ordinance.

Response: This concern is addressed in FERC's EA (pages 92, 100 [third and fourth full paragraphs], 101 [first paragraph], 167 [first full paragraph], and 200 [mitigation measure 22]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

18. The project and proposed compressor station is dangerous [4–6, 11, 13, 15, 26, 30]

Comment A.: The facility will be dangerous due to the size of the site, its proximity to other residents, Adelphia's inability to control fire at the site, and Rich Hill Road between Rt. 309 and Whaland Road being unlined and not ideal for emergency vehicles.

Comment B.: "I always thought when I read about [the] Bhopal [methyl isocyanate gas leak incident], … well, thank God I don't live in India, because things like that don't happen here in America. We take safety precautions. We don't ask people to live next door to these industrial, terrible sites."

Response A.–B.: Safety concerns regarding the proposed compressor station, including the siting of the compressor building, are addressed in FERC's EA (pages 144–145 [section B.9.3] and 147 [section B.9.5]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment C.: Residents should be made aware of the potential dangers of the project, including possible leaks or explosions, and given the proper emergency procedure in the case of such events.

Comment D.: "This is too close to home that if this thing [proposed compressor station] would ever have a catastrophe, we'd be in trouble."

Comment E.: "Putting this Natural Gas Compressor Station here is like putting a dirty time bomb in my community, and environment. The significant number of people, and animals who will get sick, and die as a result of Adelphia's Compressor Station makes Adelphia no better than a mass murdurer (*sic*)."

Response C.–E.: Safety concerns regarding the potential for accidents/emergencies at the proposed facility/site are addressed in FERC's EA (pages 142 [first full paragraph], 144–145 [section B.9.3, first paragraph], and 147–152 [sections B.9.6–B.9.8]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Concerns regarding the potential health effects of living near the proposed compressor station are addressed in DEP's responses to General Concern 4.

19. Want environmental impact statement (EIS) prepared for the proposed project instead of EA [4, 12–13, 27, 31]

Comment A.: An EIS should be prepared before any approvals are extended or work is started.

Comment B.: The EIS should be based on facts and hard data, not guesses or estimates.

Comment C.: DEP or a neutral third party should prepare the EIS.

Comment D.: "DEP needs to demand an extensive, thorough and unbiased 3rd party [EIS] of the entire Pipeline route (as pertaining to GAS transportation). When this pipeline was built in [the] 1970's -documents indicate the Interstate Energy [Company]'s [(IEC's)] 'PACE report' was actually used to format the Delaware River Basin Commission [(DRBC)] revisions to include pipeline in their Comprehensive plan. Was there a second study done at that time- since Intestate's (*sic*) would most likely be biased and may have (conveniently) left out some important facts and remediations?"

Work Practice Request #3: Springfield Township strongly urges DEP to mandate an extensive, thorough, and unbiased third-party EIS of the entire pipeline route (pertaining to gas transportation rather than oil), or at least through the Cooks Creek Watershed and karst-prone areas in Springfield Township.

Response: This concern is addressed in FERC's EA (pages 28 [last paragraph]–29 [first paragraph]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Therefore, the Air Quality Plan Approval will not include the requested work practice.

20. Proposed site is in a residential and historic area [5–7, 11, 16, 29, 31]

Comment A.: The proposed site is zoned RC (residential conservation [designated by West Rockhill Township as ecosystems and habitats deserving special consideration to remain pristine environments capable supporting rare and threatened species]), not industrial, so the proposed compressor station should not be allowed there.

Comment B.: "Although it may seem rural, it is most definitely a residential area where people are looking to live and raise families without the concern of putting their families at risk."

Comment C.: "I have a great concern that Adelphia is choosing a very unconservative, non-best practice design of their compressor station in a residential conservation neighborhood as opposed to an industrial complex, where there is more acreage and buffers, and addresses for safety."

Response A.–C.: Concerns regarding siting authority for the proposed facility/site are addressed in DEP's response to General Concern 3 (under Comment D.).

Comment D.: The area around the proposed site has historic farmhouses and John Fries' house.

Response D.: Concerns regarding cultural resources in the vicinity of the proposed facility are addressed in FERC's EA (pages 112 [last paragraph]–114 [fifth paragraph]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

21. Pipeline integrity [5–6, 9, 11, 14, 25, 27, 30]

Comment A.: The pipeline is 45+ years old (from the 1970s).

Comment B.: The pipeline had crude oil going through it, which is very abrasive, and will now be re-purposed for natural gas.

Comment C.: The pressure in the pipeline will be increased significantly with natural gas, and the pipes have not been readied for high-pressure natural gas.

Comment D.: Having pipeline integrity inspections performed only once every 5–7 years is unacceptable. Pipeline integrity inspections should take place more frequently than this, especially since the pipeline is located adjacent to an active quarry. "What happens in between the inspections?"

Response: Concerns regarding pipeline integrity for the proposed project are addressed in FERC's EA (pages 142–144 [sections B.9.1–B.9.2], 144–145 [section B.9.3, first paragraph], and 145–147 [section B.9.4]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

22. Gas leaks/explosions [6, 9, 15]

Comment A.: Not being able to smell a gas leak from the proposed facility.

Response A.: Concerns regarding not being able to smell a gas leak are addressed in the Air Quality Plan Approval application (page 9 [section 3.3.4]: "[t]he gas in the pipeline will be odorized").

Comment B.: Natural gas from blowdowns traveling to nearby Rt. 309 and igniting.

Response B.: Concerns regarding natural gas traveling a distance and igniting are addressed in FERC's EA (page 142 [second full paragraph]: "[m]ethane is buoyant at atmospheric temperatures and disperses upward rapidly in air").

Comment C.: What is the blast area for the pipeline?

Comment D.: "This is too close to home that if this thing [proposed compressor station] would ever have a catastrophe, we'd be in trouble."

Comment E.: "It is very common for these compressor stations to leak, and explode causing catastrophic effects. These stations are unreliable and fail frequently according to studies of already existing Natural Gas Compressor stations. These failures, and explosions could also lead to forest Fires that could wipe out all of the residential neihborhoods (*sic*), forests, and historic farms."

Response C.–E.: Safety concerns regarding the potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18.

23. Adelphia needs to find an alternative, safer site for the proposed compressor station [6, 12–13, 30–31]

Comment A.: "[L]et's face the reality at this specific location, there is not enough land to build a facility that requires much more land for buffering and emergency access. Please review the land along the pipeline and select a location that is suitable to build this gas compression station."

Comment B.: "The proposed location defies logic and common sense especially when other sites were available to Adelphia and [FERC] … in less sensitive environmental and residential areas."

Comment C.: "Why can't this compressor station be placed in a location that is more safe? Other locations were turned down—WHY?"

Response: This concern is addressed in DEP's response to General Concern 15.

24. Effect of compressor station construction/operation on roads [6, 33]

Comment A.: Additional access roads or driveways needing to be built or widened for the proposed compressor station.

Response A.: Concerns regarding access roads are addressed in FERC's EA (pages 11–14 [section A.5.4], 74 and 76 [second full paragraphs], and 101 [last paragraph]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment B.: "The increased traffic caused by the compressor station will create safety risks for school buses from the Quakertown and Pennridge school districts, both of which use Rich Hill Road."

Response B.: Concerns regarding safety and traffic impacts from construction activities on school buses using Rich Hill Road are addressed in FERC's EA (pages 104 [last paragraph]–105 [first paragraph]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment C.: Rich Hill Road is unlined and not ideal for emergency vehicles or wide enough for compressor station maintenance vehicles.

Response C.: Safety concerns regarding the siting of the proposed compressor building and potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18. While beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval, since the access road for the site is not proposed to be modified as part of the project (see page 12 [Table A-4] of FERC's EA), DEP presumes that Rich Hill Road is able to accommodate the compressor station maintenance vehicles.

25. "The downstream [GHG] and climate change impacts of the proposed Adelphia Gateway pipeline must not compromise the integrity of our breathable air, and the true costs of the carbon impact should be thoroughly evaluated and integrated into any cost/benefit analysis of this proposed project." [8]

Response: This concern is addressed in FERC's EA (pages 119 [first full paragraph], 132 [last paragraph], 155 [last paragraph]–156 [first paragraph], and 169–172 [section B.10.10]).

26. The proposed project will pose catastrophic risks, but provide little or no benefit, to the community/not in the public interest/all about money [8, 10, 12–13, 15–18, 25, 31]

Comment A.: The potential harm to Pennsylvania residents outweighs the short-term economic benefits of the few.

Comment B.: The potential economic gain from natural gas development should not come at the expense of residents and visitors.

Comment C.: "We feel that people should be the first priority to this proposed site and how they're going to be building it."

Comment D.: "What about the HUMAN BEINGS who live here?"

Comment E.: "Our community doesn't even have gas in it."

Comment F.: "[T]he public need for the proposed project has yet to be demonstrated, and it seems to me that this is a clear case of corporate greed trumping the rights of private citizens."

Comment G.: "This land is OURS. It is not for sale to some corporation! Eminent domain is NOT FOR SALE for corporate profit."

Comment H.: "[T]his is not about feeding the local residents gas. This is about pumping large amounts of … natural gas down to Marcus Hook, … reconditioning it for shipping overseas into liquid gas to sell to Europe."

Comment I.: "They want to pump the natural gas down to a Marcus Hook storage facility. Whoever owns the storage tanks will then sell our (Pennsylvania's) Natural Gas to the highest bidder- very likely a foreign country. We will not see a dime of this money made off of our damaged land! But we sure will see accumulating effects!"

Comment J.: "Adelphia does not care about our right to live, and all they care about is making a quick buck at the cost of my community's way of life and lives for that matter."

Comment K.: "[B]asically, this [project] is a Hail Mary [by Adelphia] just to find a community where the two pipelines connect and to override our community, our small community and to make money."

Comment L.: Adelphia declined to choose other locations because there would be additional expense involved.

Response: This concern is addressed in DEP's response to General Concern 10 (under Comment B.)

27. Change in location for the public hearing [8, 16]

Comment A.: "[T]his is my official request for a new hearing, as the last-minute change … to a new location was disenfranchising to the general public and prohibitive to the public's engagement during this review process."

Response A.: DEP does not concur. DEP made the decision to change the location for the public hearing in consultation with members of the West Rockhill Township Board of Supervisors based on feedback from them and other affected stakeholders indicating that the West Rockhill Township Municipal Building (i.e., the original location) would be too small to accommodate the number of people potentially interested in attending the public hearing. Once DEP made the decision on November 30, 2018, to change the location for the public hearing to the West Rockhill Elementary School, it promptly implemented the following measures to inform as many affected stakeholders as possible of the change:

- A press release specifying the change in location.
- An update to the location for the public hearing on DEP's webpage for the proposed project specified in DEP's response to General Concern 1.
- Direct outreach to members of the West Rockhill Township Board of Supervisors and affected stakeholders.

- Having a sign specifying the change in location posted on the front door of the West Rockhill Township Municipal Building.

In addition to it having sufficient capacity to accommodate the number of people potentially interested in attending the public hearing, DEP chose the West Rockhill Elementary School as the new location for the public hearing based on it being as close as possible to the original location (i.e., approximately 1 mile and less than 5 minutes by car).

At worst, anyone who did not receive advance notice of the change in location and sought to attend the public hearing at the West Rockhill Township Municipal Building would have seen the sign on the front door and have had to travel an additional few minutes to the new location.

Therefore, DEP does not consider the change in location for the public hearing to have had an adverse impact on the public's ability to attend the public hearing, and will not hold an additional hearing.

Comment B.: "[T]he late notice of this location change for the hearing makes me suspect and distrustful."

Response B.: As specified in DEP's response to Comment A., above, DEP had a valid reason for changing the location for the public hearing, and did so in consultation with members of the West Rockhill Township Board of Supervisors. To be clear, the change in location has no bearing on DEP's determinations regarding the Air Quality Plan Approval application.

28. Request that DEP adequately review the proposed project from its origin as the IEC pipeline [8, 27]

Comment A.: "DEP needs to demand an extensive, thorough and unbiased 3rd party [EIS] of the entire Pipeline route (as pertaining to GAS transportation). When this pipeline was built in [the] 1970's -documents indicate the [(IEC's)] 'PACE report' was actually used to format the [DRBC] revisions to include pipeline in their Comprehensive plan. Was there a second study done at that time- since Intestate's (*sic*) would most likely be biased and may have (conveniently) left out some important facts and remediations?"

Comment B.: "The 1970's file contents seemed to indicate that Erosion and Sedimentation Control [(ESC)] permits, stream crossing permits and other documents for original pipeline approval may have been 'rubber stamped', and insufficiently reviewed, along with requiring some inspections and oversight. Also, additional streams were added to the permit application after the permit was issued."

Comment C.: "Springfield Township Board of Supervisors and Bucks County Planning Commission (along with other parties) perceived enough inaccuracies and deficiencies in the initial pipeline plan to file as Intervenors in the Court of Law."

Response: Concerns regarding the adequacy of the review of the application and EIS for IEC's original pipeline project were litigated in the 1970's in ***Bucks County Bd. of Com'rs v. Interstate Energy Co.***, 403 F. Supp. 805 (E.D. Pa. 1975), and are beyond the scope of the Air Quality Plan Approval.

Comment D.: DEP should "look into any anomalies that have happened in the past with this pipeline that would have belonged to [IEC]."

Comment E.: "Has (*sic*) there been discussions with PHMSA [Pipeline and Hazardous Materials Safety Administration] as to the numerous events/incidents/notices regarding the pipeline over the past 10 years?"

Response: DEP has not investigated or had any discussions with PHMSA regarding pipeline incidents, as that is beyond the scope of DEP's review of the Air Quality Plan Approval application.

29. "The facility could do more to incorporate [EPA's] Natural Gas STAR [program] emission reduction recommendations as well." [9]

Response: This concern is addressed in FERC's EA (pages 127 [second paragraph] and 132 [first paragraph]) and the Air Quality Plan Approval application (page 16 [Table 4-5]).[7]

30. Mitigate some of the risks to residents by either relocating the compressor station or installing electric compressors rather than gas-powered ones [9, 13]

Response: Concerns regarding alternative sites proposed by Adelphia for the compressor station are addressed in FERC's EA (pages 183 [first half of first paragraph]–184), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Concerns regarding installing electric compressors rather than gas-powered ones are addressed in DEP's response to General Concern 31.

31. Adelphia should install electric compressors rather than gas-powered ones [9, 12–13, 19, 25, 29, 36]

Comment A.: "[T]he proposal made by Adelphia, which is really New Jersey Energy, is obsolete equipment. They're proposing stuff that the EPA says you should switch from. In other words, [DEP] must be ignorant of what the EPA is requesting, because [DEP] should have rejected this thing when it crossed [DEP's] desk."

Comment B.: "The people want CLEAN ENERGY."

Comment C.: Electric compressors have lower capital investment and long-term operating and maintenance costs than gas-powered ones.

Comment D.: Electric compressors would improve the efficiency of the compressor station, eliminate combustion emissions, and generate far less noise than gas-powered ones.

Comment E.: Electric compressors would result in increasingly lower emissions over time due to the increasing phase-in of cleaner energy generation to the grid (e.g., power plants transitioning from coal to natural gas and renewable energy sources).

Comment F.: Electric compressors would require a smaller footprint for the compressor building than gas-powered ones, which would make complying with National Pollutant Discharge Elimination System (NPDES) and stormwater permitting easier.

Comment G.: Electric compressors would increase the demand on power generation stations and require the running of high-capacity power lines to the stations (the latter of which "should be relatively minor" for Marcus Hook, but "may be more significant [for Quakertown] if the existing supply is insufficient").

Comment H.: Electric compressors would require increasing the size of the emergency generator set at the proposed facility.

Work Practice Request #4: The Clean Air Council recommends that DEP require Adelphia to complete a cost analysis for installing an electric- vs. gas-powered compressor station to show whether or not electric compressors are feasible.

Response: This concern is addressed in FERC's EA (pages 186–187 [section B.6.3]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. [Note: Also see DEP's response to General Concern 4 (under Comments A.–G.), for discussion regarding the extent of DEP's authority.] Therefore, the Air Quality Plan Approval will not include the requested work practice.

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[7] DEP identified conflicting statements between FERC's EA (page 127: "Adelphia ... has expressed intent to ... recapture and recycle gas normally vented at compressor stations through the use of recovery piping.") and the Air Quality Plan Approval application (under *Reducing Emissions When Taking Compressors Off-Line*: "[T]he current design of the station does not allow for recycling of engine blowdowns.") on the recycling of blowdowns. DEP discussed this issue with Adelphia, which Adelphia addressed in the e-mail mentioned in DEP's response to General Concern 4 (under Comments H.–K./Condition Request #1).

32. Fenceline monitoring should be installed to protect public health, ensure better leak detection, and provide transparent oversight [9, 29, 36]

Comment A.: "To ensure accurate data collection from fenceline monitoring systems, at least three active monitors should be placed downwind of the proposed facility, and at the north, east, south, and west fencelines of the proposed facility. These monitors should be placed in positions that take into account site layout, topography, meteorological conditions, and the position of surrounding communities. Each monitor should be capable of measuring concentrations of the following pollutants: speciated VOCs and HAPs [hazardous air pollutants] via canisters, xylene, ethane, isobutene, methane, propane, nitrogen oxides, carbon monoxides, and sulfur dioxide, as well as wind direction/weather conditions. The facility should also be surrounded by passive sorbent tubes in order to pick up gaps in this active network (similar to placement outlined in 40 CFR Parts 60 and 63 - the 'refinery rule' NSPS/NESHAP)."

Comment B.: "Ideally, [fenceline] monitoring would be managed by [DEP], funded by Adelphia, and conducted by independent third parties, such as research organizations or academic institutions."

Comment C.: "There is no discussion of monitoring at the fence line to ensure that fugitive emissions are not adversely impacting the surrounding area. It is [the Concerned Residents Committee's] understanding that such monitoring is becoming the industry standard and we do not understand why it is not proposed or required.

Work Practice Request #5: The Clean Air Council recommends that DEP require Adelphia to complete an analysis to determine the usefulness and practicality of passive samplers; active, non-methane VOC samplers tag; SUMMA canisters; UV-DOAS; FTIR; and auto-GC/MS systems.

Response: As stated in DEP's response to General Concern 4 (under Comments A.–G.), "DEP's authority is limited to ensuring that companies comply with all applicable federal and state regulations and requirements for proposed or actual sources of air contaminant emissions." Currently, there are no federal or state regulations that require mandatory fenceline monitoring. Therefore, DEP cannot require Adelphia to install fenceline monitors, and the Air Quality Plan Approval will not include the requested work practice.

33. "[W]here does the plan [approval] address construction, the noise, fire, drainage, lighting, [and the] use of trucks?" [10]

Response: Concerns regarding construction at the proposed facility are addressed in FERC's EA (sections A.6–A.7 and throughout sections B.–D.). Concerns regarding noise, fire, and lighting at the proposed facility are addressed in DEP's responses to General Concerns 6, 18 (under Comments C.–E.), and 43, respectively. Concerns regarding drainage at the proposed facility are addressed in DEP's response to General Concern 49. Concerns regarding the use of heavy equipment and trucks are addressed in FERC's EA (pages 103 and 123 [third full paragraphs], 168 [second full and last paragraphs]–169 [first full paragraph] and throughout sections B.–D.). Generally, however, these concerns are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

34. Bucks County already has a failing grade for air quality. Pennsylvania is the third largest amount of air pollution state in the United States. A new compressor station will only exacerbate this problem." [10]

Response: As discussed in DEP's response to General Concern 4 (under Comments A.–G.), DEP has determined that the potentials to emit any pollutants from the proposed facility do not exceed any of the major facility thresholds for the Southeast Pennsylvania air basin, cause or contribute to a violation of the NAAQS, or result in significant impacts on air quality.

35. Residents strongly opposed to the proposed compressor station [11–12, 14–15, 18, 24–25, 32–33]

Comment A.: "I really resent this [compressor station] being shoved down our [residents'] throats. I think we all resent that."

Comment B.: "I don't want that thing [compressor station] in my backyard."

Comment C.: "The proposed compressor station interferes with residents' right to the reasonable use and enjoyment of their properties."

Response: As stated in DEP's response to General Concern 4 (under Comments A.–G.), "DEP's authority is limited to ensuring that companies comply with all applicable federal and state regulations and requirements for proposed or actual sources of air contaminant emissions." That being said, DEP would like to reiterate that, as discussed in DEP's responses to General Concerns 4 (under Comments A.–G.) and 7 (under Comments A.–E.), it has determined that the emissions from the project do not result in significant impacts on air, soil, or water quality.

36. Effect of the proposed compressor station on the local environment, including wildlife/endangered species (bog turtle, fox, coyote, coywolf, birds [bald eagle, woodpecker, heron, hawk, owl, turkey], deer [sometimes hunted for food], rabbit, squirrel, groundhog, bear)**, plants, Butter Creek, the Manderfield preserve/bird sanctuary, and agricultural operations** (i.e., farming and/or livestock) [12–13, 15, 17, 22, 24, 32–33]

Comment A.: Agricultural land surrounds most of the proposed site of the compressor station (as close as 500 *ft*), and agricultural operations are only source of income for many residents in the area.

Comment B.: "The air and water quality is amazingly pristine, and clean which is the only reason why these important and diverse Ecosystems are able to survive in a sustainable fashion."

Response A.–B.: Concerns regarding the atmospheric deposition of pollutants into the local soil and water are addressed in DEP's response to General Concern 4 (under Comments A.–G.). (Also discussed is that DEP determined that the potentials to emit any pollutants from the proposed facility do not cause or contribute to a violation of the secondary NAAQS, which is designed to protect public welfare, including "effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate.") Concerns regarding the Butter Creek and Quakertown Swamp Pennsylvania natural heritage areas are addressed in FERC's EA (pages 69 [last paragraph]–70 [first paragraph]), and are beyond the scope of the Air Quality Plan Approval. Concerns regarding the impact of construction and operation of the proposed project on wildlife, migratory birds, threatened and endangered species, and/or vegetation are addressed in FERC's EA (pages 75–86 [sections B.3.3, B.3.4, and B.4], 100 [first and second full paragraphs], 155 [first full paragraph] and 166 [section B.10.5]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

Comment C.: "I enjoy the birds, the deer, the rabbits, and the other wildlife, and they will disappear from this noise."

Response C.: Concerns regarding noise from the proposed facility/site are addressed in DEP's response to General Concern 6.

37. Adelphia has not set into place minimal safety precautions for affected residents/Adelphia will only do the bare minimum in ensuring that residents are safe from air and noise pollution [12, 32]

Response: Safety concerns regarding the siting of the proposed compressor building and potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18. In addition, concerns regarding pipeline integrity for the proposed project are addressed in DEP's response to General Concern 21.

38. Impact of the proposed project and pipeline installation on forming sinkholes [13, 15, 27, 32]

Comment: "Springfield Township Springtown area has underlying karst topography that may be prone to instability, sinkholes and contamination risk. The karst topography is in the more heavily populated areas of Springtown."

Work Practice Request #6: **Springfield Township strongly urges DEP to require Adelphia to perform frequent and thorough inspections in areas of known karst geology for sinkholes or other subsidence indicators that may affect the integrity and safety of the pipeline.**

Response: This concern is addressed in FERC's EA (pages 37 [second paragraph]–38 [first full paragraph]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

39. The design of the proposed compressor station is not responsible [16]

Comment: "I have a great concern that Adelphia is choosing a very unconservative, non-best practice design of their compressor station in a residential conservation neighborhood as opposed to an industrial complex, where there is more acreage and buffers, and addresses for safety. ... It appears that you are choosing higher risk, less responsible designs in an area where you should be taking extra precautions for the safety of our community first. I also have a concern for the ability of emergency response. Responsibility—I want responsible designs. I, and we, do not appreciate putting extra risk on our community, who has to trust industry to be safe, responsible, conservative, and uncomplacent. I feel your priorities are over desiring ease and convenience of design, or less cost, rather than making a safe design that is a little more conservative and probably costs more. But it's not an industrial complex. We don't have the type of rules protecting us. Risk analysis, take a look, think about risk analysis."

Response: Along the lines of DEP's response to General Concern 4 (under Comments A.–G.), DEP's review of the design of the compressor station is limited to ensuring that the air contaminant emissions from it comply with all applicable federal and state regulations and requirements. Outside of this, concerns regarding the design of the proposed compressor station are addressed in FERC's EA (pages 15 and 127 [second full paragraph], 132 [first paragraph], 141 [last full paragraph] and 143–145 [sections B.9.2–B.9.3]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Concerns regarding the siting or size of, and buffering and siting authority for, the proposed facility/site are addressed in DEP's responses to General Concern 3 (under Comments A.–D., respectively). Safety concerns regarding the siting of the proposed compressor building and potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18. Concerns regarding the performance of a risk assessment for the proposed compressor station are addressed in FERC's EA (page 130 [second paragraph]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

40. What kind, if any, alternative analysis was done, not just to alternative sites but alternative technology that may have been considered during this? ... [T]here's a lot of other options that could have been considered that I don't think were." [20]

Response: Concerns regarding alternative sites considered for the proposed compressor station are addressed in DEP's response to General Concerns 15 and 30. Concerns regarding installing electric compressors rather than gas-powered ones are addressed in DEP's response to General Concern 31.

41. "So, is this [the proposed project] a done deal? ... [I]s this [the public hearing] for show? Is this to placate us? This is what I heard, that the feds already got this all wrapped up. That you have no say in it. It's a federal thing, not a local thing. Is that true? So, what is this, a show?" [25]

Response: As detailed in FERC's EA (pages 29–32 [section A.10]), numerous federal and state agencies are involved in the permitting/approval of all or part of the proposed project. Regarding the Air Quality Plan Approval application (or any other applications submitted to DEP), DEP always has final authority on the determination made.

42. "I don't hear any promises here that, if this goes bad, who's going to fix it? I don't hear any promises here that, not only for the short-term, [a] fix be made, but that a long-term fix be in place." [26]

Response: Safety concerns regarding the siting of the proposed compressor building and potential for accidents/emergencies at the proposed facility/site are addressed in DEP's response to General Concern 18. In addition, concerns regarding pipeline integrity for the proposed project are addressed in DEP's response to General Concern 21. As indicated in DEP's response to General Concern 4 (under Comments H.–K./Condition Request #1), any adverse events occurring at/effects resulting from the compressor station would ostensibly be Adelphia's responsibility.

43. Effect of lighting from the proposed compressor station on nearby residents [28]

Comment: The lighting from the proposed compressor station "will result in continuous disturbance of surrounding properties."

Condition Request #6: West Rockhill Township requests that the Air Quality Plan Approval include a condition requiring Adelphia to comply with local ordinance #1808 (lighting), especially the requirement that no light may spill onto adjacent properties.

Response: This concern is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Therefore, the Air Quality Plan Approval will not include the requested condition.

44. "There is located .85 mile from the proposed compressor site a mobile home park which is currently undergoing an expansion which will add twenty-one additional units to the park." [28]

Response: This concern is addressed in FERC's EA (pages 156 [last paragraph], 161 [Table B-30], and 164 [second paragraph]), and is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval.

45. "There is a large stone quarry which is located approximately three miles from the proposed compressor site. The pipeline itself is located less than a half mile from the quarry at a number of locations. [West Rockhill] Township thinks that the location of a compressor station this close to an active quarry, which blasts rock on a regular basis, is dangerous and ill-advised." [28]

Response: This concern is beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval; however, a study conducted by the U.S. Bureau of Mines (see *Attachment #2*) indicates that blasting from the quarry should not have any adverse effects on the pipeline or proposed compressor station.

46. Natural gas discharges and venting [28]

Comment: "Nothing in the [Plan Approval] addresses the prevention of the venting of natural gas or monitoring to insure (*sic*) that natural gas is not being vented."

Condition Request #7: West Rockhill Township requests that the Air Quality Plan Approval set forth objective standards for the monitoring, prevention, and reporting of venting events when they happen.

Response: This concern is addressed in DEP's response to General Concern 4 (under Comments H.–K./ Condition Request #1). As such, the Air Quality Plan Approval will not include the requested condition.

47. *Condition Request #8:* West Rockhill Township requests that the Air Quality Plan Approval include a condition requiring notification to EPA/DEP and the Township within 24 hours of any emergency event and anytime testing/monitoring exceeds permit limits. [28]

Response: Condition # 019(a), Section C, of the draft Air Quality Plan Approval, requires Adelphia to notify DEP "within 2 hours of discovery" "of any malfunction(s) of a source(s) and/or associated air pollution control device(s)." Condition # 003(d), Section D (under Source ID 600), of the draft Air Quality Plan Approval, and Condition # 006(d), Section E (under the Compressor Engine & Oxidation Catalyst source group), of the draft Air

Quality Plan Approval, require Adelphia to submit a complete test report, including the results and all operating conditions, for each stack test to DEP within 60 days after the respective stack test. Modifying these conditions to require Adelphia to provide notification or test reports to EPA and West Rockhill Township is beyond DEP's Air Quality purview. Therefore, the Air Quality Plan Approval will not include the requested condition.

48. Stormwater management controls for the proposed site [28–29]

Comment A.: "Given the proximity of wetlands to the proposed compressor station, stormwater management controls are especially important."

Comment B.: "The application states that no coordination with other DEP permits is required. However, the development of the site will require an NPDES permit issued by the DEP."

Condition Request #9: West Rockhill Township requests that the permit include a condition requiring Adelphia to comply with local ordinances #209 and #219 (stormwater management) and #229 (grading/ESC), obtain ESC approval from the Bucks County Conservation District [(BCCD)], and obtain a NPDES permit from DEP, if required.

Response: Concerns regarding drainage at the proposed facility will be addressed in Adelphia's applications for Waterways and Wetlands permits to DEP. Concerns regarding permitting by the BCCD are addressed in FERC's EA (page 31 [Table A-7]), and are beyond DEP's Air Quality purview and the scope of the Air Quality Plan Approval. Moreover, as stated on the cover page of the draft Air Quality Plan Approval, "Nothing in this plan approval relieves the permittee from its obligations to comply with all applicable Federal, State and Local laws and regulations." Therefore, the Air Quality Plan Approval will not include the requested condition.

49. Potable water and sanitary sewage needs for the proposed site [28–29]

Comment A.: "Regardless of whether the facility will be staffed with full-time employees, bathroom facilities should be available. Public water and sewer is not available to the site; therefore, Adelphia will need to identify a satisfactory location for a sanitary sewer system and secure the necessary permits from the Bucks County Health Department."

Comment B.: "[T]he development plans shared to date have not addressed the use of water or sanitary facilities. Thus, a Sewerage Facilities Planning module may also be required to be approved by the DEP."

Response: DEP's Act 537 Program generally grants a waiver from sewage facilities planning to projects that do not meet the definition of the terms 'lot' or 'subdivision' in 25 Pa. Code § 71.1. More specifically, if the lot is existing and is not planned to be physically subdivided or not deemed to be subdivided due to estimated sewage flows, sewage planning is waived. Concerns regarding permitting by the BCCD are addressed in DEP's response to General Concern 49.

50. Continuous stack monitoring not proposed for the proposed compressor engines [29, 36]

Comment A.: "This is a simple means of assuring that the plant is operating as designed and expected.

- Additionally, it serves to protect the considerable investment the township has made in conserving open space, particularly wooded open space. A failure of the emission control systems would not only cause air pollution but could adversely impact the local woodlands.
- Similarly, may of the surrounding properties have agricultural operations, either farming, raising livestock or both. An inadvertent release could not only impact these operations but the local food supply, as well.
- This entire area is zone Residential Conservation and has been designated by the Township as ecosystems and habitats deserving special consideration to remain pristine environments capable supporting rare and threatened species.

It is our opinion that continuous stack monitoring would afford the local residents and community at large a sense of security while providing Adelphia valuable information on the functioning of their facility. Such information could limit the maintenance costs or repairing damaged or non-functioning equipment before the repair becomes larger. This information could also permit Adelphia to address releases before such discharged create significant impacts to the environment and additional perception issues. The need for continuous stock monitoring is obvious given the damage that could be caused by an equipment failure, that may not be detected for a full quarter, under a quarterly monitoring program."

Work Practice Request #7: **The Clean Air Council and Delaware Riverkeeper Network recommend that DEP require Adelphia to conduct continuous stack monitoring for NO_x and report the data quarterly, due to the close proximity of the compressor station to residential areas.**

Response: As stated in DEP's response to General Concern 4 (under Comments A.–G.), "DEP's authority is limited to ensuring that companies comply with all applicable federal and state regulations and requirements for proposed or actual sources of air contaminant emissions." Generally, continuous emission monitoring systems (CEMS) are only mandatory for certain significant sources of air contaminant emissions (e.g., electric generating units, municipal waste combustors) or ones that are subject to certain federal regulations. Therefore, DEP cannot require Adelphia to install CEMS, and the Air Quality Plan Approval will not include the requested work practice.

51. "The human life, land, water and sensitive wildlife should be taken into consideration along the entire pipeline, especially around the immediate gas compressor facilities were there is no buffer to absorb the daily outpouring of toxins" [30]

Response: Concerns regarding buffering for, and the potential health effects of living near, the proposed compressor station are addressed in DEP's responses to General Concerns 3 (under Comment C.) and 4, respectively. Concerns regarding the effect of the proposed compressor station on the local environment, including the land and wildlife, are addressed in DEP's response to General Concern 36 (under Comments A.–B.). Concerns regarding the effect of the proposed compressor station on well water, waterways, and wetlands are addressed in DEP's responses to General Concerns 7 (under Comments A.–E.) and 48–49.

Concerns regarding soils; water resources and wetlands; vegetation, fisheries, and wildlife; special status species; land use; and cumulative impacts from these for the entire pipeline are addressed in FERC's EA (sections B.1.2, B.2, B.3, B.4, B.5.1, and B.10.3–B.10.6, respectively), and are beyond the scope of the Air Quality Plan Approval.

52. "I believe the project Adelphia has proposed will permanently destroy the environmental, as well as the cultural aspects of the surrounding neighborhoods in West Rockhill and Richland Townships." [31]

Response: Concerns regarding the effect of the proposed project on the local environment and nearby cultural resources are addressed in DEP's responses to General Concerns 36 (under Comments A.–B.) and 20 (under Comment D.), respectively.

53. "Adelphia's environmental plan and the DEP response seems to be 100+ pages of BAT ... or skewed statistics to support their conclusions. The problem with BAT is that it does not guarantee outcomes. The Adelphia plan prepared by their consulting company involved only statistics that showed the best case scenario for all aspects of their study including emissions and the environment. Obviously, that is unrealistic. It appears Adelphia does not want realistic data because it could reduce the chances for approval." [31]

Response: The draft Air Quality Plan Approval includes emission rate restrictions for the proposed compressor engines and engine of the proposed Cummins emergency generator set that satisfy the BAT requirements of 25 Pa. Code § 127.1. Based on this and calculations of the potential (i.e., worst-case) emissions from the proposed facility, as stated in DEP's response to General Concern 4 (under Comments A.–G.), "DEP has determined that the potentials to emit any pollutants from the proposed facility would not exceed any of the major facility

thresholds for the Southeast Pennsylvania air basin, cause or contribute to a violation of the NAAQS, or result in significant impacts on air quality."

As discussed in DEP's response to General Concern 12, the draft Air Quality Plan Approval includes stack testing and periodic monitoring requirements for the proposed compressor engines and engine of the proposed Cummins emergency generator set to demonstrate compliance with the applicable pollutant emission restrictions, as well as LDAR requirements for the existing and proposed fugitive emissions components (i.e., AVO inspections, periodic monitoring surveys, and leak repair) to minimize fugitive emissions.

54. Does Adelphia address what effect all this [the proposed facility] would have on the OTR (ozone transport region) that Bucks County is in? The effects and results should be noted." [31]

Response: This concern is addressed in FERC's EA (page 169 [third full paragraph]) for the proposed project. [Note: See FERC's EA (pages 118 [last paragraph]–119 [first paragraph]) for further discussion of the OTR.] Moreover, as discussed in DEP's response to General Concern 4 (under Comments A.–G.), DEP has determined that the potentials to emit NO_x and VOC from the proposed facility would not exceed any of the major facility thresholds for the Southeast Pennsylvania air basin, cause or contribute to a violation of the NAAQS, or result in significant impacts on air quality.

General Comments in Support

1. The proposed pipeline project will benefit Pennsylvania and Greater Philadelphia [34–35, 37–40]

Comment A.: "This project will deliver affordable, abundant energy using existing infrastructure, revitalizing brownfield locations, and minimizing community and environmental impact. Adelphia Gateway will be at 100 percent capacity as soon as it is in service because the consumer demand for low-cost, clean-burning natural gas is already here in southeastern Pennsylvania."

Comment B.: "The need for affordable clean-burning natural gas has been demonstrated by support from end users such as our Chester mill facility, where Kimberly-Clark will transform its co-generation power plant from a coal-fired one into one fueled by natural gas delivered by Adelphia Gateway. Pipeline buildout—and the supporting infrastructure such as compressor stations necessary for pipelines to operate safely and properly—is making this economic and environmental revitalization of a local manufacturing site possible."

Comment C.: "The Adelphia Gateway project can help us reach our national goals to continue as a global leader in natural gas production and help to establish our energy independence from regions of the world that manipulate energy prices and threaten our national security."

Comment D.: The proposed project will increase infrastructure capacity in the region to help meet ever-increasing demand.

Comment E.: The proposed project will lower natural gas market prices in the Greater Philadelphia region (which, as part of "the Mid-Atlantic and Northeast continue to pay prices above the national average for natural gas because the region lacks an adequate pipeline network that could carry gas downstream to end users").

Comment F.: The proposed project will provide economic benefits (more than $16 million in savings over the first 15 years for industrial natural gas customers, and $402 million in savings for residential customers) and help protect lower- and fixed-income households.

Comment G.: The proposed project will support regional businesses in the manufacturing industry by boosting their ability to remain competitive, as well as surrounding communities through businesses investing energy savings in economic development, additional jobs, and higher salaries.

Response: DEP appreciates the comments, though must note that they have no bearing on DEP's review of the Air Quality Plan Approval application.

2. **Compressor stations are safe and well-regulated** [35, 38–40]

Comment A.: "These safe and well-regulated facilities must comply with standards established by both [FERC] and the U.S. Department of Transportation (USDOT). They are remotely controlled and monitored 24 hours a day, 7 days a week, by highly skilled technicians, operators and gas control specialists. The planned compressor stations for Adelphia Gateway utilize a thick-walled structure to reduce residual sound and will comply with FERC's regulations for noise transmission. ... In addition, the facility is equipped with air quality controls that keep emissions well below federal limits."

Comment B.: "[T]hese highly regulated facilities must adhere to strict industry standards, including installing noise-reduction features and limiting emissions. ... These sites must be engineered, constructed, operated and maintained in accordance with [PHMSA] standards, and they are frequently inspected. Adelphia Gateway's proposed compressor station is no different, and it has been reviewed for strict safety and environmental standard adherence so it can exist harmoniously with the surrounding community."

Response: DEP appreciates the comments.

Comments Relating to Article 1, Section 27, of the Pennsylvania Constitution [8, 10, 12, 15]

1. **"[DEP's] mission is to protect Pennsylvania's air, land, and water from pollution and to provide for the health and safety of its citizens through a cleaner environment. However, the proposed Adelphia Gateway project would undoubtedly result in immeasurable harms to our clean air, pure water, and the natural, scenic, historic, and aesthetic values of our environment for generations to come. To even consider granting Adelphia Gateway the permits that are necessary to repurpose the Interstate Energy Company pipeline, which during its lifetime has already resulted in substantial harms to the very resources it is your mission to protect, is fossil foolishness, and evidences the rubber-stamp nature of the agencies that are currently overseeing the review of this project."**

2. **"[I]t is now clear that when the existing IEC pipeline was first installed in the 1970s, the Department of Environmental Resources [DER], their review of the proposed project at that time was inadequate and failed to address significant concerns regarding public safety, the environmental impacts, and integrity management of this pipeline. At present, our communities and our environment are already suffering from the substantial harms of over three decades of negative environmental impacts, all as a result of [DER's] inadequate review of this pipeline as it was first proposed and installed in the 1970s. ... Due diligence was never done by DER to review the environmental impacts of these sensitive stream crossings, which have resulted in substantial degradation to our exceptional value watershed in the present day. The evident environmental harms in these appeals, which came before the Environmental Hearing Board at that time, went unheeded and we are now forced to reckon with the cumulative negative impacts which are the byproduct of this pipeline's legacy. Furthermore, as a result of the many negative environmental impacts that have come to fruition over the years [from the IEC pipeline], it is now clear that DEP section 401 water quality certifications, chapter 105 permits, [ESC] permits, air quality approvals, and operating permits necessary for this project to proceed should not be granted, and the longstanding harms to our resources that are duly protected by our Commonwealth under Article 1, Section 27 of Pennsylvania State Constitution, should be remediated."**

3. **"And in the PA Constitution, Article 1, Section 27, residents have a right to clean air and clean water."**

4. **"Article 1, Section 27, of our PA State Constitution states plainly that 'The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic, and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.' This section claims that our heritage is for all the people, not for all of the corporations and energy giants. How can we mortgage the legacy of the generations yet to come, of our grandchildren, and of our great grandchildren for the benefit of a quick**

gain of a few bucks for these business owners who offer us nothing in return? ... Adelphia is looking to squeeze the last drops of a dying energy source out of our ground, oblivious to the cries of the people who live here who plead for protection as our air, ground and water become fouled. Whoever these owners are would reap all the benefit of exploiting our natural resources, which belong to all of us, so that they can profit. A faceless corporation should not have rights greater than the human beings who live here. ... It is our right as citizens of this Commonwealth to the benefits of the clean land and air that we currently share. It is our right, and our children's right, and our great grandchildren's right. Our PA Constitution guarantees this right to our progeny. Shame on our governments if they allow Adelphia to destroy what has been guaranteed to us by our forefathers."

5. **"What about our PA Constitution that guarantees that WE, the citizens, have the RIGHT to clean air, land, and water?"**

6. **"Today there is (*sic*) many residents in West [R]ockhill who greatly value their right to clean air and water granted to them by the Pennsylvania Constitution. The Pennsylvania [C]onstitution Article 1 [S]ection 27 grants Pennsylvania citizens the right to clean air and water."**

Response: DEP reviewed the Air Quality Plan Approval application for the air quality emissions associated with the operation and maintenance of the proposed compressor station and existing and proposed metering stations. Based on this review, DEP has determined that Adelphia Gateway, LLC (Adelphia) has satisfied the applicable Commonwealth statutory and regulatory requirements for obtaining an air quality Plan Approval required for the proposed project. DEP reached this determination only after an extensive iterative process with Adelphia, where DEP ultimately determined that the application and supporting materials submitted by Adelphia and its consultants adequately addressed the comments and deficiencies raised by DEP and satisfied all applicable legal requirements for issuance, including those enumerated by the commentator referring to Article I, Section 27, of the Pennsylvania Constitution. These requirements, the application submissions by Adelphia, DEP's thorough review process, as well as the project-specific terms and conditions of the Air Quality Plan Approval, satisfy Article I, Section 27, of the Pennsylvania Constitution.

DEP reviewed the air quality Plan Approval application in accordance with 25 Pa. Code, Chapter 127, regulations, and based on that review, DEP has determined that Adelphia has satisfactorily demonstrated compliance with the regulatory requirements contained therein, including those pertaining to emissions, control technologies, and impacts to the National Ambient Air Quality Standards (NAAQS) and other air quality resources. As part of its application for Certificate of Public Convenience and Necessity to the Federal Energy Regulatory Commission (FERC), Adelphia conducted air quality impact modeling for the proposed project, which is not required by the Commonwealth for the Air Quality Plan Approval application for the proposed project. The air quality impact modeling demonstrated that the emissions from the proposed project would not cause any degradation to the attainment with the NAAQS. Moreover, Adelphia has confirmed that it will "implement recycling of the blowdown volumes where possible such as recycling the gas into fuel gas." Lastly, whereas other natural gas compressor station facilities in the area are major sources of air pollution, the Air Quality Plan Approval will require Adelphia to maintain air quality emissions from the proposed project below major source thresholds (as proposed by Adelphia in its Air Quality Plan Approval application), which will minimize the diminution of the local and regional air quality.

DEP conducted a comprehensive environmental evaluation of the proposed project and has concluded that the application and Air Quality Plan Approval satisfy the regulatory requirements and Article 1, Section 27, of the Pennsylvania Constitution.

Comments Relating to DEP's Fulfillment of Its Mission [4, 8, 10–11, 22]

1. **"[A]s indicated in your agency title, protect us from this unsafe compressor station."**

2. **"DEP your agency was put in place to protect us citizens (the word "protection" is even in your title) please stand up in the face of greed and corruption and PROTECT THE CITIZENS OF THIS COUNTRY... you have a unique opportunity to set the example for the other regulatory agencies by protecting us from this dangerous facility which Adelphia Gateway is forcing on our community. To do anything less would be negligent on your part."**

3. **"[W]e will hold DEP responsible for the public safety risks and environmental harms that will be wrought upon our communities for generations to come if the permits for this project are granted in a way that does not protect the health and welfare of our communities over the interests of a limited liability corporation."**

4. **"[W]e have Pennsylvania laws, which the DEP is well aware of, to prevent new construction which would emit all this methane and other pollutants with new construction."**

5. **"Our legacy to future generations must be a decrease in pollution in order to protect health and safety of all citizens. The DEP needs to strongly enforce current state legislation and evaluate the cumulative impact how this compressor station affects future changes to the environment and impact radius."**

6. **"The other thing I have a concern with is that, you know, DEP was always an organization to benefit the people. ... Adelphia came to our Township and strong-armed our planning commission, and, come DEP, wants to do the same thing."**

7. **"And in your permits you say, in your own writing, it says: 'Nothing in the general permit relieves the permittee from its obligations to comply with all applicable federal, state, and local laws.' Why wouldn't you follow that? I don't get it. And if I didn't know no better, I'd figure Adelphia is in your pocket somehow, because this pipeline only affects a certain group of people—there's not one person that is in this room that wants this pipeline."**

8. **"I don't believe that people like you, the DEP and my elected officials, have adequately explained this whole compressor to me and to my wife and everybody in this community. It's as if Adelphia and perhaps even you have come in like a thief in the night and tried to ramrod this into us. ... [T]he environment is fragile, and the DEP is supposed to be there to protect us. So, is that really true, or is the fox running the henhouse?"**

Response: DEP reviewed the Air Quality Plan Approval application for the air quality emissions associated with the operation and maintenance of the proposed compressor station and existing and proposed metering stations. Based on this review, DEP has determined that Adelphia Gateway, LLC (Adelphia) has satisfied the applicable Commonwealth statutory and regulatory requirements for obtaining an air quality Plan Approval required for the proposed project. DEP reached this determination only after an extensive iterative process with Adelphia, where DEP ultimately determined that the application and supporting materials submitted by Adelphia and its consultants adequately addressed the comments and deficiencies raised by DEP and satisfied all applicable legal requirements for issuance.

DEP reviewed the air quality Plan Approval application in accordance with 25 Pa. Code, Chapter 127, regulations, and based on that review, DEP has determined that Adelphia has satisfactorily demonstrated compliance with the regulatory requirements contained therein, including those pertaining to emissions, control technologies, and impacts to the National Ambient Air Quality Standards (NAAQS) and other air quality resources. As part of its application for Certificate of Public Convenience and Necessity to the Federal Energy Regulatory Commission (FERC), Adelphia conducted air quality impact modeling for the proposed project, which

is not required by the Commonwealth for the Air Quality Plan Approval application for the proposed project. The air quality impact modeling demonstrated that the emissions from the proposed project would not cause any degradation to the attainment with the NAAQS. Moreover, Adelphia has confirmed that it will "implement recycling of the blowdown volumes where possible such as recycling the gas into fuel gas." Lastly, whereas other natural gas compressor station facilities in the area are major sources of air pollution, the Air Quality Plan Approval will require Adelphia to maintain air quality emissions from the proposed project below major source thresholds (as proposed by Adelphia in its Air Quality Plan Approval application), which will minimize the diminution of the local and regional air quality.

Questions for Adelphia Employees [18]

1. **"Can you admit honestly that you would be fine living with this 11,000 square foot building in your backyard, 700 feet away from your child's playground while they're breathing in the air that is 'clean,' even though compressor stations emit CO and formaldehyde that, supposedly, will fall under the levels that are acceptable?"**

2. **"Would you be willing to play outside with your kid while there's a constant 'dishwasher' sound going on, which, according to studies done by the University of Maryland, exceed 55 decibels, which is the maximum level allowed in Richland Township?"**

3. **"[I]f there's going to be vibrations constantly, is that really 55 decibels?"**

4. **"[W]ould you want to wake up in the middle of night to what people compare to a jet engine taking off?"**

5. **"I ask that you please consider this construction of a compressor station with a little more empathy and a lot less greed. ... I'd just like for you to, maybe, think about it on a more personal level, not just with money, like we're people who matter."**

Response: The public comment period is designated for DEP to receive comments regarding the draft Air Quality Plan Approval and DEP's review and decision on the Air Quality Plan Approval application. Along these lines, DEP can only offer responses to comments regarding the draft Air Quality Plan Approval and DEP's review and decision on the Air Quality Plan Approval application, and not to comments that are directed to the company.

Buchanan Ingersoll & Rooney List of Meetings and Conference Calls with Public Officials/Agencies

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
5/18/17 Harrisburg, PA	**PA Public Utility Commission** • Chairman Brown's staff • Vice Chairman Place's staff • Commissioner Sweet & staff • Commissioner Powelson's staff • Commissioner Coleman & staff • BTUS • Law Bureau staff	**NJR** • Nancy Washington • Bill Scharfenberg • Dave Johnson **BIR Attendees** • John Poviliatis	Introduction and project overview
10/23/17 Washington, D.C.	**FERC Chairman Neil Chatterjee** • Robert Ross, Legal Advisor • Andrea Spring, Policy Advisor • Len Tao, Director, Office of External Affairs • Lawrence Greenfield, Associate General Counsel • Pamela Boudreau, Deputy Director, Division of Pipeline Certificates	**NJR** • Nancy Washington • Bill Scharfenberg • Steve Westhoven • Dave Johnson **BIR Attendees** • Kim Pizzingrilli • Ed Hild	Introduction and project overview
10/23/17 Washington, D.C.	**Commissioner Robert Powelson (stopped in briefly)** • Rik Hull, Legal Advisor Brett Rendina, Legal Advisor • Brian George, Advisor	**NJR** • Nancy Washington • Bill Scharfenberg • Steve Westhoven • Dave Johnson **BIR Attendees** • Kim Pizzingrilli • Ed Hild	Introduction and project overview

Attachment #1a

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
10/23/17 Washington, D.C.	**Commissioner LaFleur** • Andrew Weinstein, Legal Advisor	**NJR** • Nancy Washington • Bill Scharfenberg • Steve Westhoven • Dave Johnson **BIR Attendees** • Kim Pizzingrilli • Ed Hild	Introduction and project overview
11/20/17 Harrisburg, PA	**Governor's Office** • Rob Ghormoz, Deputy Chief of Staff • Sam Robinson, Deputy Secretary of Policy & Planning **Department of Community & Economic Development** • Denise Brinley, Special Assistant, Strategic Industry Initiatives • Brent Vernon, Executive Director-Governor's Action Team **Department of Environmental Protection** • Ramez Ziadeh, Executive Deputy Secretary	**NJR** • Steve Westhoven • Dave Johnson • Jack Herbert • Keith Edmonds • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction and project overview

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
1/23/18 Harrisburg, PA	**PA House/Senate** • Representative Michael Corr • Representative Brian Kirkland • Nolan Ritchie, Executive Director-Senate Transportation Committee (Senator John Rafferty's office) • John Munera, District Office (Senator John Rafferty's office) • Senator Bob Mensch and Lisa Walter, COS • Representative Duane Milne	**NJR** • Jack Herbert • Jen Godoski **BIR Attendees** • Steve DeFrank • Eric Battisti	Introduction and project overview
1/24/18 Harrisburg, PA	**PA House/Senate** • Representative Chris Quinn • Representative Marcy Toepel • Senator Tom Killion and Shannon Royer, COS • Senator Andrew Dinniman • Representative Carolyn Comitta	**NJR** • Jack Herbert • Jen Godoski **BIR Attendees** • Steve DeFrank • Eric Battisti	Introduction and project overview
1/29/18 Harrisburg, PA	**PA Senate** • Senator Mario Scavello • Senator Lisa Boscola	**BIR Attendees** • Steve DeFrank	Project overview
2/5/18 Glen Mills, PA	**Concord Township** • Amanda Serock, Township Manager • Tom Nelling, Concordville Fire Chief • Dominic Pileggi, Councilman • John Gillespie, Councilman • John Crossan, Councilman	**NJR** • Keith Edmonds • Jack Herbert **BIR Attendees** • Steve DeFrank	Introduction and project overview
2/6/18 Harrisburg, PA	**PA House** • Representative Marcia Hahn • Representative Robert Freeman • Representative Stephen Barrar	**BIR Attendees** • Steve DeFrank • Eric Battisti	Project overview

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
2/7/18 (via phone)	**PA House** • Representative Warren Kampf	**BIR Attendees** • Steve DeFrank • Andy Giorgione	Project overview
2/21/18 Exton, PA Royersford, PA Quakerstown, PA	**PA House** • Representative Becky Corbin • Representative Tom Quigley • Representative Craig Staats	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction and project overview
2/27/18 Bethlehem, PA Nazareth, PA	**PA House** • Representative Steve Samuelson • Representative Joe Emrick	**BIR Attendees** • Steve DeFrank	Project overview
2/28/18 Media, PA Cheyney, PA	**County of Delaware, PA** • Tim Boyce, Director-Dept. of Emergency Services **Thornbury Township** • James Raith, Chairman, Board of Supervisors • Jeff Seagraves, Township Manager • Ken Kynett, Township Solicitor • Alex Rodriguez, Township Engineer	**NJR** • Jen Godoski • Keith Edmonds • Jack Herbert **BIR Attendees** • Steve DeFrank	Introduction, project overview and discussion of emergency management plans Introduction and project overview
3/22/18 Glen Mills, PA	**Thornbury Township** • Greenbriar HOA Board of Directors • Jeff Seagraves, Township Manager	**NJR** • Jen Godoski • Keith Edmonds • Jack Herbert **BIR Attendees** • Steve DeFrank	Project overview

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
3/27/18 Media, PA	**Southern Delaware County Authority** • Mike Ciocco • Andrew Reilly	**NJR** • Jen Godoski • Keith Edmonds **BIR Attendees** • Steve DeFrank	Introduction, project overview and discussion of ROW amendment
Sellersville, PA	**West Rockhill Township** • Greg Lippincott, Township Manager • Steve Baluh, Township Engineer	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction, project overview and discussion of compressor station
West Chester, PA	**PA Senate** • Don Vymazal (Senator Dinniman's office)	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Project update
West Chester, PA	**East Goshen Township** • Rick Smith, Township Manager • Martin Shane, Supervisor • Carmen Battavio, Supervisor • David Shuey, Supervisor	**NJR** • Jen Godoski (via phone) **BIR Attendees** • Steve DeFrank	Follow-up on information requested

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
4/16/18 Linwood, PA	**Lower Chichester Township** • Joe Possenti, Township Manager • Frank Sbandi, Solicitor • Rocco Gaspari, Supervisor • David D'Angelo, Supervisor • Raymond Baldwin, Supervisor • Raymond Nickson, Building Inspector	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction, project overview and discussion of compressor station
5/3/18 Aston, PA	**Upper Chichester Township** • George Needles, Township Manager • David Holland, Emergency Management Coordinator • Tom Bush, Chief of Police • James Putman, Road Foreman • Ed Raikowski, Commissioner • Joe Neary, Commissioner	**NJR** • Jen Godoski • Keith Edmonds **BIR Attendees** • Steve DeFrank	Introduction and project overview
Skippack, PA	**Skippack Township** • Chris Heleniak, Township Manager • Barry Miller, Solicitor	**NJR** • Jen Godoski • Keith Edmonds **BIR Attendees** • Steve DeFrank	Introduction and project overview
Quakertown, PA	**Richland Township** • Paul Stepanoff, Township Manager	**NJR** • Jen Godoski • Keith Edmonds **BIR Attendees** • Steve DeFrank	Introduction and project overview

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
7/5/18 Sellersville, PA	**West Rockhill Township** • Greg Lippincott, Township Manager • Steve Baluh, Township Engineer • Mary Eberle, Solicitor	**NJR** • Jen Godoski • Keith Edmonds • Bill Scharfenberg **BIR Attendees** • Steve DeFrank	Follow-up on compressor station and overall project
7/25/18 (via phone)	**Lower Saucon** • Priscilla DeLeon, Supervisor • Leslie Huhn, Manager	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction and project overview
8/16/18 Linwood, PA	**Lower Chichester Township** • Joe Possenti, Township Manager • Frank Sbandi, Solicitor • Raymond Nickson, Building Inspector	**NJR** • Jen Godoski • Bill Scharfenberg **BIR Attendees** • Steve DeFrank **Saul Ewing** • Elizabeth Witmer	Compressor station follow-up and discussion on permitting and zoning requirements
Quakertown, PA	**Springfield Township** • Mike Brown, Township Manager • Karen Bedics, Supervisor • Arrianne Elinich	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction and project overview

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
8/24/18 Sellersville, PA	**West Rockhill Township** • Greg Lippincott, Township Manager • Steve Baluh, Township Engineer • Mary Eberle, Solicitor (via telephone)	**NJR** • Jen Godoski • Keith Edmonds • William Scharfenberg **BIR Attendees** • Steve DeFrank **Saul Ewing** • Elizabeth Witmer	Follow-up on compressor design, permitting and zoning requirements
9/5/18 Harrisburg, PA	**DEP** • Ramez Ziadeh, Executive Deputy Secretary • Aneca Atkinson, Director-Office of Program Integration • Domenic Rocco, Environmental Program Manager-Regional Pipeline Coordination Office	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank • Eric Battisti	Project update
Harrisburg, PA	**Governor's Office** • Sam Robinson, Deputy Chief of Staff	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank • Eric Battisti	Project update
Harrisburg, PA	**DCED** • Denise Brinley, Senior Energy Advisor	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank • Eric Battisti	Project update

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
9/19/18 Malvern, PA	**East Whiteland Township** • John Nagel, Township Manager • Bill Holmes, Supervisor • Susan Drummond, Supervisor • Scott Lambert, Supervisor (via telephone)	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction and project overview
9/24/18 Chester, PA	**City of Chester** • Mayor Kirkland • Mike Galante, City Engineer	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Introduction and project overview
10/2/18 (via phone)	**City of Chester** • Mike Galante, City Engineer	**NJR** • Jen Godoski • Keith Edmonds • Jack Herbert **BIR Attendees** • Steve DeFrank	Discussion of proposed route of Tilghman Lateral
10/17/18 Harrisburg, PA	**PA Senate** • Senator Tom Killion and Shannon Royer, COS	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Project update and briefing on Tilghman Lateral
Harrisburg, PA	**PA House** • Representative Brian Kikland	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Project update and briefing on Tilghman Lateral

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
11/7/18 (via phone)	**City of Chester** • Mayor Kirkland	**NJR** • Jen Godoski **BIR Attendees** • Steve DeFrank	Follow-up on ROW acquisition on Tilghman Lateral
12/5/18 Trainer, PA	**Trainer Borough** • Fran Zalewski, Mayor • Jean Becker, Council • Joe Maher, Council • Jim Cassidy, Council • Ed McDaniel, Council • Awilda Burgos, Council • Mike Sheridan, Solicitor • Eileen Nelson, Engineer • Joe Possenti (Possenti Associates), Borough Manager	**NJR** • Keith Edmonds • William Scharfenberg • Jack Herbert **BIR Attendees** • Kim Pizzingrilli	Introduction and project overview
12/17/18 Quakertown, PA	**West Rockhill Emergency Services** • Greg Lippincott, Township Manager • John Cressman, Trumbersville Fire Chief • Joe Rausch, Fire Marshall • Ashley McElhare, Emergency Management Coordinator • Don Duvall, Supervisor	**NJR** • Jen Godoski • Keith Edmonds (via telephone) • Jeff Lamb • Robert Kumpf **BIR Attendees** • Steve DeFrank	Project overview and discussion of emergency plans dealing with compressor station

Date/Location	Meeting (Agency/Public Official Attendees)	NJR/BIR Attendees	Topic
1/15/19 Norristown, PA	**DEP, Southeast Regional Office** • John Hohenstein, Acting Regional Manager • Don Knorr, Aquatic Biologist • Bill Gerlach, Counsel • Domenic Rocco, Manager • Dave Bolig, Environmental Engineer • Andrew Foley • G. Daryan, Engineer	**NJR** • Jen Godoski • Bill Scharfenberg • Keith Edmonds • Mark Valori • Andrew Westhoven **BIR Attendees** • Eric Battisti **NV5 Attendees** • Sara Holmes • Jonathan Hess **Saul Ewing** • Andrew Bockis	Permitting meeting

Mass e-mail communications to all elected officials along the pipeline route

Date	Recipients	Subject
11/10/2017	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz, Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J. Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie	Introduction and announcement of intent to purchase IEC by Adelphia Gateway and shared news release.

Date	Recipients	Subject
	Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson, Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher Christmas	
1/15/18	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane	Notification that Adelphia has filed application with FERC and shared news release.

Date	Recipients	Subject
	Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz, Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J. Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson, Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David	

Date	Recipients	Subject
	Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher Christmas	
1/29/18	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz, Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J.	Notification that landowner notification letters were sent and that FERC public comment period has opened

Date	Recipients	Subject
	Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson, Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher Christmas	
2/20/18	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane	Notification of upcoming easement workshops for residents

Date	Recipients	Subject
	Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz, Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J. Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson, Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David	

Date	Recipients	Subject
	Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher Christmas	
3/6/18	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz, Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J. Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie	Notification that the March 7th ROW easement workshop was cancelled due to inclement weather

Date	Recipients	Subject
	Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson, Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher Christmas	
5/10/18	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz,	Announcement of upcoming FERC scoping meetings

Date	Recipients	Subject
	Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J. Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson, Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher	

Date	Recipients	Subject
	Christmas	
5/17/18	Sen. Bob Casey, Sen. Pat Toomey, Congressman Pat Meehan, Congressman Ryan Costello, Congressman Brian Fitzpatrick, Congressman Matthew Cartwright, Congressman Charlie Dent, Sen. Thomas Killion, Sen. Bob Mensch, Sen. John Rafferty, Sen. Andrew Dinniman, Sen. Charles McIlhinney, Sen. Lisa Boscola, Sen. Mario Scavello, Rep. Stephen Barrar, Rep. Brian Kirkland, Rep. Christopher Quinn, Rep. Michael Corr, Rep. Robert Godshall, Rep. Warren Kampf, Rep. Thomas Quigley, Rep. Marcy Toepel, Rep. Carolyn Comitta, Rep. Becky Corbin, Rep. Duane Milne, Rep. Craig Staats, Rep. Joe Emrick, Rep. Robert Freeman, Rep. Marcia Hahn, Rep. Steve Samuelson, Rep. Justin Simmons, Governor Tom Wolf, Sec. Patrick McDonnell, Sec. Dennis Davin, Sec. Leslie Richards, Com. Gladys Brown, Com. Andrew Place, Com. John Coleman, Com. David Sweet, Com. Norm Kennard, Kevin Madden, Colleen Morrone, Michael Culp, John McBlain, Brian Zidek, Michelle Kickline, Kathi Cozzone, Terence Farrell, Valerie Arkoosh, Kenneth Lawrence Jr., Joseph Gale, Charles Martin, Robert Loughery, Diane Ellis-Marseglia, John Cusick, William McGee, Lori Vargo Heffner, Matthew Dietz, Margaret Ferraro, Kenneth Kraft, Ronald Heckman, Tara Zrinski, Robert Werner, Lamont McClure, Josephine Laird, Bill Cox, Joe Flynn, Cheryl Everngham, John Kennard, Anna Kersey, Michael Manerchia, Andrew Weldon, Rocco Gaspari Jr., Vincent McCormick, Raymond Baldwin, David D'Angelo, John Schlachtun, Joseph Possenti Jr., Michael Gaudiuso, Joseph Neary, Joseph Baiocco, Edward Raikowski, Nicole Whitaker, George Needles, Michael Davey, Jean Stoyer, Alex Girbaldi, Mark Koehler, Trish Sharp, Dominic Pileggi, John Gillespie, Thomas Mahoney, John Crossman, Joshua Twerskey, Amanda Serock, Susan Clarke, Jordon Goldberg, Drew Baum, Philip Block, Steve Cocozza, Ginamarie Ellis, Theresa Agostinelli, Susan Timmins, James Raith, James Kelly, Sheri Perkins, Jeff Seagraves, Mike Di Domenico, Carol De Wolf, Scott Yaw, Robert Pingar, E. Martin Shane, Carmen Battavio, David Shuey, Janet Emanuel, Michael Lynch, Louis Smiith, Bill Holmes, Susan Drummond, Scott Lambert, John Nagel, Michele Moll, Theresa Santalucia, Joseph Denham, Mimi Gleason, Frank Piliero, Charles Philips, Kevin Kuhn, Michael Rodgers, Hugh Willig, Linda Csete, Ronald Graham, Russell Strauss, J. Benson Campbell, Kimberly Moretti, Kisha Tyler, John Pearson, Philip Barker, Laurie Higgins, Helene Calci, Albert Vagnozzi, Timothy Tiperman, Kevin Scholl, Cathy Johnson,	Sent copies of Adelphia Gateway mailers being sent to landowners and adjacent landowners along the route

Date	Recipients	Subject
	Tammy Liberi, Scott Martin, Philip Roncac, Stu Strauss, Pat Webster, Robert Umstead, William Patterson, Vivian Schoeller, Dean Becker, Janet Heacock, Gordon MacElhenney, Ceclie Daniel, Franco D'Angelo, Paul Fox, William Perkins Jr., Jeanene Michener, Nicolas Fountain, Christopher Heleniak, Douglas Gifford, Douglas Johnson, Keith Bergman, Christopher Canavan, Philip Heilman, Joseph Czajkowski, Kevin O'Donnell, Theodore Poatsy Jr., Richard Sacks, Amy Shafter, Barbara Lynch, John Baker, James Myers, Karen Landis, Jay Keyser, James Miller Jr., Don Duvall, Greg Lippincott, Tim Arnold, Rick Orloff, Timothy Ritter, Paul Stepanoff, Rich Brittingham, Karen Bedics, David Long, Robert Zisko, James Nilsen, Anthony Matzura, Michael Brown, Michael Hudak, Thomas Nolan, John Merhottein, Malissa Davis, John Gallagher, Melissa Shafer, John O'Neil, Erik Chuss, Bob Egolf, Dan Martyak, Ed Moore, John Cornell, Susan Disidore, David Ascani, Michael Deberardinis, Sandra Newman, Samantha Burns, James Pennington, LeRoy Bickert Jr., Martin Boucher, Robert Kucsan, Amy Templeton, Lori Stauffer, Ryan Stauffer, Sandra Yerger, Priscilla deLeon, Donna Louder, Glenn Kern, Leslie Huhn, David Colver, Michael Mitchell, Ann-Marie Panella, Robert Smith, Jeffrey Young, Christopher Christmas	

Date	Caller Name	Applicable Township	County	Message/Inquiry	Return call date	Call notes	
2/6/2017	Mija Hyon			Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	left vm	
2/6/2017	Chris Eckerd	Skippack Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	Confirmed abbutter, no additional questions	
2/6/2017	Kathy Leidheiser			Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	left vm, spoke on the phone 2/6/2018 asked for map of line in relations to property, map emailed 2/7/2018	
11/10/2017	Richard Eales	Willistown Township	Chester County	Thinks pipeline runs through a preserve in Willistown Township, Chester County. Thinks conversion to natural gas is needed and supports it. Want more information.	11/14/2017	Explained that the route does not run through the preserve. Ivana emailed information on the project.	
12/19/2017	Christina Johnson			Questions regarding Adelphia Gateway			
12/28/2017	Orval Gubrud			Wrong number, no applicable message.	n/a	n/a	
12/30/2017	Robert Fuller			no voicemail was left	n/a	n/a	
1/15/18	Amber Queen			calling about 3 properties that she things may be affected	1/15/2019	Spoke to Keith who will send maps via email.	
1/17/2018	Mike Fitzgerald			AVE home apartments, offering services to house workers.	1/18/2018	Mike's information will be passed to the project team if needed.	
1/29/2018	James Latsios	Concord Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/29/2018	from ROW: The landowner has one parcel on the line between MP 6 and MP 7. Their current ROW Agreement allows for the transportation of natural gas, so no amendment is needed on our end.	ROW: wants to put a shed close to but not near the ROW. How can he coordinate this.
1/29/2018	Ronald Avalino	East Goshen Township	Chester County	Business Manager for St. Simon and Jude Parish (Rev. John F. O'hara). Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	Requesting close up map of line closest to Church area, map sent via email 1/31/18	
1/29/2018	Andy Reuben	East Pikeland Township	Chester County	Wilshire Associates (7300 City Ave, Philadlephia) re: 550 Kemberton Road, Phoenixville, PA (East Pikeland Township). Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Left VM, abutting property, spoke in person 2/9/2018	
1/29/2018	Bonnie Durrenzl	Salford Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abbuting property only	
1/29/2018	Anthony Italiani	Bethlehem Township	Northhampton County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Spoke with Bill Sharpenburg (NJR attorney)	
1/29/2018	Ken Butkus	Concord Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abbuting property only	
1/29/2018	Joe Bezpalko			Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left VM 2/2/2018 confirming abutter, phone conversation 2/2	
1/29/2018	Mark Christman	Richlandtown	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	online landowner, nothing needed	
1/29/2018	Holly Shue	Thornbury Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Returned the phone call and explained why she was considered an abutting property. Township owns greenspace around her development. She now has clarification.	
1/29/2018	Rosemary Whitelock	East Pikeland Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property, close up map and what exactly is to be done in her community.	1/30/2018	left vm, called hotline 2/6/18, Ivana left VM 2/6/18	
1/29/2018	Alicia Katz	Thornbury Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.		resolved, spoke to Mark Valori	
1/29/2018	Wayne Aravich	Bethlehem Township	Northhampton County	Looking for more information of the project	1/29/2018	Left VM 1/29, phone tag. Reached 1/30/2018, Abutting property only.	
1/29/2018	Karyl Waltman	Salford Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Abutting property, explained proximity.	
1/29/2018	Stacy Hicks	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Abutting property close to Quakertown (Rich Hill) site	

Attachment #1b

1/29/2018	Matt and Renee Virgilio	West Pikeland	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left vm, spoke on 2/12/18 asked for map	
1/29/2018	Sharita Kuders	Concord Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left vm	
1/29/2018	Randy Esbin			Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left vm	
1/29/2018	Barton F			no voicemail was left	n/a		
1/29/2018	Gina Rominelli			Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	supporter of the project, wishes lots of luck.	
1/29/2018	Jacob Singer			Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left message with Elaine - Jacob Singer real estate	
1/29/2018	George Jones	Thornbury Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	He's a current landowner, anything else needed from him at this time: amendment? Ivana called back confirming nothing is needed at this time 1/31/18	
1/30/2018	Charles Audino	Perkiomen Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abutting property, only worry is if lateral will be on his property	
1/30/2018	Mike Miller			Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	left VM, online landowner, no needs at this time	
1/30/2018	Thomas Ward			Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	online landowner, no needs at this time	
1/30/2018	Neil Fischer			Hankin Group, Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left vm	
1/30/2018	Patricia Arabia	Thornbury Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abbuting property	
1/30/2018	Katrina Daly		Chester County	Received FERC landowner letter. Looking for more information on affect to property. Call at the end of the day.	1/30/2018	2 other property owners would like additional packets: Derek Stonorov, was going to ask brother if she can give contact info. Ivana left vm on 2/6/2018, Ivana left VM again no 2/15/2018	Wants more information on what has to be done to a 50 year old pipeline to get it to transport natural gas safely
1/30/2018	Frank Kuders	Concord Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018		
1/30/2018	Mark Wilcox			Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	tried to call 1/30 at 5:19, office line no extension, left VM 1/31	
1/30/2018	Emily Dewy	Forks Township		Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	On Jan 19th, a woman was seen on their home camera, seeming to survey the property. Not sure if this was AG or not	
1/30/2018	Holly Hosterman	Lower Salford Township	Montgomery County	Administrative Assistant for Lower Salford Township. Received letter, looking for information.	1/30/2018		
1/30/2018	John Healey	Thornbury Township	Delaware County	on Mile Post 10 on the pipeline. Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left VM	
1/30/2018	Michelle Fleck	Forks Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abbuting property	
1/30/2018	Thomas Miller	Springfield Township	Bucks County	neighbor received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	office line, left vm.	
1/30/2018	Frank Molster	West Rockhill Township		neighbor received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abbuting property	
1/30/2018	Jeff Victor	Concord Township?	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abbuting property	
1/30/2018	Nancy Daley	Charlestown Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	left vm, 1/31 spoke on the phone. Nancy is an assistant to Lisa Scottoline, landowner. Nothing is needed at this time.	
1/30/2018	Graham Wilkinson	Springfield Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abutting property, strong supporter	
1/30/2018	Everett Warren	East Goshen Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Requesting a map copy of where the line traverses through his property. Is the property directly impacted? Want this in writing. Ivana emailed map 2/6/2018	
1/30/2018	Mike Dottaviano	Upper Salford Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	abutting property, supporter, spoke about the project	

1/30/2018	Mary Lou Winkler Hoffman	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	general concerns about construction in her area, there's a development proposed behind her. I explained the work scope of the project and that the North end has been transporting natural gas already	
1/30/2018	Jeff Viola	Concord Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	online landowner, no needs at this time	
1/30/2018	Alix Coleman	Charlestown Township	Chester County	abutter	1/31/2018	abutting property, requests map of line in proximity to her property emailed. Map emailed 1/31/18 at 1:50 pm	
1/31/2018	Wendy				1/31/2018	left VM	
1/31/2018	Thomas Rowe	Lower Saucon Township	Northampton County	Wants to know where the metering station or lateral is with Columbia Gas	1/31/2018	Informed him location of existing Columbia meter station	
1/31/2018	Dorothy Strunk	East Pikeland Township	Chester County	abutting property only	1/31/2018	emailed AG as well on 1/31 at 9:09.	
1/31/2018	Linda Walsh	East Goshen Township	Chester County	Centennial Equity Group owns a few properties in Media, PA. Wondering which property is affected	1/31/2018	abutter, but already sold last year	
1/31/2018	Scott Seymore	Lower Saucon Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	left vm, spoke 1/31 abutter.	
1/31/2018	Ray Derstine			Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	online landowner, no needed at this time. Explained project, economic benefit, need for natural gas transport in SEPA.	
1/31/2018	James Mathis			Received FERC landowner letter. Looking for more information on affect to property.		abutting landowner, left VM	
1/31/2018	Donna McGrath Hrynkow			Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	called for Naylor Russell R Suzanne C, abbuter. called again 2/7/2018 asking if towers are being erected nearby, Ivana explained locations of propsed compressor stations	
1/31/2018	Robert Well			no VM left			
1/31/2018	Nick Conti	Upper Providence Township		Nick & Les Inc, abbuting landowner	1/31/2018	abutter	
1/31/2018	James Walt	East Pikeland Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	abutter	
1/31/2018	Evelynn			Knotts Management Properties	1/31/2018	left vm	
1/31/2018	Walter Chan			Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	abutter	
1/31/2018	Diane Bernard		jebb@rcn.com	Received FERC landowner letter. Looking for more information on affect to property.	1/31/2018	abutter	
1/31/2018	Jan Gerhart			Follow up to email	1/31/2018	abutter	
1/31/2018	Dina Jenney			request call at 4:30	1/31/2018	left vm, left VM again on 2/6/18, spoke on 2/8 explained nothing is needed at this time	
2/1/2018	Phillip Carr		carrcrew@comcast.net	requesting screenshot of property	1/31/2018	requesting screenshot of property, emailed 2/6/2018	
2/1/2018	Deborah Givens			confirming as abbuting property	2/1/2018	confirmed abbuter	
2/1/2018	Carl Kemmerer			confirming as abbuting property	2/1/2018	confirmed abbuter	
2/1/2018	Leonard Messina			Where new facilities are in Quakertown	2/1/2018	confirmed abbuter and location of compressor station in Bucks	
2/1/2018	Charles Focht			no VM left			
2/1/2018	Joe Getts			Received FERC landowner letter. Looking for more information on affect to property.	2/1/2018	confirmed abbuter	
2/1/2018	William Jacono	Chester Township	Delaware County	They're in a legal battle with Delaware County/ Chester Sewer Authority because they wanted 50' ROW from them. Wants to know if AG is in this same ROW	2/1/2018	Informed him lateral ROW is still to be completely finalized, surveys will determine if ROW is shared	

2/1/2018	Han Kyung Kyo				2/1/2018	left VM confirming abutter Green St, Marcus Hook PA 19061 (Tilghman)	
2/2/2018	Nick TSIADIS				2/2/2018	excited about getting natural gas, asked when he can get it to his home. Informed him that's a better question for PECO but explained that's part of the reason for the project.	
2/2/2018	Thomas Yatsko				2/2/2018	Have 3.5 acres there where the ROW runs. Would the pipeline be interested in selling his entire property since he's about 84 year old. Ivana forwarded to Keith.	
2/2/2018	Marjorie Alleva	Charlestown Township	Chester County		2/2/2018	left vm abbutter, spoke on the phone 2/2	
2/2/2018	Mike Fitzgerald			AVE apartments - wanted to see if project needs to house workers	2/2/2018	left vm that info has been forwarded to project manager	
2/2/2018	Joanne Simone			Holding a binder of FERC docs, wonders if her name is specifically on any correspondence. Someone called specifically for her and asked for the binder.	2/2/2018	spoke about the project, Ivana will check on name mention.	
2/2/2018	Lawrence Davidson	East Pikeland Township	Chester County	asked by Keith to follow up on his questions to ROW	2/2/2018	left VM with contact info.	
2/2/2018	Joe Chernaskey			online landowner, wanted to confirm if he needed to do anything. Saw in Morning Call that there's a deadline to respond by Feb. 5th (he saw a story about PennEast)	2/2/2018	confirmed nothing is needed at this time. Joe is friendly and used to integrity folks	
2/2/2018	Mia Lampa			Called Mark Valori, abbuting property	2/2/2018	confirmed abbuter	
2/3/2018	Timothy Walters			Received FERC landowner letter. Looking for more information on affect to property.	2/5/2018	Tim Walters Lawn and Landscaping Inc. 610-867-3533 had helped with ROW clean-up/ maintenance. Wants to offer services for future needs.	
2/5/2018	William MacCane			Called on behalf of parents, online LO, need amendment	2/5/2018	ROW will call him back specifically regarding property needs	
2/5/2018	John Ackerman			Received FERC landowner letter. Looking for more information on affect to property.	2/5/2018	Confirmed abbutter	
2/5/2018	Marvin C Leister, Jr			calling for parents not in good shape about notification	2/5/2018	Confirmed abbutter	
2/5/2018	David Smith				2/7/2018	left vm, no amendments needed	
2/5/2018	Jeanette Ranaglia			Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	tried to explain that ROW already exists and follows the transmission lines ROW, asked for a call back at 10:45, no answer at 11 am left VM, requests map to be sent to her house. ROW to send map	
2/5/2018	Elizabeth Facenda			Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	left VM confirming abbutter	
2/5/2018	Wayne Rosen			Received FERC landowner letter. Looking for more information on affect to property.	2/7/2018	confirmed online but no needs at this time	
2/5/2018	Chris			Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	Confirmed abbutter	
2/5/2018	Frank, Fiancee of Lisa Voshelle			Frank stated that he has cameras on the property and that there were surveyors out putting stakes in the ground on the property. He wasn't irate by any measure, basically just wanted to know what was going on and why we were on the property without permission. I told him as a first step we would confirm whether any construction was planned for the property and area and if Adelphia had any surveyors in the area.	2/6/2018	Bill called Frank back today and left a message confirming that there is no construction planned for this area and no survey activity ongoing.	
2/6/2018	Alfred Capecci	Lower Mount Bethel Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	2/6/2018	left vm, called again 2/12/2018	
2/6/2018	Janet Robertson	Westtown Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	2/7/2018	Would like detailed map of house to line and would like to know location of valves. map sent	

2/6/2018	Effie Maltezos	Lower Chichester Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	2/7/2018	confirmed abbuter	
2/6/2018	Kerry Bloom	Palmer Township	Northampton County	Looking for more information	2/7/2018	left VM, touched base 3/6/18, requests map, map emailed	
2/7/2018	Martha Parker	East Pikeland Township	Chester County	A homeowner in their coverage area received landowner letter, looking for more information on affect to property.	2/7/2018	confirmed Mr. Peffall is an abutter, map emailed 2/9/18	
2/8/2018	John Calbert	1140 S. Old Bethlehem Pike, Quakertown, PA		Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	Calling on behalf of mother, no further questions.	
2/8/2018	Andrew Barr			Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	left vm	
2/8/2018	Jim Dallen			voicemail to Keith, looking to meet with HOA, Ivana gave dates March 14, 20-23 on 3/5	2/9/2018	Called, will send email with map, and brochures. Requested potential meeting with 5 HOA board members. NJR met with Greenbriar I and II on 3/22/2018	
2/9/2018	Erik Miller	Charlestown Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	left vm	
2/9/2018	Deborah Ewer			Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	online landowner, nothing needed. Left VM	
2/9/2018	Lindsay Sheckler			Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	left VM 2/9/2018, touched base 2/27, let her know on-line property but no amendments needed at this time	
2/9/2018	Karen and Curt Gwynne	Concord Township	Delaware County	Wants to know exactly where the valve will be in Concord	2/9/2018	abutting landowner but expressed concern about where the valve location will be in Concord. Stated that husband spoke with attorney today. Asked for specific drawings, I informed her it is public knowledge on the FERC website.	
2/9/2018	David Krem			Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	confirmed abutter	
2/12/2018	Joseph Rico			Received FERC landowner letter. Looking for more information on affect to property.	2/9/2018	abutter, proposed lateral to PECO is along Rt. 291	
2/12/2018	Karen Crotts			Received FERC landowner letter. Looking for more information on affect to property.	2/12/2018	210 acre dairy farm split up into pieces. Doesn't know address that this is affecting but knows she has a farm lot on Slifer Valley Road. Name of the parnership is:Helwig Family Partnership. Would like specific map. Ivana emailed map 2/13/18	
2/12/2018	Robert Romig	Lower Saucon Township	Northampton County	Property close to Columbia Metering Station. Interested in selling his property, wondering if NJR wants to buy it from him.	2/12/2018	left VM letting him know I've passed along the interest	
2/12/2018	Patricia Bochnowicz	West Rockhill Township		Received FERC landowner letter. Looking for more information on affect to property.	2/12/2018	confirmed abutter	
2/13/2018	Paul Rimel	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	2/13/2018	confirmed abutter	
2/13/2018	Robin Davidheiser	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	2/13/2018	confirmed abutter	
2/14/2018	Linda Yavanovich	Bethlehem Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	2/20/2018	left vm, connected 2/21 confirmed abbutter	

2/14/2018	Frank Tosco	East Pikeland Township	Chester County	requested map, map sent 2/15/2018	2/14/2018	requests map	
2/14/2018	Kathleen George	Westtown Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	2/14/2018	abbuter only, no follow up questions	
2/14/2018	Frank Dougherty	Bethlehem Township	Northampton County	requested map	2/14/2018	abuter only, requested map, map sent 2/14/2018	
2/14/2018	Eileen Dehope	East Goshen Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	2/15/2018	abutter only, ask her for an email if she asks for a map	
2/14/2018	Francis Strenkoski			Received FERC landowner letter. Looking for more information on affect to property.	2/15/2018	confirmed abutter	
2/14/2018	Alice Fisher	Upper Salford Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	2/20/2018	confirmed abutter	
2/15/2018	John Furlong	West Rockhill Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	2/15/2018	confirmed abutter	
2/15/2018	Ray Nickson/ Dominic Marusco			Received FERC landowner letter. Looking for more information on affect to property.	2/16/2018	Tilghman lateral abutter, map sent to Ray Nickson (Lower Chi) on 2/16/2018	
2/16/2018	Mike Borchert	Lower Chichester Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property in Marcus Hook.	2/15/2018	abutter only to the existing facility on Ridge Road, Lower Chichester. There is a proposed compressor station to be built here.	
2/16/2018	Karen Davis			Received FERC landowner letter. Looking for more information on affect to property.	2/15/2018	Letter was sent to wrong address. Karen Davis is over 2 miles from pipeline. Letter was addressed to : Richard H and katherine L Davis.	
2/16/2018	Tara Tobin	Chester Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	2/16/2018	confirmed abutter Tilghman, expressed interest in selling 2 properties	
2/16/2018	Eileen Mulvano, Borough Engineer	Brookhaven Borough	Delaware County	Brookhaven resident received FERC landowner letter. Looking for more information.	2/20/2018	Defrank clarified locations	
2/16/2018	Paul Tobin	Chester Township	Delaware County	Received FERC landowner letter. Looking for more information on affect to property.	2/16/2018	abutter only for Tilghman lateral * Contacted Tara above., called NJR 2/20, Ivana returned call 2/21	
2/16/2018	Arthur McClaskey	Chester Heights	Delaware County	Gail Gallagher calling for Arthur McClasky. Received FERC landowner letter. Looking for more information on affect to property.	2/16/2018	confirmed abutter	
2/20/2018	Dave Emery	Bethlehem Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	2/20/2018	confirmed abutter	
2/20/2018	Lee Ann Golin, Michael Pompei	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	2/20/2018	confirmed abutter	
2/20/2018	George Molnar	Palmer Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	2/20/2018	online landowner, nothing needed	
2/21/2018	Paula Kocher	East Whiteland Township	Chester County	Abutter only	2/22/2018	Was confused with other pipeline. No follow up necessary.	
2/22/2018	Dawn Scatton		Luzern County	Received FERC landowner letter. Looking for more information on affect to property.	2/22/2018	Remove from mailing list. Addressed to William C and Dawn Holoman at this address. Holoman is her maiden name. Never owned property amywhere near pipeline. This property is 44 miles away from pipeline.	
2/22/2018	Suzie Helm	Westtown Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	2/22/2018	She wants to see a more detailed map and walk the line to see exactly where the pipeline is., map sent 2/23/18, email bounced back, will reconfirm Monday	

2/27/2018	Robert Hibble	Lower Nazareth Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property, wants better map		confirmed abutter, request map to be sent to his home. ROW to mail map		
2/27/2018	Robert Rufinski	Lower Saucon Township	Northampton County	Received FERC landowner letter. asked which property is in question; this property is an abutter: 2545 Quarry Ln, Hellertown, PA 18055	2/28/2018	left VM,		
2/27/2018	Mike Malloy	East Goshen Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	2/28/2018	left VM; New Kent apartments already have existing right of way along Boot Road side, but we do not anticipate construction there or needing anything from them. Ivana Connected 3/1, General Counsel requested copy of easement language that covers product transport. Easement sent via email on 3/7/2018 by Scharfenberg.	mike.malloy@hankingroup.com	General Counsel
2/27/2018	Diana Gredone	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property and where Quakertown compressor is located.	2/27/2018	Map emailed 3/5/2018		
2/27/2018	Andrew and Sandra Rasich	Lower Saucon Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	2/27/2018	confirmed abutter		
3/2/2018	John Vergona	Bethlehem Township	Northampton County	He was calling to find out if there would be any construction on or around his property.	3/2/2018	Bill confirmed for him that no construction was planned.		
3/6/2018	James Fannon	Concord Township	Delaware County	Requests map of project close to his property	3/6/2018	Map emailed. FYI - states he works for Dept. of Energy and is friends with Joe Biden		
3/14/2018	Evan Stone		Bucks County	Received FERC landowner letter. Looking for more information on affect to property.		GR to handle communications with Bucks County Planning Commission		
3/19/2018	David Seifert	Lower Saucon Township		Received FERC landowner letter. Looking for more information on affect to property.	3/20/2018	confirmed abutter		
3/19/2018	Joseph McGinnis	East Pikeland Township	Chester County	Neighbor told him anout project, concerned about his area.	3/20/2018	confirmed abutter and existing pipeline		
3/19/2018	Alfred Capecci	Lower Mount Bethel Township	Northampton County	Received FERC landowner letter. Looking for more information on affect to property.	3/20/2018	complaint to note: laims IEC crews do not clean up well when they do maintenance/ ROW trimming. Ivana encouraged him to call IEC for landowner issue since they still maintain the line.		
3/20/2018	TH Prop, Kevin Stranad			Received FERC landowner letter. Looking for more information on affect to property.	3/21/2018	confirmed no affect to property		
3/23/2018	Mel Ciociola (sounds like Sissyola)	Lower Mount Bethel Township	Northampton County	Called William P. Scharfenberg, received FERC landowner letter. Looking for more information on affect to property	3/26/2018	left vm, spoke on 3/27/2018, on-line landowner bought from PURDY four years ago, no amendments needed		
3/23/2018	Cynthia and James Nadolski	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	3/26/2018	confirmed abutter		
3/27/2018	Mike Choi	n/a	n/a	Offering services for pipeline engineering.	3/27/2018	Ivana responded to email sent on 3/27 stating information has been passed to project manager.		
4/2/2018	Chris Burke			Received FERC landowner letter. Looking for more information on affect to property.	4/2/2018	left VM		
4/2/2018	Alexandra Parente Carpenter	Trainer Borough		Received FERC landowner letter. Looking for more information on affect to property.	4/4/2018	Requested map to be emailed. Map emailed 4/16/18		
4/3/2018	Summer Landis				4/5/2018			
4/5/2018	Graham Crouse	East Pikeland Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	4/6/2018	Requested map to be emailed. Map emailed 4/16/18		
5/3/2018	Colleen Mahoney, Evergreen Properties		New Castle County	Received FERC landowner letter. Looking for more information on affect to property.	5/4/2018	William Schafenberg responded to email letting her know that the property is approx. 1700 feet away from Linwood compressor station and will not be affected.		
5/4/2018	Eunice Sewell		New Castle County	Received FERC landowner letter. Looking for more information on affect to property, requests better map	5/7/2018	Property within 1/2 mile of Linwood compressor station and will not be affected.		
5/7/2018	Dr. Ed Nathan, Beth Chaim Reform Congregation	East Whiteland Township	Chester County	Received FERC landowner letter. Looking for more information on affect to property.	5/7/2018	VM letting them know congregation is an abutting property		
5/8/2018	Robert Miklas, Miklas Realty	Springfield Township	Bucks County	Selling the property of Gertrude Vargo who received the FERC package. Looking to see if the property is affected.	5/8/2018	Confirmed abutter		

5/8/2018	Julie Papa	Concord Township	Delaware County	Called Bill Scharfenberg, wondering if the letter she received was sent to the correct person because the letter has her address, but there's a different person's name on it.	5/11/2018	Ivana to email map and check why letter was sent to CONDIGN ASSOCIATES LP but to their address.	
5/8/2018	Bruce Kershaw	Concord Township	Delaware County	Called Bill Scharfenberg, He is wondering if the pipes will be crossing his property.	5/11/2018	Informed Mr. Kershaw that he is an online landowner, explained project and that it is not an installation of a new pipe.	
5/10/2018	Jared Mehl	Perkiomen Township	Montgomery County	Received FERC landowner letter. Looking for more information on affect to property.	5/15/2018	Left VM confirmed abutting property	
5/15/2018	Acquanetta Harper	Chester Township	Delaware County	Via William Sharfenberg: J.D. Hoyle (202-502-6198) from the FERC Dispute Resolution Service called me to say that Ms. Aquanetta (sp?) Harper with address of 2730 West Street, Westchester, PA, with telephone # 610-497-5283 had called. She received a recent letter from Adelphia and is concerned about the impact on her property. She would like us to call her back.	5/15/2018	She told me that she is elderly in her 70's and claims to have dimentia and other health concerns. She stated she has no interest in moving from her residence. I informed Ms. Harper that we do not have intention to do so but explained that there is a proposed pipeline installation under RT 291 but her property will not be impacted. She thanked me for the information.	
5/17/2018	Elmer and Virginia Shemeley			Asking where Quakertown compressor station and metering station will be.	5/18/2018	Left VM with contact info	
5/18/2018	Diana Wheeler	Perkiomen Township	Montgomery County	Received several letters and brochures in the mail. Looking for more information on affect to property.	5/18/2018	Requested map and expressed concern about gas line. I explained that natural gas provides heat and cooking energy to homes and businesses. Ivana to send map and safety brochures.	
5/21/2018	Eileen McKenzie	Concord Township	Delaware County	Called for more information	5/22/2018	Had former address of 21 Newberry Ct, Glenn Mills, PA but no longer lives there. Mail was bring forwarded from this address. Confirmed that AG does not go through Havertown.	
5/22/2018	Robert Rafinski			Received several letters and brochures in the mail. Looking for more information on home access to natural gas.	5/29/2018	Does not want to recceive more mailers. Asked if distribution to natural gas for his area is guaranteed from this project; I explained that AG gives LDCs more access to natural gas due to increased supply, but at the end it would be up to LDC to fulfill those projects.	
5/23/2018	Mike Pileggi for ISCHIA LT				5/25/2018	Confirmed abutter	
5/23/2018	Ken Foster for Lower Saucon Township			question about depth of the pipeline	5/25/2018		
5/23/2018	Marion Karcanes			Calls to ask to be removed from distribution, she no longer owns 26 Freedom Ter, Easton, PA, 18045	5/25/2018	confirmed that the Freedom Terrace property was an abutter, and will try to remove her from the mailing. Apologized in advance if it gets to her again and to ignore it	
5/29/2018	Robert and Mary Louise Castelletti			Received FERC landowner letter. Looking for more information on affect to property.	5/30/2018	Left Voicemail and contact information.	
5/30/2018	Alfonso Akutowicz			Called William Sharfenberg for more information on the pipeline and affect to property	6/4/2018	Confirmed abbutter and will send map via email. He also asked for more information on pipeline safety as he has general concerns of gas transportation close to his home.	
5/31/2018	Rosemary Merrigan			Dave Johnson received a voicemail on the Adelphia Open Season line from Rose, who lives adjacent to the compressor location (my translation), seeking more information and also complaining no one from Adelphia was in attendance.	6/1/2018	5/31/2018 - Rosemary Cuce called Adelphia Open Season Line 6/1/2018 - Ivana called Rosemary, left a voicemail and contact information 6/4/2018 - Ivana and Rosemary connected via phone. Rose asked questions about: compressor buildings, noise, orders, if there are any drilling activities related to construction, frequency of technicians visiting the site. Ivana will look into these questions and get back to Rosemary. 6/10/2018 - Ivana left voicemail letting Rosemary know that we are working on questions. 6/19/2018 - Ivana called Rosemary to discuss the items she asked about during the previous call. Answers were given and Ivana asked if Rosemary and her husband would be willing to meet in person to discuss the project and specifically landscaping buffers from her house as she had a question about aesthetics). Rosemary became emotional, so we will touch base again in a couple of weeks. 7/2/2018 - Ivana called Rosemary to touch base on previous conversation. Reminded her that the offer to meet in person still stands. Rose stated that she thinks it wouldn't be best for her to meet with Adelphia at this time because they don't want the station altogether. The conversation also revolved around Adelphia's meeting with West Rockhill Township Planning Commission.	

6/12/2018	Tony Mazzamuto			Received FERC landowner letter. Looking for more information on affect to property.	6/12/2018	Left VM, confirmed abutter and contact info	
6/12/2018	Sue Dialy, Remax 440			Realtor selling parcel owned by Edwin Nusbaum, looking for more information on affect to property.	6/14/2018	Left VM, online landowner but no amendments were needed. Permission to send map given by Nusbaum on 6/15/18, map emailed 6/17/2018	
6/14/2018	Christina Ziff, Wawa Real Estate		Delaware County		6/15/2018	Left VM and connected that WAWA property is an abutter, Ivana emailed mapping 6/18/2018	
6/15/2018	Stacy Hicks	Richland Township	Bucks County	Received FERC landowner letter. Looking for more information on affect to property.	1/30/2018	Abutting property close to Quakertown (Rich Hill) site	
7/2/2018	Louis Joyner	Lower Saucon Township	Northampton County	Louis Joyner and realtor Petrina Calanto asked for more information on the project and affect to property as they are planning to sell a part of the land.	7/3/2018	Spoke with Petrina Calanto and sent email with map of the property, depicting the route	
7/9/2018	Drake Nakiishi	Chester City	Delaware County	Received FERC letter. Looking for more information on Tilghman lateral plans	9/11/2018	Left Voicemail and contact information. Spoke on the phone 9/11/18, requested proposed map of lateral path and copy of FERC submission.	
7/11/2018	Michael Trenwith	Richland Township	Bucks County	Called JD Hoyle (FERC) with questions regarding the impact of the Adelphia project on their property. William Sharfenberg informed internal team.	9/12/2018	Left voicemail confirming abutter and closest construction is Quakertown compressor station. Left contact information. Connected afternoon of 7/12/18 and confirmed mentioned information.	
7/26/2018	Gregory Beck	West Rockhill Resident	Bucks County	Calling about West Rockhill Township and when the next meeting is planned? He is a West Rockhill Resident and wants to find a way to support the project.	7/27/2018	Steamfitters Local 420. Thanked him for his support and encouraged for him to go to the website for more information.	
8/8/2018	Ron Gross		Bucks County	Interested in buying a home on High Meadow Road in Coopersburg, Bucks County and wondered if it was a part of the southern segment to be converted. Wondered if the valve site close by is going to have construction on it.	8/9/2018	Confirmed that High Meadow Road is a part of the northern segment and that the valve is not part of the list to be upgraded with blow downs.	
8/24/2018	Shirley Mann	West Rockhill Resident	Bucks County	Wants a public meeting with West Rockhill Township and residents, does not want a one-on-one meeting.	8/25/2018	Ivana called the originating number, but no voicemail was set up. Ivana attempted outreach again on 8/29/2018	
10/10/2018	Amon Smith			Seeking more information about the project.	10/12/2019	left voicemail	
1/17/2019	Rajwinder Nagra	Bethlehem	Norhampton County	Received mailing, called to see if he is affected by the project.	1/17/2019	Explained he is an abutter and received correspondence just as an FYI	
1/18/2019	Jane and Mike Kerr	East Pikeland	Chester County	Property at 2901 Doris Ct, Phoenixville PA is an abutter	1/23/2019	Informed Ms. Kerr that their property at 2901 Doris Ct, Phoenixville PA is an abutter	
1/21/19	Gene Coccia	East Pikeland	Chester County	Own a few properties in East Pikeland, asking for more information and whether or not the project affects his current agreement with IEC	1/23/2019	Imformed Coccia that there is no expecded construction on his property. Ivana will send one-page materials via mail, since he does not want to comb through the many package materials he had received.	
1/29/2019	Bruce Dorblan	Marcus Hook Borough	Delaware County	Seeking more information about the project and if it affects Marcus Hook Borough	1/31/2018		

Date	Name	Applicable Township	County	Message/Inquiry
2/1/2018	Sheila Vogelstang McCarthy	West Rockhill Township	Bucks County	Letter sent addressed to Mark Valori asking for more information on the survey permission on their property and plan for Quakertown Compressor Station. Western Land or project team to address.
2/2/2018	Christopher and Mary Scavello			Attorney George Randolph of Riley, Riper, Collins and Colagreco law firm sent mail correspondence to IEC and Western Land Services to let the project know of legal representation and requested a call back regarding the Scavello property and amendment needs. Letter is dated 2/2/2018.
2/2/2018	Richard and Georgeann Wambold	Lower Mount Bethel	Northampton County	Attorney Joseph Piperato from Piperato Law Office sent mail correspondence to Mark Valori to let the project know of legal representation of the Wambold household. AG receipt letter sent 2/6/2018
2/2/2018	James and Shelly Bartolacci	Lower Mount Bethel	Northampton County	Attorney Joseph Piperato from Piperato Law Office sent mail correspondence to Mark Valori to let the project know of legal representation of the Bartolacci household. AG receipt letter sent 2/6/2018
2/2/2018	Robert and Sonia Alford	Lower Mount Bethel	Northampton County	Attorney Joseph Piperato from Piperato Law Office sent mail correspondence to Mark Valori to let the project know of legal representation of the Alford household. AG receipt letter sent 2/6/2018
2/2/2018	Paul and Tammy Abernathy	Lower Mount Bethel	Northampton County	Attorney Joseph Piperato from Piperato Law Office sent mail correspondence to Mark Valori to let the project know of legal representation of the Abernathy household. AG receipt letter sent 2/6/2018
2/2/2018	Seth Walbridge	Lower Mount Bethel	Northampton County	Attorney Joseph Piperato from Piperato Law Office sent mail correspondence to Mark Valori to let the project know of legal representation of the Walbridge household. AG receipt letter sent 2/6/2018
3/2/2018	John Vergona	Bethlehem Township	Northampton County	Scharfenberg received call to see if any construction will be happening on or around their property. Scharfenberg explained that there will not be construction near them.
3/6/2018	Churchill Cemetary Inc.	Lower Mount Bethel	Northampton County	Attorney Christopher Spadoni sent mail correspondence to Adelphia Gateway to let the project know of legal representation of the Churchill Cemetary property. Letter is dated 3/6/2018. William Scharfenberg mailed letter acknowledging representation on 3/9. Attorney Spadoni sent a follow-up letter dated 3/13 claiming no response from AG; potential overlap in mailings.
3/6/2018	Melissa Moyer			Called Scharfenberg's office to ask about the Quakertown Compressor Station but hung up before more information was given
3/22/2018	Loch Aerie Mansion, LLC	East Whiteland Township	Chester County	James B. Griffin P.C. sent mail correspondence to Mark Valori to let the project know of legal representation of the Walbridge household.
3/30/2018	David Litishin	East Pikeland Township	Chester County	
4/13/2018	Mr. Joe D'Orazio and Ms. Carol Swerdon			Scharfenberg sent email with more information on the project.
5/8/2018	Julie Papa	Concord Township	Delaware County	Called Bill Scharfenberg, wondering if the letter she received was sent to the correct person because the letter has her address, but there's a different person's name on it. Ivana to email map and check why letter was sent to CONDIGN ASSOCIATES LP but to their address.
9/12/2018	Rosemary Merrigan and Thomas Cuce	West Rockhill Township	Bucks County	Letter dated 1/15/2019 was sent to Mark Valori expressing opposition to the Quakertown Compressor Station
10/4/2018	Adele Chernekoff-Paulin	East Goshen Township	Chester County	Inquiry came to Vinson & Elkins LLP on FERC mapping, AG sent email over with mapping of ROW related to property and asked for contact information to speak on the phone. No phone number given.
12/11/2018	Robin Bryant	Chester City	Delaware County	Attended meeting with Trainer Borough. AG to follow up on any questions. Meeting to be scheduled.
1/15/2019	Virginia Moore	Chester City	Delaware County	Contacted Scharfenberg in reseponse to the EA notice and asked where the pipeline are relative to properties at 113 Grace St, 100 Lewis St. and 131 Lewis St. Scharfenberg sent mapping and explanation of Tilghman lateral on 1/15/2019.
1/16/2019	Mark Wilcox	Concord Township	Delaware County	Mr. Wilcox owns property at 145, 179, 226 and 266 Ivy Mills Rd. He contacted FERC Landowner Helpline in response to a notice received for the FERC EA. Scharfenberg emailed mapping on 1/16/2019 and followed back up with FERC.

Attachment #1c

Date	Name	Applicable Township	County	Message/Inquiry	Assigned to	Return email date	notes
12/14/2017	Rick Smith	East Goshen Township	Chester County	Township Manager asking for information on the project	Stephen DeFrank		
1/26/2018	Charles Higgins				n/a		Comment about not wanting pipeline
1/29/2018	Jan H. Gerhart	West Rockhill Township	Bucks County	Looking for map indicating line close to her property	Ivana Wolfe	1/31/2018	abutting property, sent email to confirm address first on 1/31/18, map sent 2/1/2018
1/30/2018	Nancy Lichak	Lower Saucon Township	Bucks County	Looking for map indicating line close to her property	Ivana Wolfe	1/31/2018	abutting property, sent email to confirm address first on 1/31/18, map sent 2/1/2018
1/31/2018	Dorothy Strunk	East Pikeland Township	Chester County	Looking to see if property is affected	Ivana Wolfe	1/31/2018	
2/1/2018	Dallas Pulliam	Bethlehem Township	orthampton County		Ivana Wolfe	2/6/2018	left message and emailed back 2/6/2018
2/2/2018	Tom Marino	Richland Township		Parks and Recreations Director for Richland Township, interested in adding a multipurpose trail for the Township and asked if Adelphia would be interested in supporting.	Stephen DeFrank		
2/4/2018	Laura Sterns	Lower Saucon Township	orthampton Coun	Recently bought the property and asked for ROW records to be updated	Ivana Wolfe		Confirmed receipt of email and sent to Western Land for any necessary updates
2/5/2018	Justin Hunt			Aaron Bass from IEC forwarded note from Justin Hunt asking if the project would affect their Kimberton Project	Ivana Wolfe	2/6/2018	left VM asking for more info on Kimberton Glen project: 106 Meadow Lane, Phoenixville, PA or 461 Schuykill Road, Phoenixville , touched base 2/6/2018, map sent 2/8/2017
2/9/2018	Katrina Harris	Upper Chichester Township	Delaware County	Looking to see if property is affected	Ivana Wolfe		
2/9/2018	Andrew Smith	East Goshen Township	Chester County	Looking for map indicating line close to property	Ivana Wolfe	2/9/2018	Map sent 2/9/2018, they are a part of the White Chimney HOA which Western Land is meeting with in February
2/14/2018	Trien Pham			Looking for map indicating line close to her property	Ivana Wolfe	2/16/2018	map sent 2/16/2018
2/16/2018	Joshua Cal		Delaware County	Wants to work on the Adelphia project, lives close to Marcus Hook	Ivana Wolfe	2/17/2018	Informed that the project is still in the early stages but will pass interest along to project team
2/18/2018	Dot Meier	Forks Township	orthampton Coun	Received FERC notice and wants to know if she is impacted	Ivana Wolfe	2/21/2018	called back, confirmed abutter
2/20/2018	Robert McCafferty	Lower Saucon Township	orthampton Coun	Received FERC notice and wants to know if he is impacted, asked for map	Ivana Wolfe	2/21/2018	called back, confirmed abutter
2/23/2018	Chernekoff-Paulin and Mitchell	East Goshen Township	Chester County	Informed that they will not be attending the easement workshop	Ivana Wolfe	2/23/2018	confirmed receipt of RSVP
2/25/2018	David McClanahan			RSVP to easement workshop	Ivana Wolfe	2/25/2018	confirmed receipt of RSVP
2/26/2018	John Bermel			RSVP to easement workshop	Ivana Wolfe	2/26/2018	confirmed receipt of RSVP
2/26/2018	Brian and Teresa Filippo	East Pikeland Township	Chester County	RSVP to easement workshop	Ivana Wolfe	2/26/2018	confirmed receipt of RSVP
2/26/2018	Bob Ottinger	East Pikeland Township	Chester County	RSVP no to easement workshop, wanted to make sure amendment does not include another pipeline construction	Ivana Wolfe	2/26/2018	Ivana forwarded to Western Land
3/1/2018	Susan Britton Seylers			Asked for detailed Chester County Map	Ivana Wolfe	3/3/2018	Emailed county-wide map and suggests that she follows the website for future information
3/2/2018	Rochelle Quirple	East Pikeland Township	Chester County	RSVP to easement workshop	Ivana Wolfe	3/2/2018	confirmed receipt of RSVP
3/8/2018	Nevin Scholl	Trappe Township	Bucks County	Asking if Trappe Borough is affected by the project	Ivana Wolfe		
4/6/2018	Richard Garaffa	Bethlehem Township	orthampton Coun	Ask for a closer map	Ivana Wolfe		
5/5/2018	Michael Erwin	Richland Township	Bucks County	Ask for specific location of the Quakertown Compressor Station	Ivana Wolfe	5/10/2018	Emailed map of property with pipeline ROW depicted
5/6/2018	Emily Hajjar	Bethel Township	Delaware County	Received FERC mailing, asked for closer map	Ivana Wolfe		
5/19/2018	Don Lindauer	Westtown Township	Chester County	Asked whether he will be able to connect to natural gas because of the project	Ivana Wolfe	5/25/2018	Ivana called and explained the project is for the transmission pipeline.
5/20/2018	Jeff Givens	Upper Salford Township	Montgomery Coun	Asked for a closer map		5/24/2018	Asked if there's a specific property to reference. No response
5/21/2018	Holly Stefanow	Thornbury Township	Delaware County	Asked to update the homeowner of record		5/24/2018	Confirmed receipt, sent info to ROW
5/22/2018	Jerry Coleman			Asked for mapping		5/23/2018	Address requested via email, but did not respond
5/24/2018	Jennifer Jankowski		New Castle Count	Called on behalf of Rep. Matthews (DE) if business at business is Naaman's Beverage Mart, located at 2713, 109 Naamans Rd, Claymont, DE 19703 is affected.		5/24/2018	Ivana called office and described the project. Property in question is not impacted.
6/10/2018	Margaret Quinn		Chester County	Asked for Chester County Map		6/25/2018	Map emailed 6/25/2018, follow up mapping 7/2/2018

Attachment #1d

6/19/2018	Carla Joy Zambelli	East Whiteland Township	Chester County	Email stating opposition to the project to IEC, Enbridge, Sen. Dinniman's office and Chester Co Planning Commission		6/21/2018	CCPC responded with general pipeline information and stated she is not on-line on 6/20/2018. IEC emailed on 6/21/2018. Email sent on 6/23 if there are additional/ unanswered questions. Ivana to meet in person on 7/23/2018. Meeting was attended by Lynda Farrell (PSC), neighbor Christine Kantrowitz, Virginia Kerslake and Scott Lambert (E. Whiteland Supervisor).
6/29/2018	Scott MacNair	Springfield Township	Bucks County	Solicitor for Springfield Township looking for more information on project and to set up meeting	Stephen DeFrank		
7/9/2018	Drake Nakaishi			Chester Economic Development Authority looking for more information		7/10/2018	Ivana called and briefed over the phone. Mapping emailed 7/26/2018. Steve DeFrank and Jen to connect with Chester City
7/24/2018	Lynda Farrell			Representing Pipeline Safety Coalition, sending information after meeting with Carla Zambelli Mudry			
9/4/2018	Larry Bak			Via IEC, connecting with Delaware County Emergency Management Services on pipeline risk analysis	Stephen DeFrank		
10/4/2018	Adele Chernekoff-Paulin	East Goshen Township	Chester County	Inquiry came to Vinson & Elkins LLP on FERC mapping		10/5/2018	AG sent email over with mapping of ROW related to property and asked for contact information to speak on the phone. No phone number given.
11/14/2018	Andrew Heimark			Heimark, on behalf of Bucks County Planning Commission asking for future contact for AG after transition from IEC		11/4/2018	IEC responded and connected the group
11/16/2018	Robert McCafferty	Lower Saucon Township	lorthampton Coun	Asked for mapping	Ivana Wolfe	11/18/2018	Mapping emailed
12/21/2018	Bruce Swalm			asking about ROW agreements and what's needed	Ivana Wolfe	12/21/2018	Emailed if he is inquiring about specific property and gave brief description of project
1/4/2019	Rosemary Merrigan	West Rockhill Township	Bucks County	Statement/opinion			
1/17/2019	Julia Wilson	Concord Township	Delaware County	Spoke with Keith Edmonds on 1/17/2018	Ivana Wolfe	1/17/2019	Emailed mapping and clarification on project scope

RI 9523

REPORT OF INVESTIGATIONS/1994

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Surface Mine Blasting Near Pressurized Transmission Pipelines

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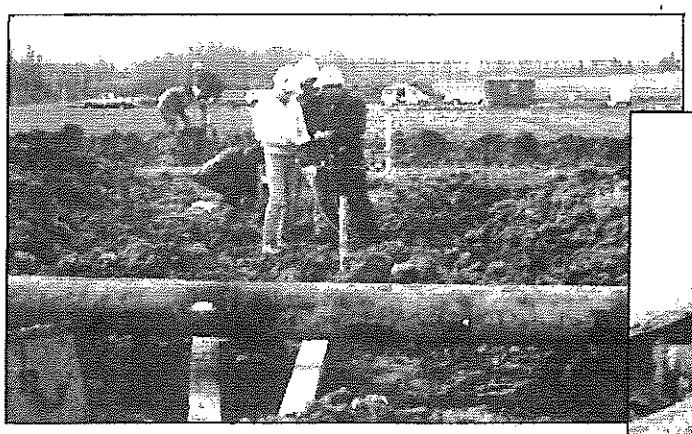
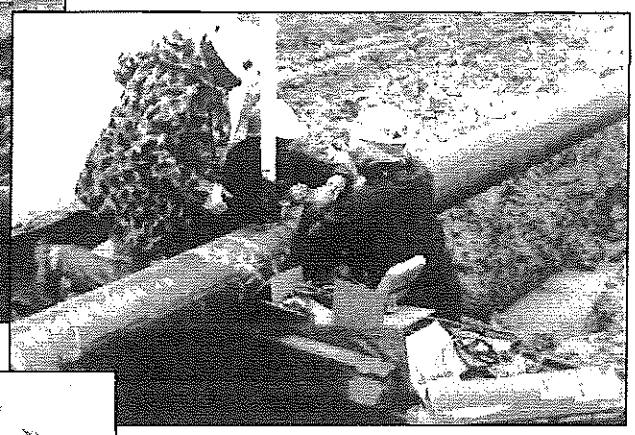
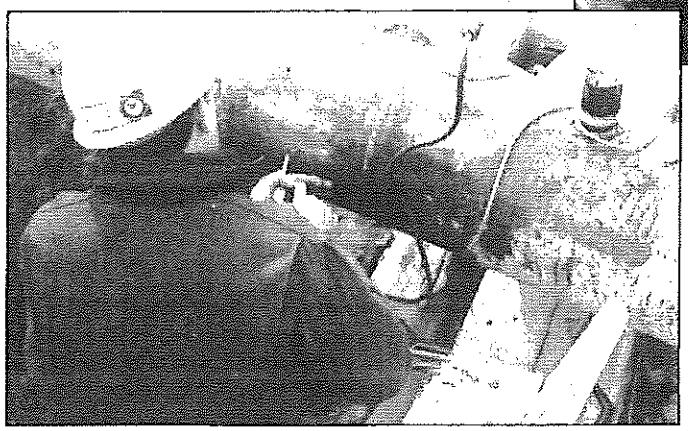
By David E. Siskind, Mark S. Stagg, John E. Wiegand, and David L. Schulz







UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

Attachment #2

U.S. Department of the Interior Mission Statement

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Cover: U.S. Bureau of Mines researchers install strain and vibration sensors on transmission pipelines before the pipelines are buried and backfilled on a surface coal mine highwall. Five pipe sections were tested for their response to blast vibrations and potential damage.

Report of Investigations 9523

Surface Mine Blasting Near Pressurized Transmission Pipelines

By David E. Siskind, Mark S. Stagg, John E. Wiegand, and David L. Schulz

UNITED STATES DEPARTMENT OF THE INTERIOR
Bruce Babbitt, Secretary

BUREAU OF MINES
Rhea L. Graham, Director

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

Metric Units

cm	centimeter	m/s	meter per second
dB	decibel	min	minute
g/cm^3	gram per cubic centimeter	mm	millimeter
GPa	gigapascal	mm/s	millimeter per second (particle velocity)
h	hour	MPa	megapascal (million newtons per square meter)
Hz	hertz		
kg	kilogram	ms	millisecond
km	kilometer	Pa	pascal (newton per square meter) (pressure and stress)
m	meter	pct	percent
$m/kg^{0.33}$	meter per scaled kilogram, cube root scaled distance	s	second
$m/kg^{0.4}$	meter per scaled kilogram, 0.4 root scaled distance	$\mu mm/mm$	micromillimeter per millimeter (microstrain)
$m/kg^{0.5}$	meter per scaled kilogram, square root scaled distance		

U.S. Customary Units

cal/g	calorie per gram (specific energy)	in/s	inch per second (particle velocity)
ft	foot	lb	pound
ft/lb	foot per pound	lb/ft^2	pound per square foot (pressure)
ft-lb	foot pound (energy)	lb/in^2	pound per square inch (pressure and stress)
ft-lb/lb	foot pound per pound (specific energy)	$lb\text{-}s^2/ft^4$	pound second squared per foot to the fourth (mass density)
ft/s	foot per second (propagation velocity)		
in	inch	lb/yd^3	pound per cubic yard

Reference to specific products does not imply endorsement by the U.S. Bureau of Mines.

SURFACE MINE BLASTING NEAR PRESSURIZED TRANSMISSION PIPELINES

By David E. Siskind,[1] Mark S. Stagg,[2] John E. Wiegand,[3] and David L. Schultz[4]

ABSTRACT

The U.S. Bureau of Mines and the State of Indiana cooperated with AMAX Coal Co. and its consultants to determine the effects of coal mine overburden blasting on nearby pipelines. Five pressurized 76-m pipeline sections were installed on the Minnehaha Mine highwall near Sullivan, IN, for testing to failure. Four 17- to 51-cm-diameter welded steel pipes and one 22-cm PVC pipe were monitored for vibration, strain, and pressure for a period of 6 months while production blasting advanced up to the test pipeline field. In contrast to previous studies of small-scale, close-in blasting for construction, these tests involved overburden blasts of up to 950 kg per delay in 31-cm blastholes.

Analyses found low pipe responses, strains, and calculated stresses from even large blasts. Ground vibrations of 120 to 250 mm/s produced worst case strains that were about 25 pct of the strains resulting from normal pipeline operations and calculated stresses of only about 10 to 18 pct of the ultimate tensile strength. No pressurization failures or permanent strains occurred even at vibration amplitudes of 600 mm/s.

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[2]Civil engineer, Twin Cities Research Center.
[3]Proprietor, Vibronics, Inc., Evansville, IN.
[4]Electronics technician, Twin Cities Research Center.

INTRODUCTION

The U.S. Bureau of Mines (USBM) participated in a study of surface mine blasting impacts on gas and water transmission pipelines in a cooperative effort with the Division of Reclamation of the Indiana Department of Natural Resources (IDNR), AMAX Coal Co., and its consultants, Vibronics, Inc., New Mexico Institute of Mining and Technology, and Ohio Valley Pipeline, Inc. AMAX had concerns about blasting near active pressurized transmission pipelines at its Minnehaha Mine, near Sullivan, IN, as well as at other mines. As a result, the company approached the USBM and other cooperators in the fall of 1991 about the feasibility of conducting a study involving a variety of test pipelines subjected to full-scale overburden blasts at one of its surface coal mines.

This project provided an opportunity to study a problem of widespread concern. Numerous requests for advice on blasting near pipelines have been received by the USBM over the years, many related to mine or quarry operations. In a blast vibrations research planning document first prepared in March 1989, the USBM identified blasting near pipelines as a key research topic and industry need. Although some work was done in the 1970's and 1980's on blasting near pipelines, none to the authors' knowledge involved large-scale production mine blasting. Most, if not all, previous work examined close-in, small-scale blasts representative of excavation for pipeline installations next to existing lines. The industry and regulatory agencies need realistic guidelines for mine blasting near pressurized transmission pipelines to ensure both maximum resource recovery and the safety of such utilities.

The USBM role was to install and operate monitoring equipment for measuring strain and vibration and to interpret the results of those measurements. Other cooperators had responsibilities for pipeline installation (Ohio Valley Pipeline), supplemental vibration monitoring and continuous monitoring of internal pressures (Vibronics), and analysis, interpretation, and monitoring support (IDNR and New Mexico Tech.). AMAX provided the site, costs of pipeline installation, security fence and other facility improvements, and shot coordination.

Installation and monitoring began in March 1992, ensuring reasonable weather for the difficult installation phases. Monitoring locations were chosen so that initial vibration levels would be about 50 mm/s. Five total mining cycles of roughly 45 days each brought the blasting adjacent to the pipelines.

This report is an expanded version of a paper given at the Ninth Annual Symposium on Explosives and Blasting Research sponsored by the International Society of Explosives Engineers, January 31 - February 4, 1993, in San Diego, CA (*1*).[5]

BACKGROUND

PIPELINE IMPACTS FROM LARGE VIBRATION EVENTS

Some previous work has been done on vibration impacts on transmission pipelines. An examination of earthquake-induced pipeline responses concluded that buried pipelines move with the ground and not differentially. The most serious concern was for locations where the soil-rock characteristics abruptly change (*2*).

The U.S. Army Corps of Engineers tested pipeline responses to a concentrated 9,000-kg TNT blast (*3*). One end of a 15-cm-diameter, 67-m-long, pressurized pipeline was located only 24 m from ground zero. Although that end was in the crater and ejecta zone and experienced some permanent deformation, no visible breaks occurred. Internal pressure had dropped from 3.45 to 2.76 MPa, but no leaks could be seen. Peak dynamic strains, all measured longitudinally, were 1,100 to 1,400 μmm/mm, and estimated total strains, including those from pressurization, were about 1,550. The authors of the Corps report estimated yield stresses and strains of 414 MPa and 2,000 μmm/mm, respectively, and reported measured radial vibration of 4,270 mm/s (168 in/s).

SOUTHWEST RESEARCH INSTITUTE STUDIES

The most extensive studies of blasting and pipelines were those of Southwest Research Institute (SwRI) for the Pipeline Research Committee of the American Gas Association (*4-7*). SwRI and its sponsors were concerned with both mining and close-in construction blasts, particularly in the installation of new pipelines next to existing ones. However, because the initial soil tests and the followup tests involving blasting in rock all used small charges and short distances, there is a question of how applicable their results would be to the much larger mining blasts. Many if not all of the SwRI tests involved pipelines close to or

[5]Italic numbers in parentheses refer to items in the list of references preceding the appendixes at the end of this report.

within the zone of inelastic strain and permanent deformation. Appendix A describes the SwRI tests and results and also the adjustments made to the SwRI predictions in a more recent paper by Lambeth (*8*).

OTHER ANALYSES OF PIPELINES

Lewis L. Oriard, in his capacity as consultant for many pipeline projects, commented on the USBM's pipeline measurements given in Siskind's 1993 paper (*1*) in two personal communications to the senior author (*9-10*). His involvement with many large pipeline projects as well as roughly 350 urban pipeline and utility projects has led him to conclude that the blasting risk to pipelines is from block motion (permanent strain) or from having the pipeline in the actual blast crater zone. He suspects that no elastic wave (vibration velocity) criterion is needed, nor is it meaningful. Oriard also concludes that failure is initiated in the surrounding ground, which is weaker than the pipe, and that it is better to apply either vibration criteria or blasting criteria to the ground around the pipe rather than to the pipe alone. Oriard reported on a 2,000-km pipeline project adjacent to an existing high-pressure gas line. Blasting was as near as 4 m, with a safe-level criterion of 300 mm/s. Several unscheduled blasts were detonated, the largest consisting of nearly 27,000 kg (60,000 lb) of explosives along 2.1 km (7,000 ft) of trench, detonated instantaneously. Particle velocities were calculated to range as high as 2,500 to 3,700 mm/s. No damage occurred. Oriard also commented on very large strains (bending) observed during installation or relocation of pipes, even while the pipes were still pressurized, without damage.

Oriard's first communication also included a description of a blasting study he conducted on an unpressurized 37-m-long section of 91-cm pipeline with 11.13-mm wall. These were close-in tests with charges of 2.7 to 10.9 kg per delay. No damage was found even from the highest blast vibration: 318 mm/s, 1,494 μmm/mm strain, and calculated circumferential and longitudinal stresses of 248 MPa (36,000 lb/in^2) and 379 MPa (55,000 lb/in^2), respectively.

Jack L. Kiker who has consulted with Oriard on a variety of pipeline blasting projects, also commented on Siskind's 1993 paper (*1*). In a personal communication to the senior author, Kiker reported his experiences blasting within 3 to 6 m of an existing high-pressure pipeline (*11*). He reported one case in which a parallel ditch within 4 m of the blast had ground rupture cracks extending to the existing pipeline and in which peak particle velocities were 64 mm/s, without damage.

In another case, Kiker assisted on a project that involved blasting within 1.2 m of a 30-cm PVC sewer pipe. Vibration amplitudes up to 1,450 mm/s produced no damage. He also reported that vibration amplitude decreased 40 to 70 pct with depth at the typical pipeline burial depth of 1 to 1.2 m. Agreeing with Oriard, Kiker believes that risk to pipelines comes from ground rupture and movement of fractured rock into the pipe at high velocity, and not from vibrations per se. His reasoning is based on the short duration of these stresses, the strength of the pipe relative to the surrounding ground, and the limits on the amount of stress that can be transmitted from ground to pipeline because of these strength differences. As with the SwRI tests, all the tests of Oriard and Kiker involved small, close-in blasts.

Dowding's book (*12*) contains analyses of both unlined tunnels and buried pipelines. He addresses the cases where pipelines have low stiffnesses compared with the confining media, defining a flexibility ratio (J):

$$J = \frac{E/(1+\nu)}{\left[6E_P I_P/\left(1-\nu_P^2\right)\right]\left(1/r^3\right)},$$

where E and E_p = Young's moduli of ground and pipe, respectively,

ν and ν_P = Poisson's ratio of ground and pipe, respectively,

I_P = moment of inertia of pipe, $1/12h^3b$,

r = pipe radius,

h = pipe wall thickness,

and b = unit length along axis of pipe.

Citing work by Peck and others (*13*), Dowding states that, for J greater than 10, the restrained pipelines can be considered to be completely flexible and to deform with the ground. For lower J values, the strains in the pipes will be smaller than those in the surrounding medium. Using Dowding's values for soil of E = 10^4 lb/in^2 and ν = 0.25, J values are 28, 8.3, and 2.7, respectively, for the 50.8-, 32.4-, and 16.8-cm steel pipelines studied by the USBM and 82 for the 21.9-cm PVC pipe. The two smaller steel pipelines do not appear to meet the flexibility criteria. Considering the very wet conditions for the USBM tests, an E of 10^4 lb/in^2 for the soil is probably too high, potentially reducing the J value. In addition, there are possible stiffening effects from internal pressurization that are not addressed here.

For cases of high J (>10), such as those of the larger steel and PVC pipelines tested by the USBM, Dowding gives formulas for bending and stretching strains (ϵ) for plane wave vibrations propagating parallel to the pipeline (worst case):

Bending:

$$\epsilon = \frac{u 2\pi f r}{c_s^2},$$

where u = peak particle velocity,

f = frequency, Hz,

r = pipe radius,

and c_s = seismic S-wave velocity.

Stretching:

$$\epsilon = \frac{u}{c_p},$$

where c_p = seismic P-wave velocity.

For circumferential strains perpendicular to the axial strains and conditions of pure shear, Dowding gives a maximum strain:

$$\epsilon = \frac{u}{2c_S},$$

where c_S = seismic S-wave velocity.

The difference in stiffness between the steel and PVC is consistent with the significantly higher longitudinal strains (bending) measured by the USBM on the PVC. In this case, the strains are bending responses of the pipelines resulting from the components of compressional waves normal to the pipe axes or shear waves parallel to the axes.

O'Rourke and Wang give nearly similar relationships for bending and stretching of pipelines in totally confined and rigid conditions (*2*). For ground motion along the axis of the pipeline, they specify a maximum axial strain of

$$\epsilon = \frac{u}{c_p},$$

which is the same as Dowding's. For ground motion perpendicular to the pipeline, they give a maximum curvature (bending) of

$$\text{Bending} = \frac{2\pi f u}{c_s^2},$$

where velocity units are consistent. Because of the lack of the pipe radius term, it appears that "bending" is defined here as ϵ/r.

EXPERIMENTAL PROCEDURES

TEST PIPELINES

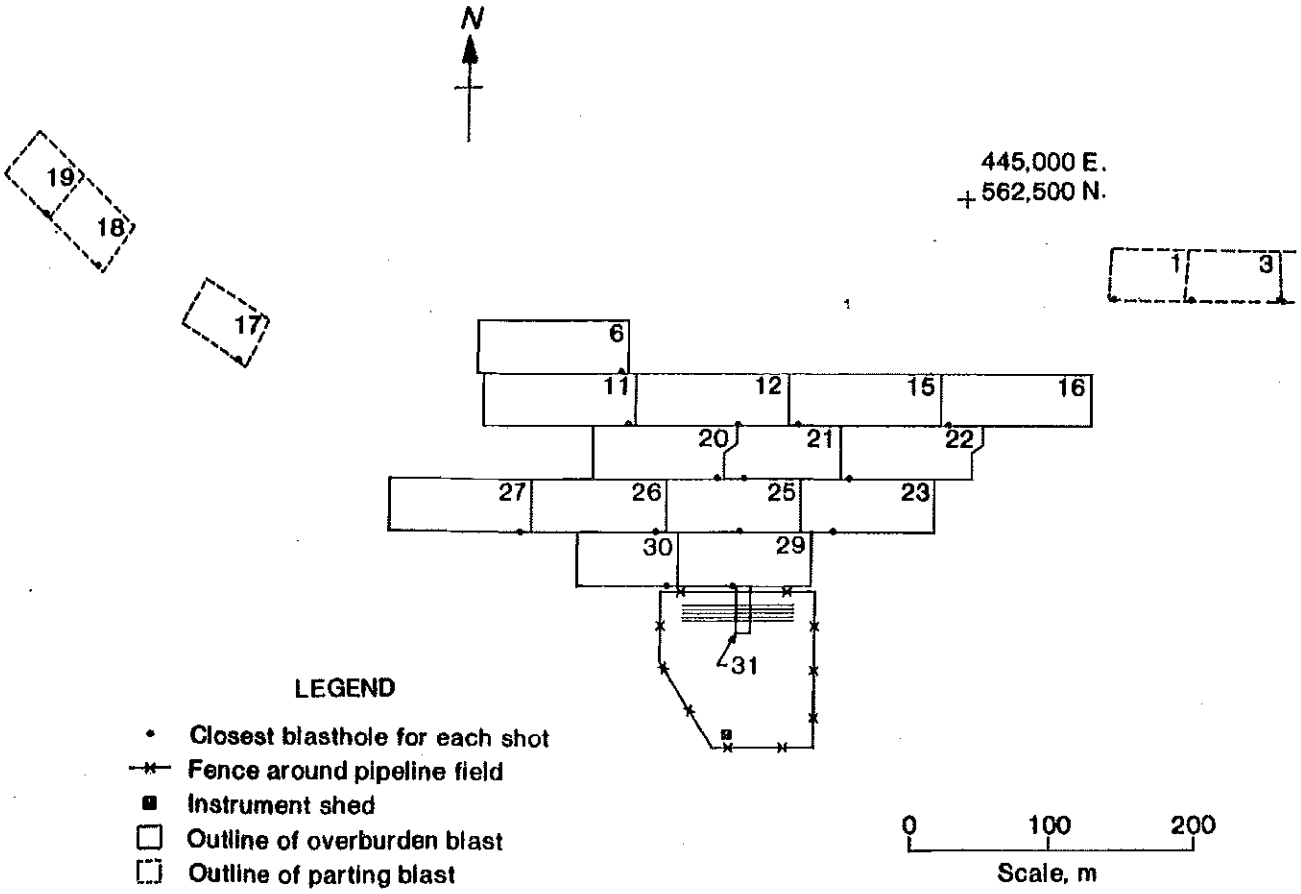
Five 76-m-long sections of transmission pipeline, with properties described in table 1, were installed on the AMAX Coal Co.'s Minnehaha Mine highwall bench for testing to destruction. They were all parallel to each other, with 3-m spacings, and also to the highwall face at an initial distance of about 150 m, as shown in figure 1. The pipe positions, in increasing distance from the highwall face, are in the same order as listed in table 1. Ohio Valley Pipeline crew welded and installed the pipelines, using their standard procedures, after the USBM workers attached longitudinal and circumferential strain gages and sensors for vibrations in the center areas of the pipelines. All pipes were placed in trenches and covered with about 1 m of the excavated clay soil. Some pipes, particularly the 50.8-cm pipeline, were installed under very wet conditions. The area was compacted by a loader and dozer; however, the soil did settle a few centimeters during the 7-month monitoring period. The pipes had three uprights each to provide access for pressurization and placement of pressure-measuring gages, and also to provide survey points to measure settlement and any other static-type responses. Figures 2 to 5 show pipe installation activities.

Table 1.—Pipeline characteristics

Outside diam, cm	Wall thickness, mm	Fill material	Age	Material type
Steel:[1]				
16.8	4.78	Gas	Used	X-42
32.4	6.35	Gas	Used	Grade B
32.4	6.35	Gas	New	X-42
50.8	6.63	Water	Used	X-56
PVC:[2]				
21.9	8.43	Water	Used	SDR26

[1]Initial pressurization 6.2 MPa (900 lb/in^2).
[2]Initial pressurization 0.62 MPa (90 lb/in^2).

Figure 1



Minnehaha Mine pipeline test area and the closer-in production blasts monitored.

MATERIAL PROPERTIES

The grade of steel pipe refers to its specified minimum yield strength (SMYS) in pounds per square inch. Therefore, X-42 means a SMYS of 290 MPa (42,000 lb/in^2). Grade B is equivalent to 241 MPa (35,000 lb/in^2). The PVC pipe has a yield tensile strength of 48.3 MPa (7,000 lb/in^2). Young's moduli for the two materials are 203 GPa (29.5×10^6 lb/in^2) and 2,760 MPa (4×10^5 lb/in^2), respectively. Poisson's ratio was assumed to be 0.3, consistent with SwRI analyses.

MONITORING

Measurements began as soon as the first pipeline was installed and the trench backfilled and continued until the final blast beneath the pipes 7 months later. After an instrumental shakedown period, complete monitoring of strains, vibrations, and pipeline pressures was done whenever overburden blasting occurred in front of the pipeline field (figure 1). Monitoring procedures were modified in response to a variety of problems, particularly water-caused failures of some strain gages and buried vibration sensors and two instances of lightning strikes in the test area. Toward the end of the study, recorders were moved from the instrumentation shack to a van for improved vibration isolation. Also, toward the end, Vibronics installed additional vibration equipment in the area, including two strong-motion three-component systems. By the time the blasting reached within 50 m of the closest pipeline, five seismic systems were in place on the surface and two on the pipelines.

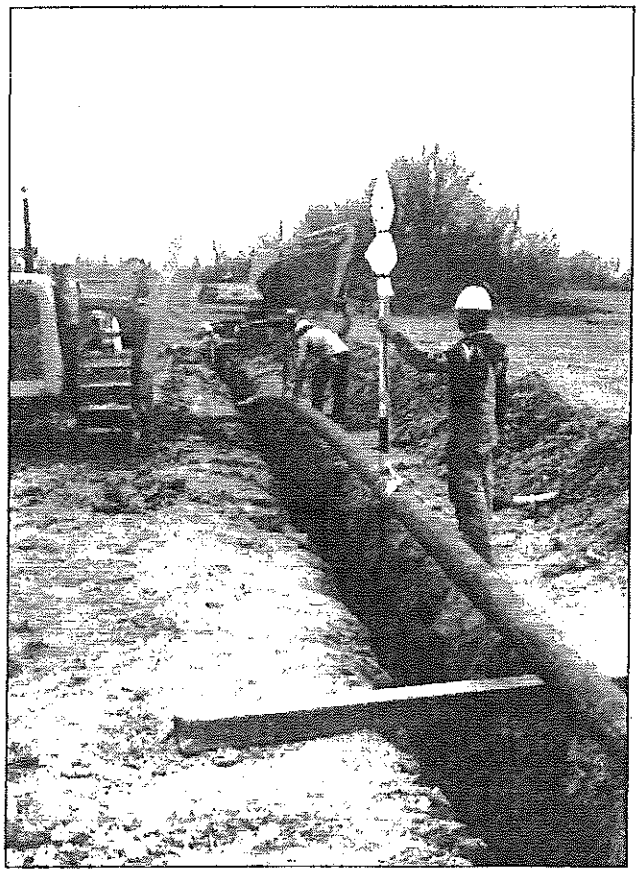
MINE SITE AND PRODUCTION BLASTING

The Minnehaha Mine is a surface coal mine, which blasts overburden by casting and also blasts a thick parting, using hole diameters of 31 cm (12-1/4 in) and

Figure 2

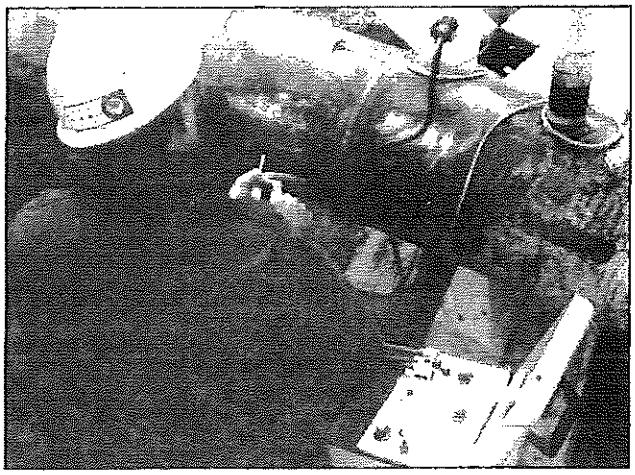
Pipeline test area.

Figure 3



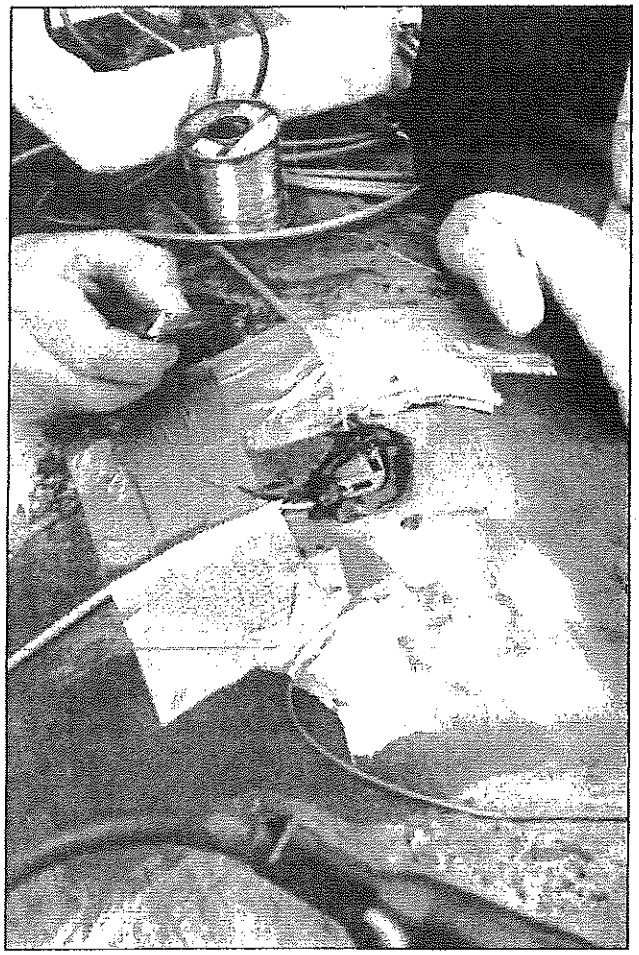
Placement of 16.8-cm pipeline in trench.

Figure 4



Installing weldable strain gages on large steel pipe.

Figure 5



Strain gage and vibration sensor.

27 cm (10-5/8 in), respectively. Charge weights per delay are as high as 950 kg. The highwall, including the pipeline field area, has about 2 m of clayey soil overlying about 12 m of shale. All nearby overburden blasts and a selected number of parting blasts were monitored over a 7-month period (figure 1 and table 2). The missed overburden blast (blast 28) was at the pit's far west end and not near the pipelines.

All blasts except the last (blast 31) were full-size overburden casting or parting rounds. No changes were made to account or adjust for the nearby pipeline field. The larger casting blasts were generally 5 rows of 10 holes each. As hole depths varied, charge weights per hole and per delay also varied; those listed in table 2 are the maximums. Hole depths were typically 20 m (66 ft) and 13 m (43 ft) for overburden and parting, respectively. Delays between rows and holes in a row were 126 and 25 ms, respectively. Smaller parting blasts also used relatively long between-row delays of 67 ms, likely intended to produce a modest cast.

Table 2.—Blasts monitored for pipeline response

Blast	Date	Time	Charge weight, kg		Distance,[1] m	Type of blast
			Total	Per delay		
1	3-18	11:07	9,162	435	338	Parting.
2	3-20	11:11	11,166	135	1,064	Overburden.
3	3-20	13:43	10,938	435	381	Parting.
4	3-20	13:53	9,841	435	436	Parting.
5	4-02	17:15	15,954	588	869	Parting.
6	4-02	17:40	30,547	751	180	Overburden.
7	4-02	18:41	10,202	218	933	Parting.
8	4-29	11:24	14,175	464	802	Parting.
9	4-29	19:20	13,561	539	347	Parting.
10 ...	6-02	11:20	22,482	626	756	Parting.
11 ...	6-02	17:21	24,398	639	146	Overburden.
12 ...	6-05	11:16	27,524	773	125	Overburden.
13 ...	6-05	11:24	7,399	301	920	Parting.
14 ...	6-05	14:07	8,073	181	951	Parting.
15 ...	6-05	17:14	29,162	689	131	Overburden.
16 ...	6-10	09:23	32,968	959	192	Overburden.
17 ...	8-03	14:13	10,408	465	387	Parting.
18 ...	8-05	11:14	14,804	828	506	Parting.
19 ...	8-06	14:55	17,245	600	552	Parting.
20 ...	8-06	17:09	30,373	731	88	Overburden.
21 ...	8-06	18:04	30,374	964	88	Overburden.
22 ...	8-07	18:18	31,741	884	116	Overburden.
23 ...	9-16	11:08	32,157	964	67	Overburden.
24 ...	9-18	14.33	ND	ND	ND	Parting.
25 ...	9-18	10:54	30,526	839	50	Overburden.
26 ...	9-19	14:25	27,072	872	74	Overburden.
27 ...	9-21	12:09	25,249	668	158	Overburden.
28 ...	10-21	Missed	ND	ND	ND	Overburden.
29 ...	10-23	11:18	34,457	839	15	Overburden.
30 ...	10-24	15:54	19,575	706	52	Overburden.
31 ...	10-24	16:25	2,880	743	1.5	Overburden.

ND Not determined.

[1]Distance is from closest blasthole to center of 16.8-cm (6-in) pipeline, which is closest to the highwall, measured on the ground surface.

STRAIN GAGES

All pipelines had longitudinal strain gages on the top and front, and the 16.8- and 50.8-cm pipes had circumferential gages as well. Two techniques for mounting strain gages on steel pipe were available, spot welding and adhesive bonding. Measurements Group type CEA-06-W250 C-350 weldable strain gages were initially chosen because of their ruggedness for the long monitoring period and the cold and wet field conditions. Weldable gages are precision foil strain gages bonded by the manufacturer to a metal carrier for spot welding to metal structures by the user. After surface preparation with a sanding disk, a sample metal carrier, supplied with each package of gages, was used to determine the proper energy setting and electrode force required to obtain a good spot weld. The two-element, 90° strain gage rosettes were aligned on the pipe and held in place with masking tape. The metal carrier was then tacked in place by a few spot welds on each side, and the tape was removed. The gage was then welded around the edges by two rows of spot welds.

Following welding, a layer of butyl rubber and a sheet of thick aluminum foil was added for mechanical protection. To keep out moisture, which causes most of the field installation failures in strain gages, a liquid sealant (M-coat FBT) was used around all the edges of the aluminum sheet and also around the lead wires, as recommended by the strain gage manufacturer. Two two-element strain gages were installed, one on top and one on the front face, at the approximate center of each 76-m length of test pipe, and were aligned with longitudinal and circumferential directions.

About a month before the end of testing, Measurements Group type CEA-06-250 UW 350 strain gages were epoxied to the 50.8-cm pipe. These were three-element 45° rectangular rosette configurations for principal strains. All strain gages used on the PVC pipe were also adhesive mounted. Figures 4 and 5 show instrumentation installation activities.

VIBRATION MEASUREMENT

Vibration transducers were attached to the top and front of the 50.8- and 16.8-cm pipelines. These were accelerometer-integrating amplifier systems with flat responses down to 1.0 Hz. The accelerometers on the larger pipe eventually failed from water intrusion in the saturated clay soil. They were replaced by an immersible Alpha-Seis velocity transducer with flat responses down to 2 Hz, starting with blast 22.

Vibrations were also measured on the ground surface above the pipelines with sensors in shallow-buried impedance-matching boxes. Both a Vibronics Alpha-Seis unit and a USBM three-component velocity gage were used throughout the study. Additionally, Vibronics installed two strong-motion systems (Dallas Instruments SR-4's) in the pipeline area starting with blast 20.

For all blasts, the radial direction was fixed as the horizontal perpendicular to the pipeline axes, with the transverse then being parallel to the axes. It was not possible to re-orient the monitoring systems for true "radial" and "transverse" with respect to the blasts nor was it desirable for assessing pipe responses.

SURVEYING FOR SETTLEMENT

Periodic surveying was done by AMAX using a laser transit to detect settlement, both natural settlement and any that could be attributed to the blasting. Of particular concern was strain-producing differential settlement of the type found by Linehan and others from pile driving near pipelines (*14*). Each pipe had three uprights extending above the ground surface, one near each end and one in the middle. Using these as indicators, eight surveys were done during the 7-month monitoring period with an emphasis on the last 5 weeks, during the heaviest blasting. Data are tabulated in appendix C.

PRESSURIZATION

Following installation, all five pipes were pressurized as shown in table 1. Pressures gradually increased in the steel pipelines, by 5 to 35 pct, as the ground warmed up from early spring to late summer. In the PVC pipe, by contrast, pressure dropped to less than half of initial (down to 0.276 MPa), consistent with information that O-ring-jointed water pipes such as this leak continuously. There was no way to visually verify leakage for the buried PVC pipe, and no joints were instrumented. Pressures were monitored and recorded every 15 min by an automated system installed by Vibronics.

VERTICAL WELL AND TELEPHONE CABLE

AMAX had arranged for the installation of a vertical well off the east end of the 16.8-cm pipeline and both coaxial and fiber-optic telephone cables in front of the pipeline field. The 37-m-deep cased well was cemented to the coal and shale formations and monitored continuously by Vibronics for pressure during the study period. On four occasions, cement bond logs were run to evaluate the bond quality between the cement and both the well casing and the formation. The four logs were done on March 19, June 11, September 24, and October 27, when maximum particle velocities had been obtained of 13, 121, 242, and greater than 600 mm/s, respectively.

Indiana Bell technicians spliced together the six individual 84-m fiber-optic strands to make a single 466-m-long telephone cable. The total cable was then long enough for light-loss measurements and also contained six additional weakness points. Tests were made by Indiana Bell before and after blast 29 using an optical time domain reflectometer and an optical attenuation meter.

MONITORING RESULTS

Up to 34 data channels, provided by both USBM and Vibronics, were used for each blast. Table 3 lists the highest measured ground vibrations, pipeline vibration responses, and strains for each blast. A complete list of all peak values is contained in the appendix B.

VIBRATIONS

Vibration amplitudes of the buried pipelines were less than corresponding motion components measured on the ground directly above. There was a consistent and significant reduction of about 40 pct at a depth of only about 1 m, which was surprising. However, it is entirely in agreement with other studies (*14*) including USBM RI 8969 (*15*), which compared vibration monitoring on the ground surface and basement walls and floors. Figures 6 and 7 compare peak values for ground vibrations and 50.8-cm pipeline vibration responses for the radial and vertical components of motion.

Table 3.—Highest vibrations and strains measured on any pipe

Blast	Vibration amplitude, mm/s		Strain, μmm/mm		
	Ground	Pipeline	Circumferential, steel	Longitudinal, steel	Longitudinal, PVC
1	13.2	9.4	5.3	4.3	6.9
2	3.8	1.8	2.8	1.18	2.5
3	10.7	5.3	2.2	2.9	4.9
4	9.1	6.4	8.0	1.6	7.0
5	9.1	3.8	3.6	1.1	2.0
6	67.1	30.5	28.0	12.5	30.3
7	5.1	1.8	2.5	0.7	1.0
8	7.9	NA	10.0	2.9	4.8
9	6.9	NA	6.3	1.8	3.6
10	5.3	NA	NA	NA	NA
11	93.5	NA	66.4	26.0	35.0
12	121	NA	51.3	31.0	47.3
13	3.3	2.3	1.8	1.4	2.0
14	3.8	1.5	NA	1.1	2.5
15	88.4	48.0	48.3	32.4	38.5
16	67.1	35.8	20.9	15.6	25.5
17	17.3	NA	13.6	6.0	10.1
18	17.0	5.8	2.7	3.5	9.6
19	16.5	6.9	10.7	4.8	15.9
20	136.1	86.9	63.0	31.1	97.5
21	166.6	102.1	33.5	51.7	102.5
22	126.0	57.9	55.8	30.8	76.2
23	205.7	148.3	43.2	50.8	92.9
24	NA	NA	NA	NA	NA
25	241.8	211.3	53.5	60.8	137
26	148.3	95.5	44.0	44.0	63.0
27	81.3	41.1	25.4	24.3	37.6
28	NA	NA	NA	NA	NA
29	647.7	274.3	94.8	156	499
30	530.9	146.3	55.8	77.5	NA
31	NA	NA	490	3,170	NA

NA Not available.

The "Background" section raised the question of how faithfully the pipelines move with the ground. Figures 8 to 10 provide an answer. They show time history record comparisons for the 50.8-cm pipeline for three blasts of increasing size. The smallest blast (figure 8) produced nearly identical waveforms for the pipe and the ground above blast. With amplitudes about five times higher, blast 27 (figure 9) had ground vibrations and pipe responses that were similar but not nearly so alike as those in figure 8. The third and largest blast of the three (blast 25, figure 10) shows considerable differences, particularly for the radial components. This blast also produced a much higher pipe response frequency. Apparently, the degree to which the pipeline response matched the ground vibration was vibration level dependent. Maximum accelerations for the three examples were 13, 53, and 340 pct of 1 gravity, respectively, suggesting a possible influence on response of pipe weight in addition to confinement.

Comparisons between responses of the two pipelines instrumented with vibration sensors are shown in figure 11. These pipes, representing both the largest and smallest steel pipelines tested, showed similar response amplitudes, although with some differences in the vertical waveforms.

Vibration frequencies were low for the relatively small blast-to-pipeline distances. This was likely a site phenomenon with a clay-soil layer over the shale. When blasts were in front of the pipeline (e.g., 15, 21, 25), the radial components had much 7- to 9-Hz energy. For these very close-in blasts, high-frequency vibrations were also present, which would normally be highly and selectively attenuated at any appreciable propagation distance in the clay-soil layer.

Propagation plots for maximum measured vibration amplitudes are shown in figure 12 for 0.4, square root, and cube root scaled charge weights. Maximums were used rather than individual components because radial and transverse components were aligned with the pipelines rather than adjusted for the direction to each blast. Over the range of distances and charge sizes represented in the plots, any of these plots can be reliably used to predict vibration amplitudes, with the scaling factor having no significant influence for this specific test site.

The cube root scaled propagation plot can be compared with the similarly scaled summary in Esparza's SwRI paper (7). The SwRI measurements go up to only 8 $m/kg^{0.33}$ (20 $ft/lb^{0.33}$), with the prediction line extrapolated to higher values. The attenuation exponent for USBM data is −1.33, compared with the SwRI value of −2.37. This is likely related to the relatively low attenuation of seismic energy in rock (USBM) compared with soil (SwRI) and possibly to seismic wave energy in contrast to plastic yielding. For conversion of the metric scaled distances shown (m/kg^x) to traditional engineering units of ft/lb^x use the following:

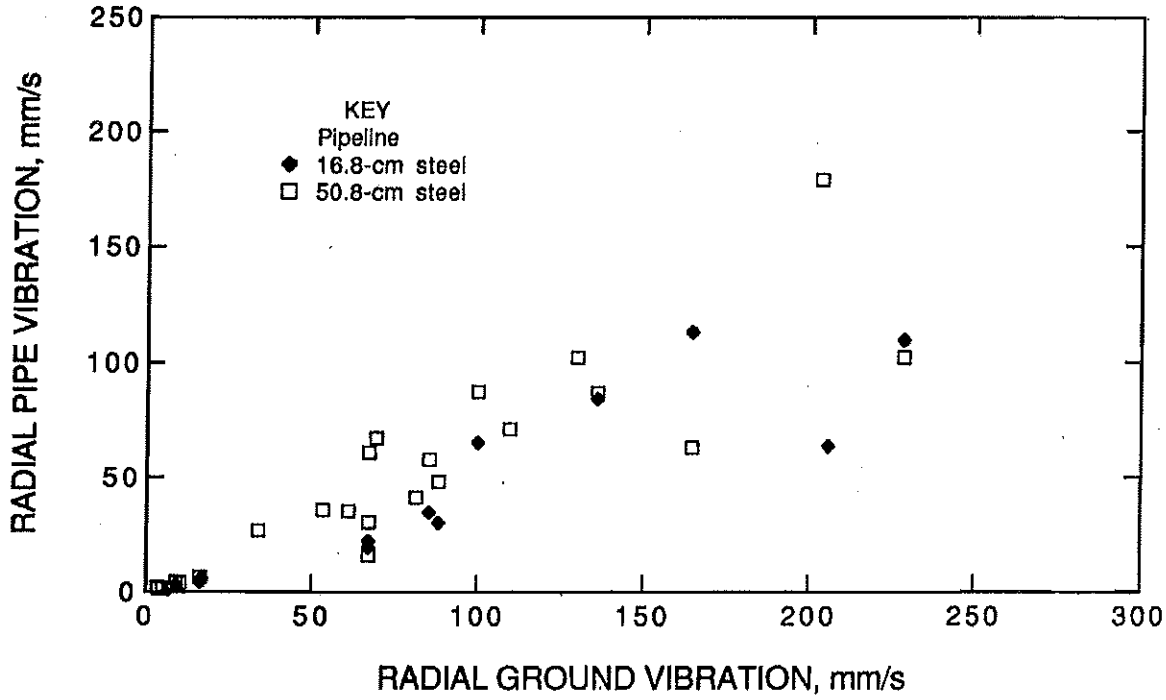
Scaling factor (x)	*Multiply by*
0.33	2.52
0.40	2.39
0.50	2.21

STRAINS

Sets of strain recordings from three of the larger blasts are shown in figures 13 to 15. For lower amplitude blasts, less than about 80 mm/s, the traces are symmetric about the zero line. Because tensions and compressions were about equal, bendings were approximately symmetrical and behavior was strictly elastic. Above this amplitude, some strain records show jumps that were either instrumental or represent real "adjustments" in pipeline positions, e.g., permanent vibration-induced displacements and settlements.

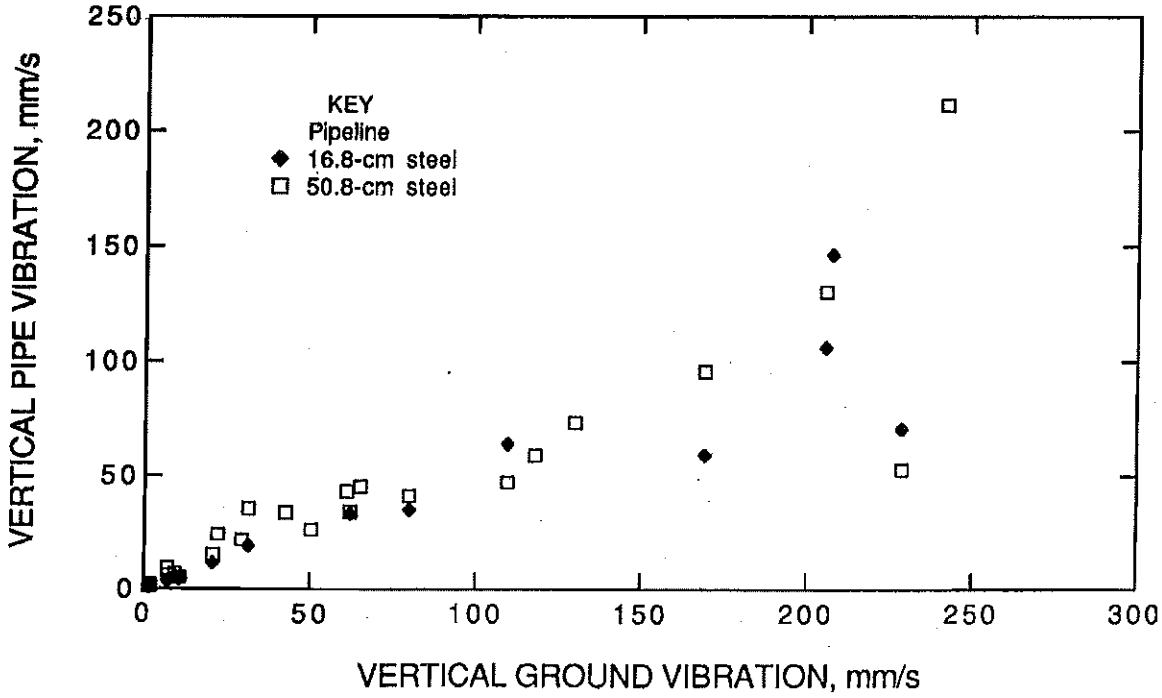
Strain propagation plots of strain amplitudes versus scaled distances are given in figures 16 and 17. These are strains from blasting alone and do not include the effects of pressurization. There is considerably more scatter than in the vibration propagation plots, probably because of response variations discussed previously, less than ideal coupling, and amplitude-dependent responses. At large distances (and relatively small vibration amplitudes), circumferential strains dominate. Closer in, there appears to be a limit on the amount of circumferential strain produced, and longitudinal strain becomes dominant. This limiting in circumferential strain could be related to imperfect coupling and relatively strong resistance to ovaling (out-of-round) deformation. Unfortunately, some strain gage failures late in the study hampered a more complete comparison (appendix B). For the 0.4-scaled plot, the USBM data can be compared with the SwRI prediction without "correction factors," which is similarly scaled. The SwRI stress and strain predictions depend weakly on pipe wall thicknesses. The lines representing their predictions and shown in figures 16, 17, and others were computed for their 61-cm pipe with a wall of 7.92 mm. A recomputed line corresponding to the USBM's 51-cm pipe (wall of 6.63 mm) would be only about 9 pct higher, an amount that would make it indistinguishable from the one shown on the figures. Within the range of the actual SwRI values (low scaled distances), USBM-measured strains are lower. At larger distances, corresponding to a large extrapolation of the SwRI prediction, USBM values exceed the SwRI prediction. A plot through the USBM data (excepting blast 31, the final ground-motion-producing blast at a scaled distance of 0.98 $m/kg^{0.4}$) would have a shallower slope than the SwRI equation. Most of this difference is

Figure 6



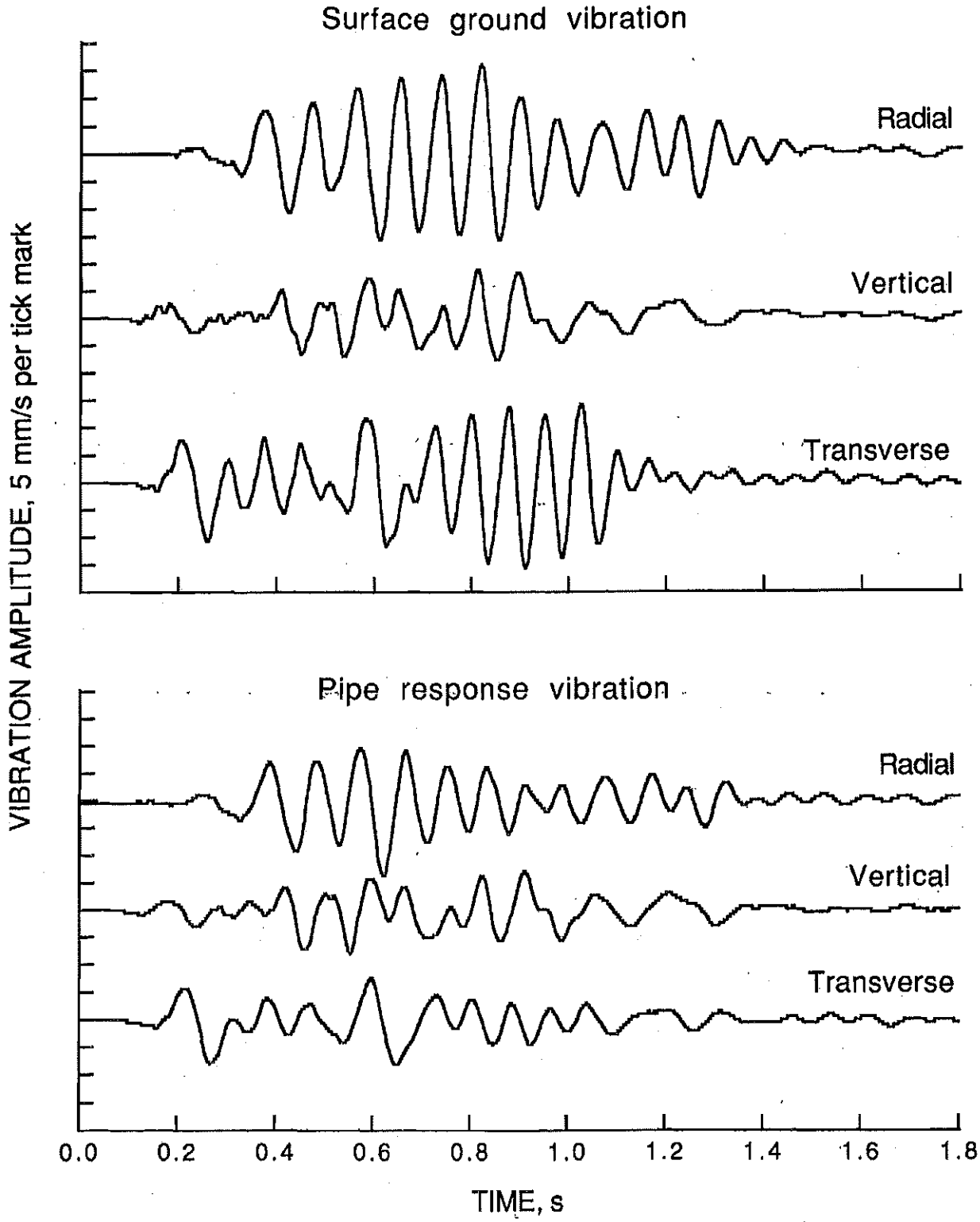
Radial ground vibration versus pipeline vibration response.

Figure 7



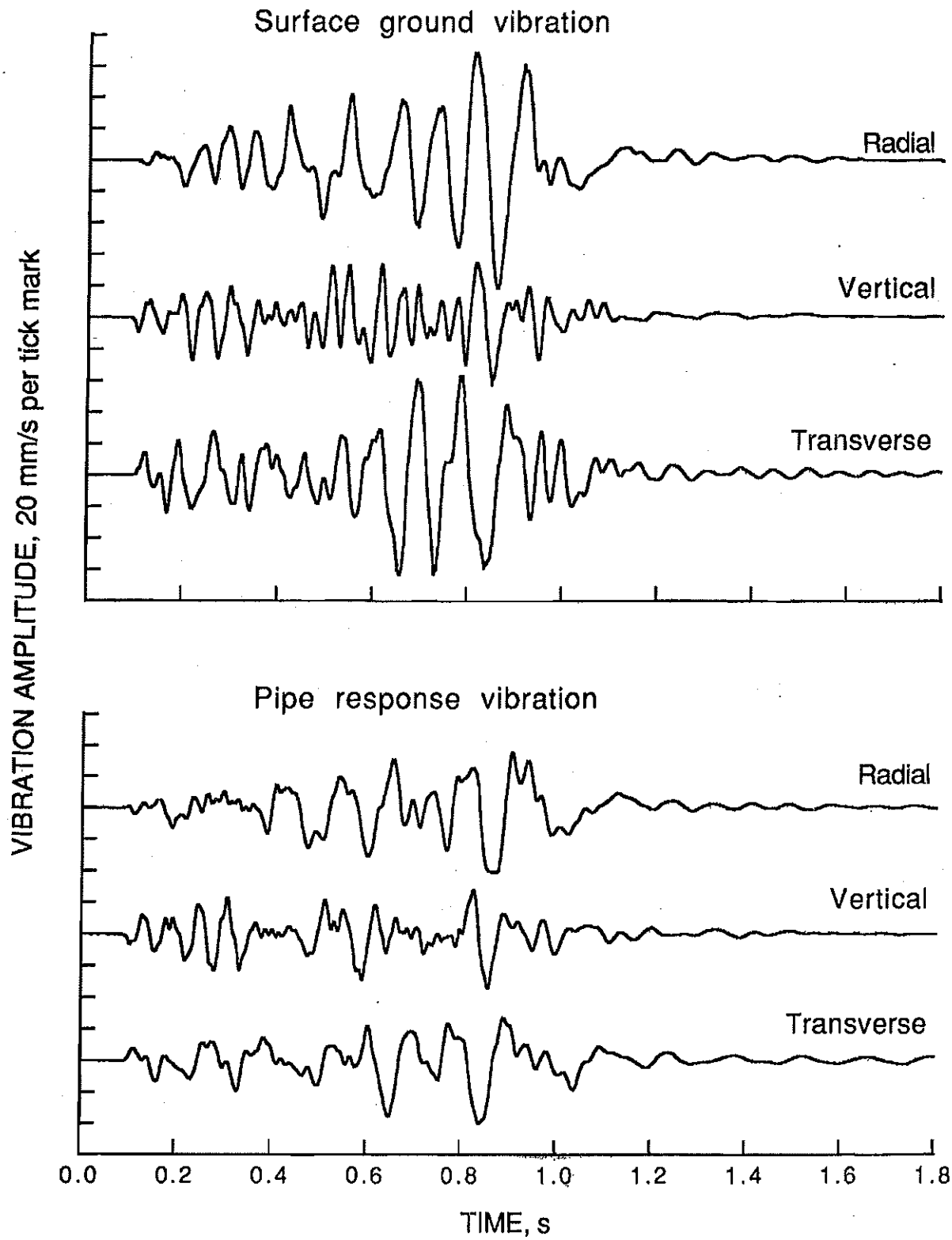
Vertical ground vibration and pipeline vibration response.

Figure 8



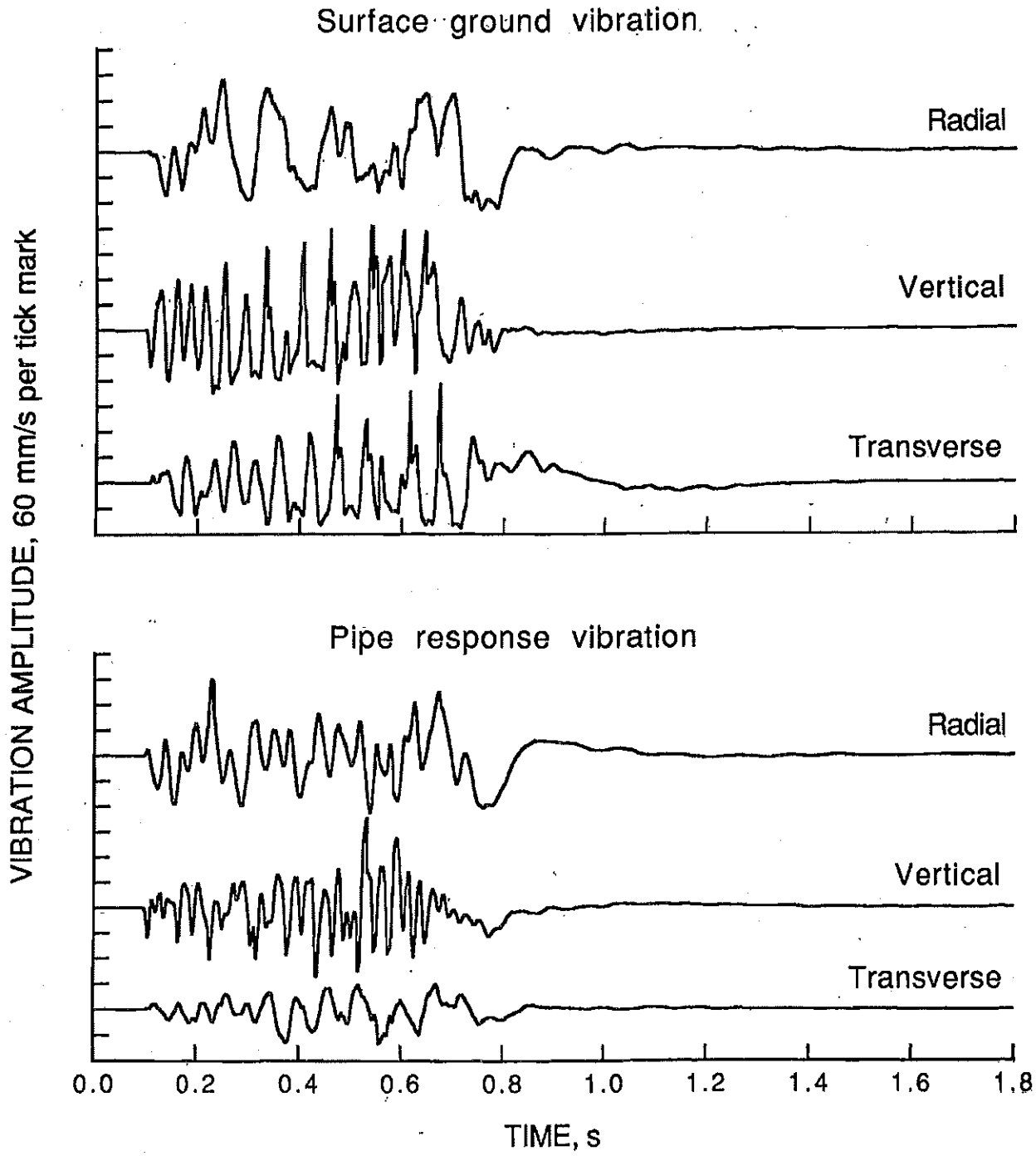
Vibration and response records for blast of September 28, 1992. This blast was part of a followup analysis.

Figure 9



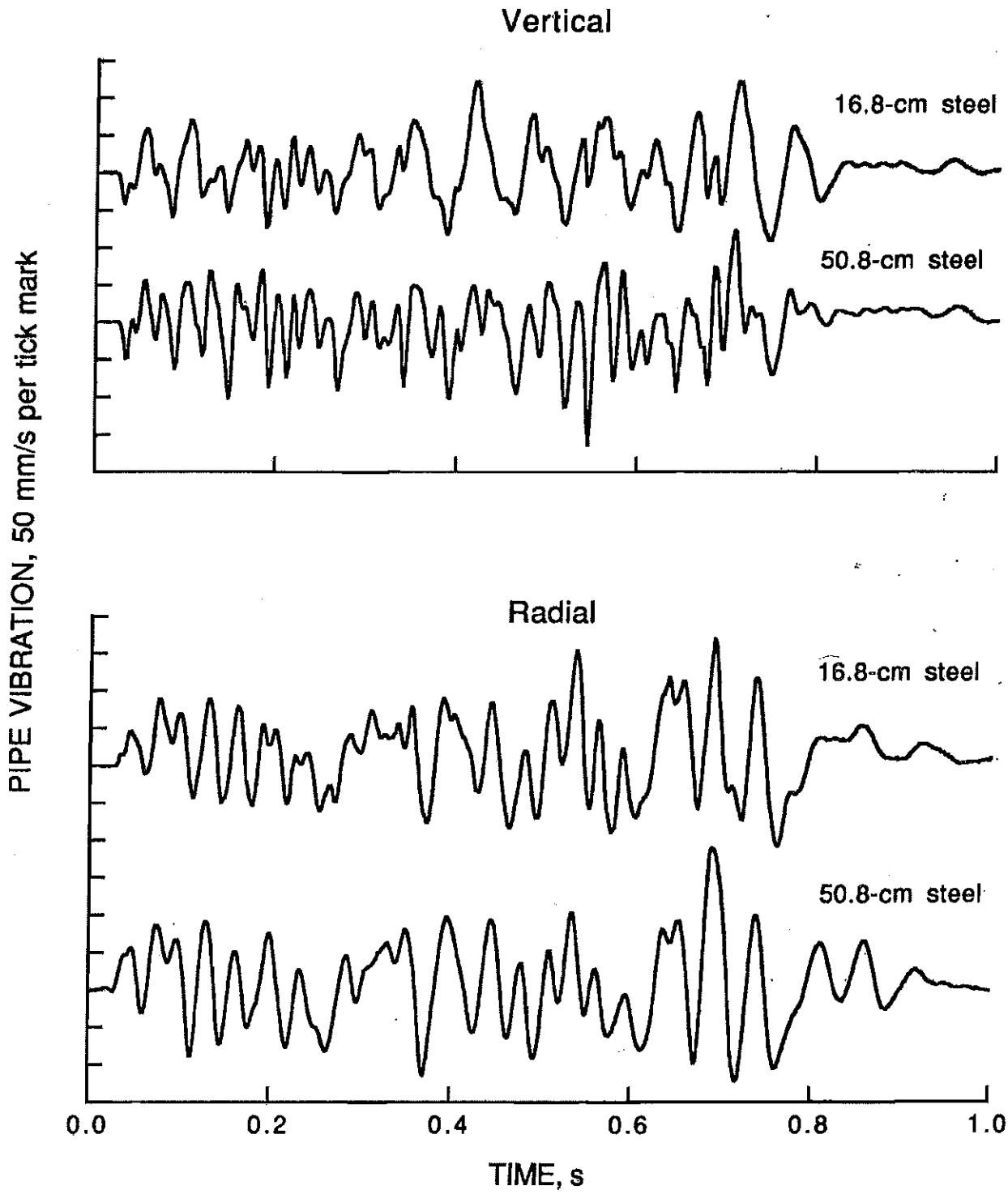
Vibration and response records for blast 27.

Figure 10



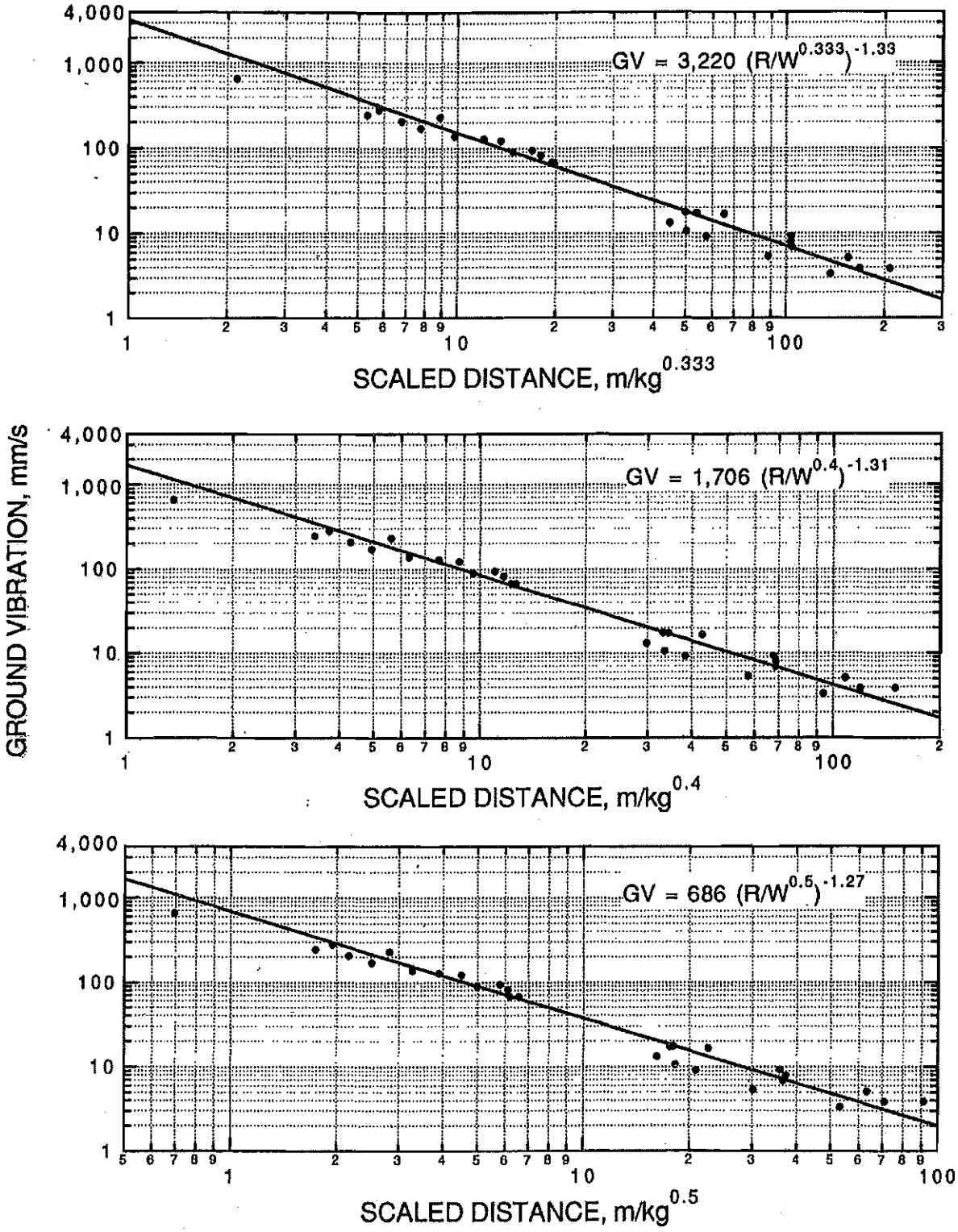
Vibration and response records for blast 25.

Figure 11



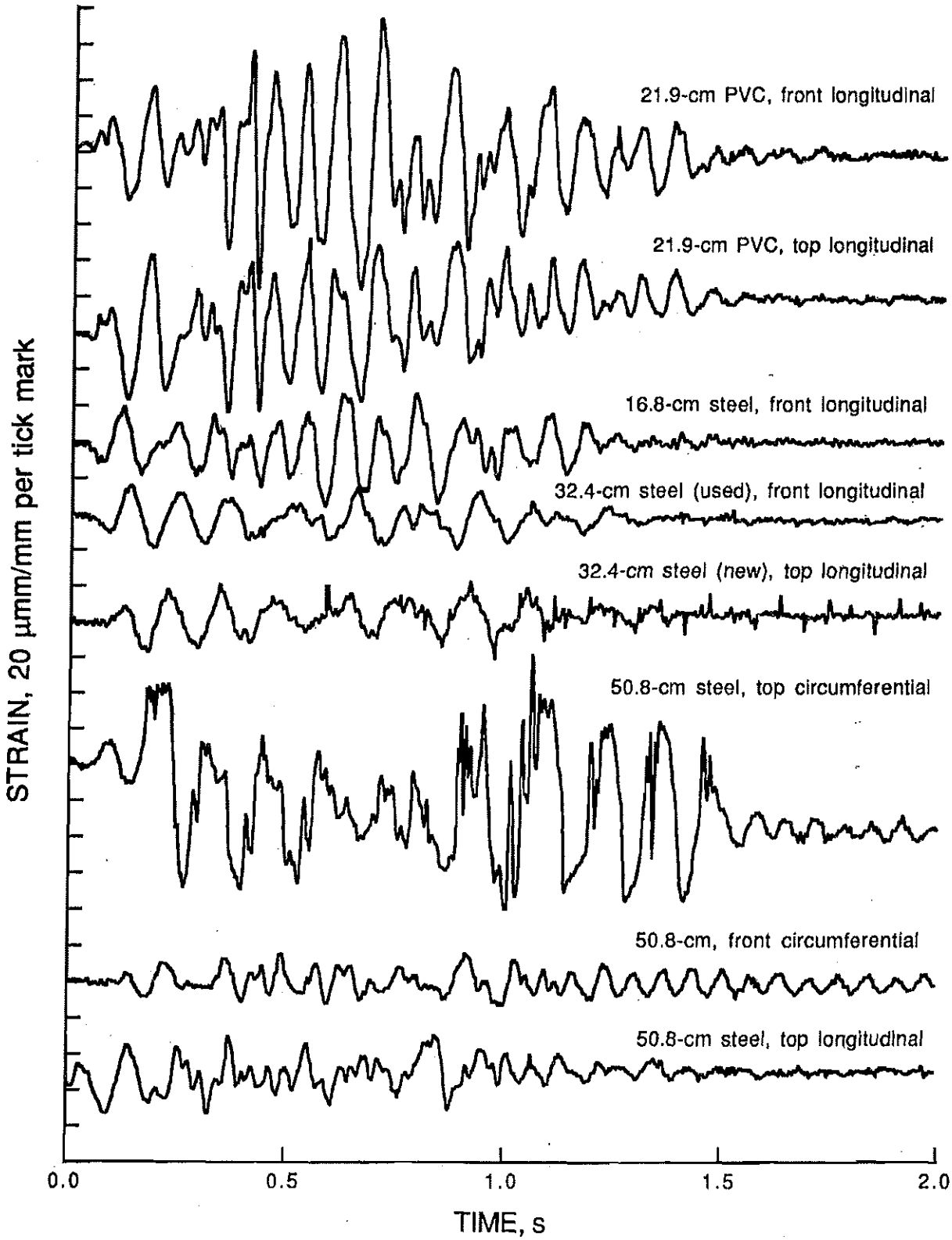
Comparisons of two pipelines' responses for blast 23.

Figure 12



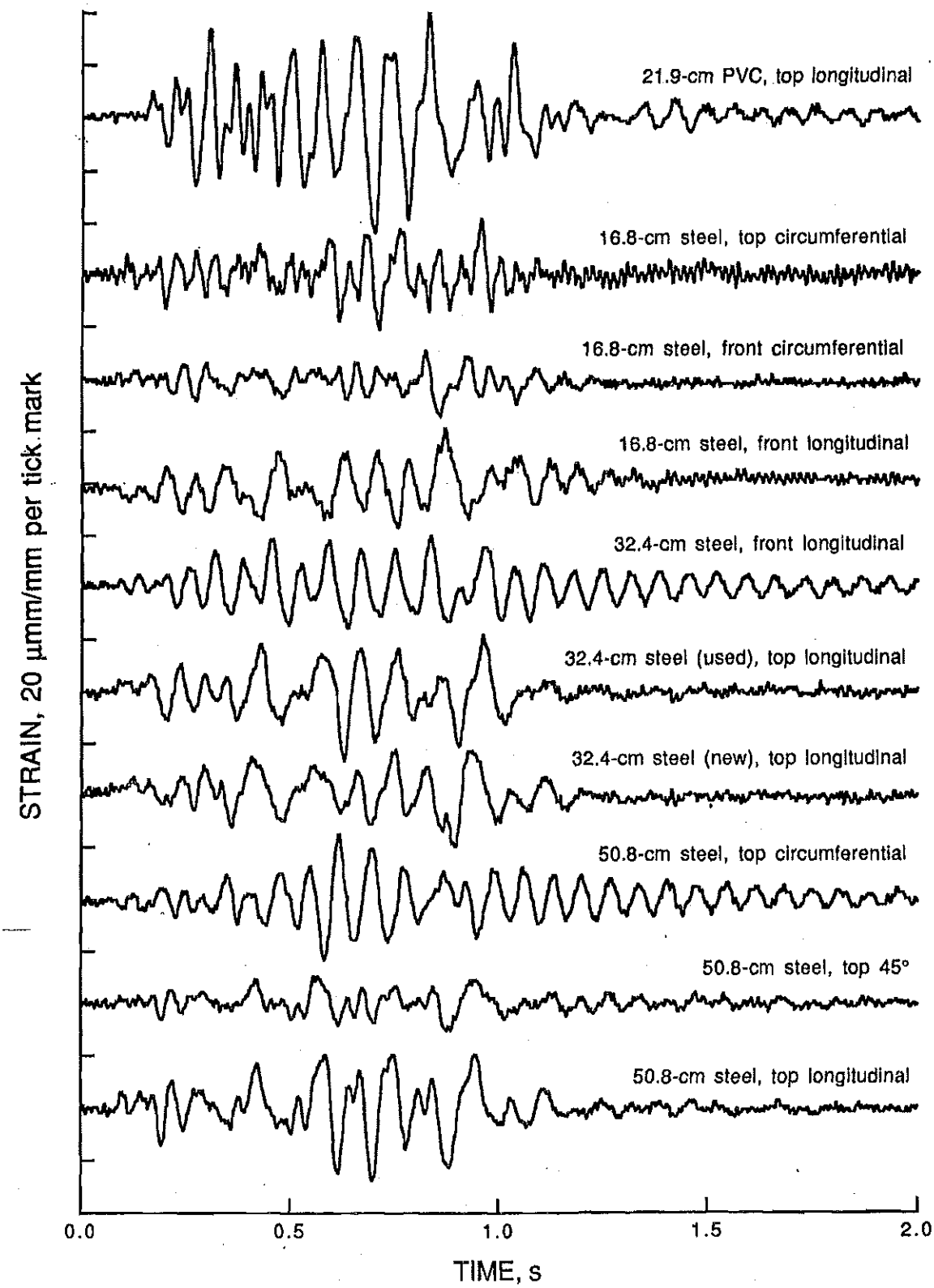
Propagation plots of maximum vibration amplitudes using cube root, 0.4 root and square root charge weight scaling. GV is ground vibration (mm/s), R is distance (m), and W is charge weight per delay (kg).

Figure 13



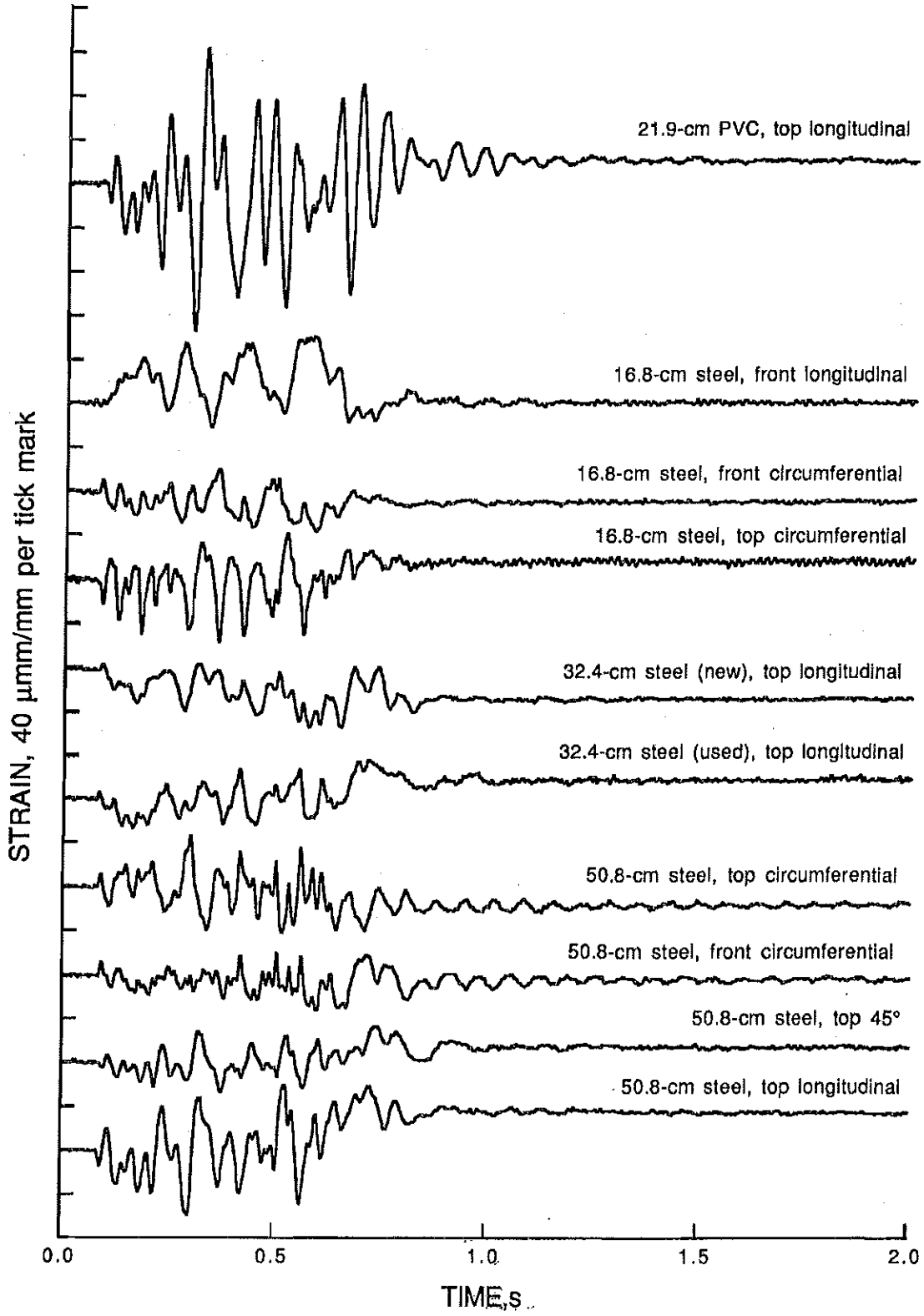
Pipeline strains for blast 22.

Figure 14



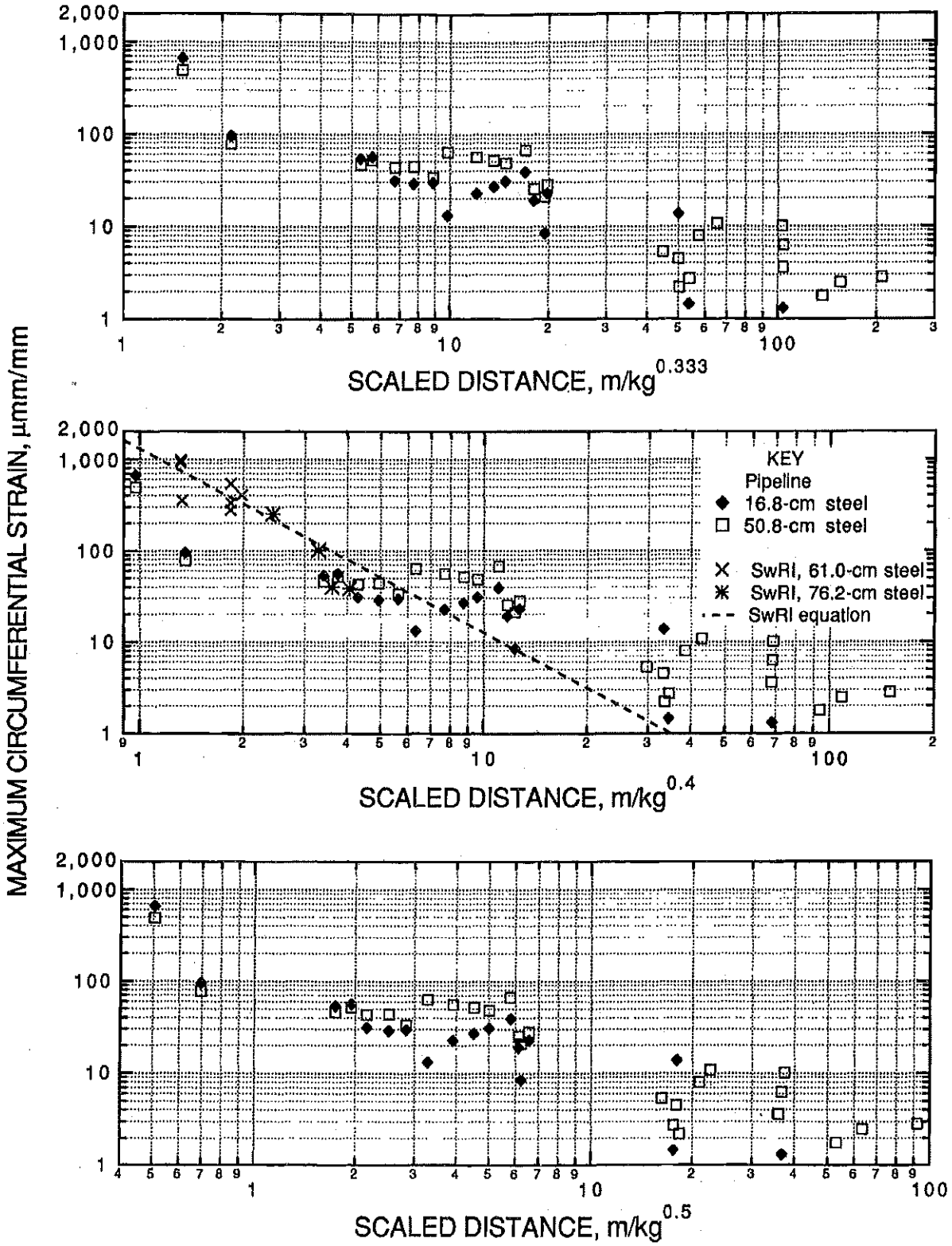
Pipeline strains for blast 27.

Figure 15



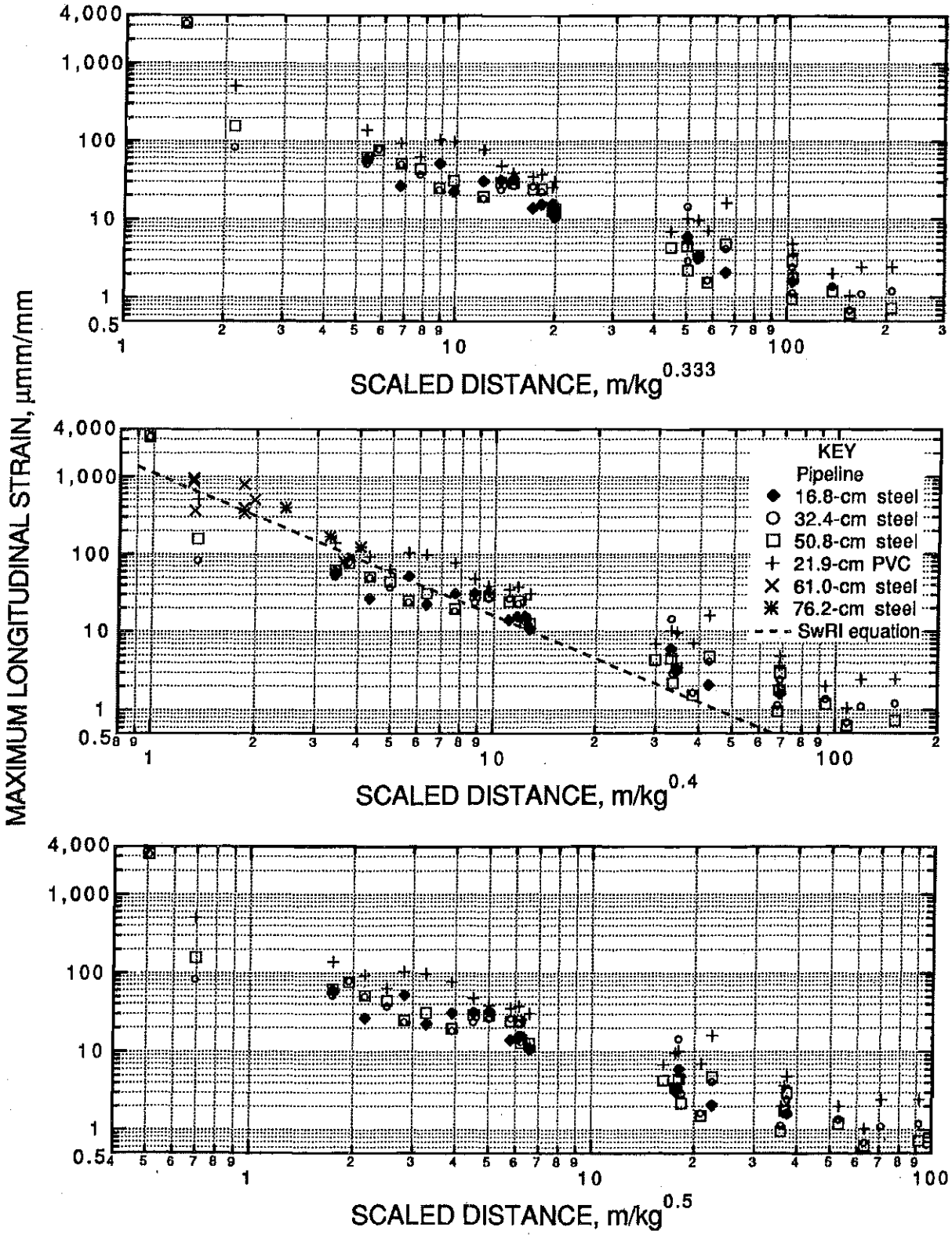
Pipeline strains for blast 25.

Figure 16



Propagation plots of circumferential strains.

Figure 17



Propagation plots of longitudinal strains.

likely because of the medium involved, rock instead of soil, and the extrapolation of the SwRI data to compare with mining-sized blast situations. The same conclusion was found for the vibration data. The USBM's final blast, blast 31, did match the SwRI prediction; however, this blast, which lifted both the ground pipes, was definitely not an elastic wave case, e.g., not a vibrations situation.

Measured peak strains versus ground vibrations are shown in figures 18 to 23 and strains versus pipeline vibration responses in figures 24 to 27, all strains being maximums. Comparisons shown in these plots are based on deformations expected to correlate with particular components of motion. For example, radial vibration compression waves (horizontal component perpendicular to the pipeline axes) are expected to flex the pipeline horizontally, causing maximum response on a longitudinal strain gage on the pipe's front (or back) side and to have little or no effect on a longitudinal strain gage on the top (or bottom). By contrast, a vertical vibration would produce exactly the opposite response.

There is also ambiguity about particle motion directions for close-in blasts. The depth of the explosive for blasts within about 60 m causes the true radial direction to have a significant upward angle. This situation makes the vertical component more important in this study than in actual production blasting where distances would not generally be so close. Relatively high longitudinal strains were measured on the PVC pipeline compared with strains on the four steel pipes, consistent with the lower PVC stiffness. If the pipelines were all fully coupled and moving with the ground, this difference should not exist. Generally, similar measurements on the steel pipelines gave similar amplitudes (e.g., the front longitudinal strain of one pipe agreed roughly with other front longitudinal measurements). Circumferential strains were often, although not always, the highest, particularly when measured on top rather than on the side.

Measured strains were relatively low for the given particle velocities. The large blasts involved in this study produced high particle velocities at relatively large distances. Hence, the pipelines experienced high vibration amplitudes at distances far enough to be clearly beyond the inelastic damage zone. By contrast, the SwRI studies measured high amplitudes only in the likely inelastic near zone. In addition, charges were in blastholes, vertical columns longer than the closest blast-to-pipeline separations. Again, this setup contrasts with that of the previous SwRI studies involving close-in "point" sources. Direct comparisons are difficult because of the vast differences in charge sizes and distances between the SwRI tests and the USBM tests, and for other reasons such as the ambiguity in some of the constants, as discussed in appendix A. Another complication in making comparisons is the possibility that the spatially extended mine charge with its relatively long detonation time impacts the pipeline less than a point-source-type blast. One comparison, using Lambeth's version of the SwRI prediction equations, is given in appendix A, table A-3.

For blasts 25 to 31, a three-gage strain rosette was used on top of the 50.8-cm (20-in) pipeline. Principal strains were calculated for these blasts, and in no cases did the peaks of the individual components occur in phase. Figure 28 shows an example of the principal strain analysis, with compression positive. In all cases measured, the components added in such a way that the principal strain peak was never much more than the maximum of those computed from single axes.

STRESSES

Stresses can be calculated from strains using the biaxial stress-strain equation given in the appendix A description of the SwRI analyses (*5*):

$$\sigma_c = \frac{E}{1 - \nu^2}(\epsilon_c + \nu\epsilon_l),$$

$$\sigma_l = \frac{E}{1 - \nu^2}(\epsilon_l + \nu\epsilon_c).$$

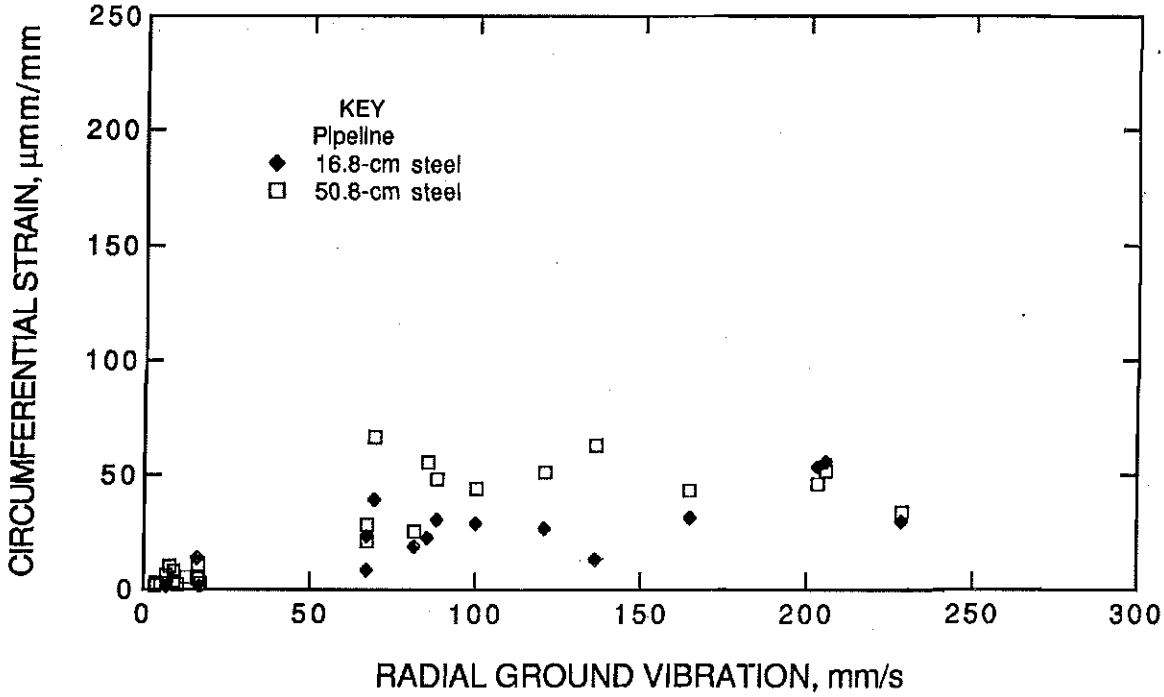
Use of these equations with the maximums rather than time-related values represents a worst case, assuming that circumferential and longitudinal peak strains occur at the same time and are of the same sense (both tensional or compressional). This computation of maximum possible stress is analogous to a pseudo vector sum compared with a true vector sum for three-component vibration analyses. Time-correlated strains should be employed to calculate true stresses. In addition, if ϵ_c and ϵ_l are of significantly different amplitudes, one will dominate the stress calculations. These equations generally overestimate stresses by up to 30 pct.

The principal strain analysis discussed previously showed that peaks did not coincide in time for the blasts analyzed and that simplified biaxial equations could be used:

$$\sigma_c = \frac{E}{1 - \nu^2}\epsilon_c,$$

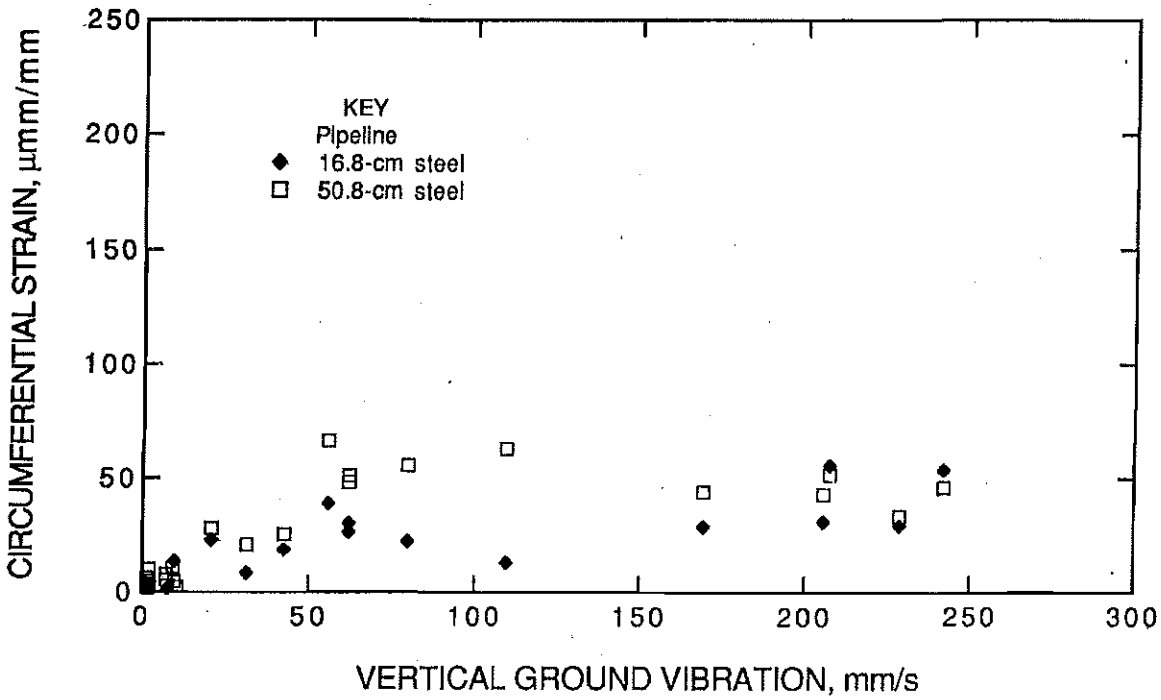
$$\sigma_l = \frac{E}{1 - \nu^2}\epsilon_l.$$

Figure 18



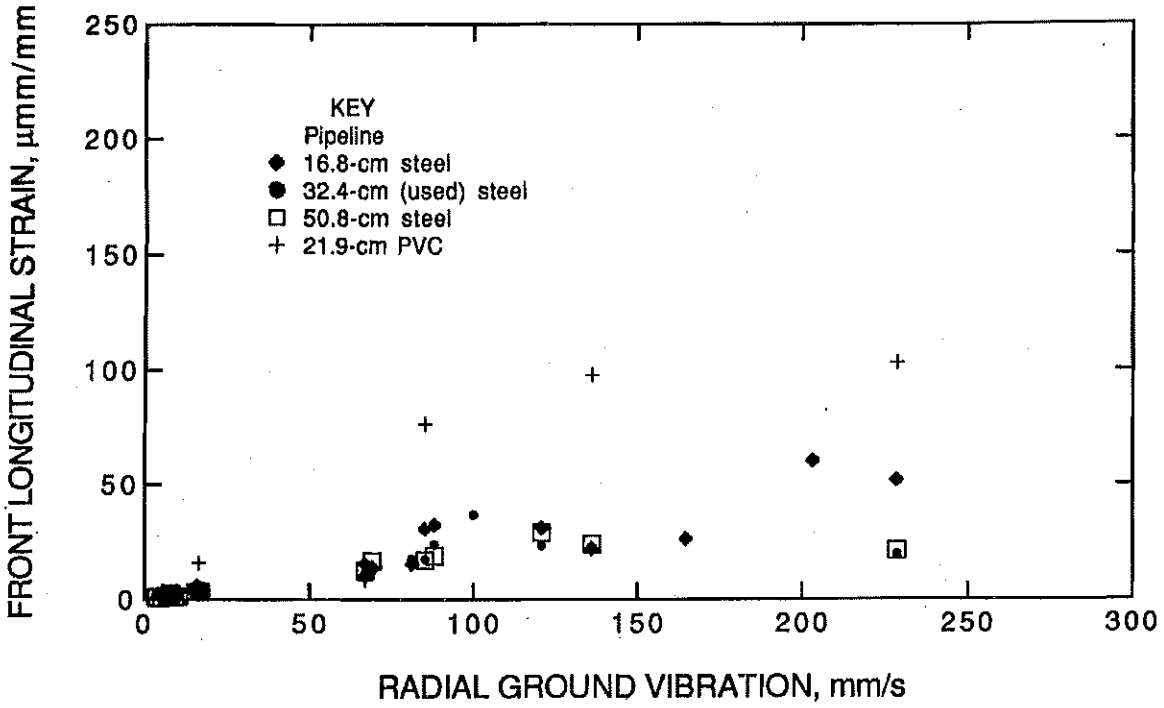
Circumferential strain versus radial ground vibration.

Figure 19



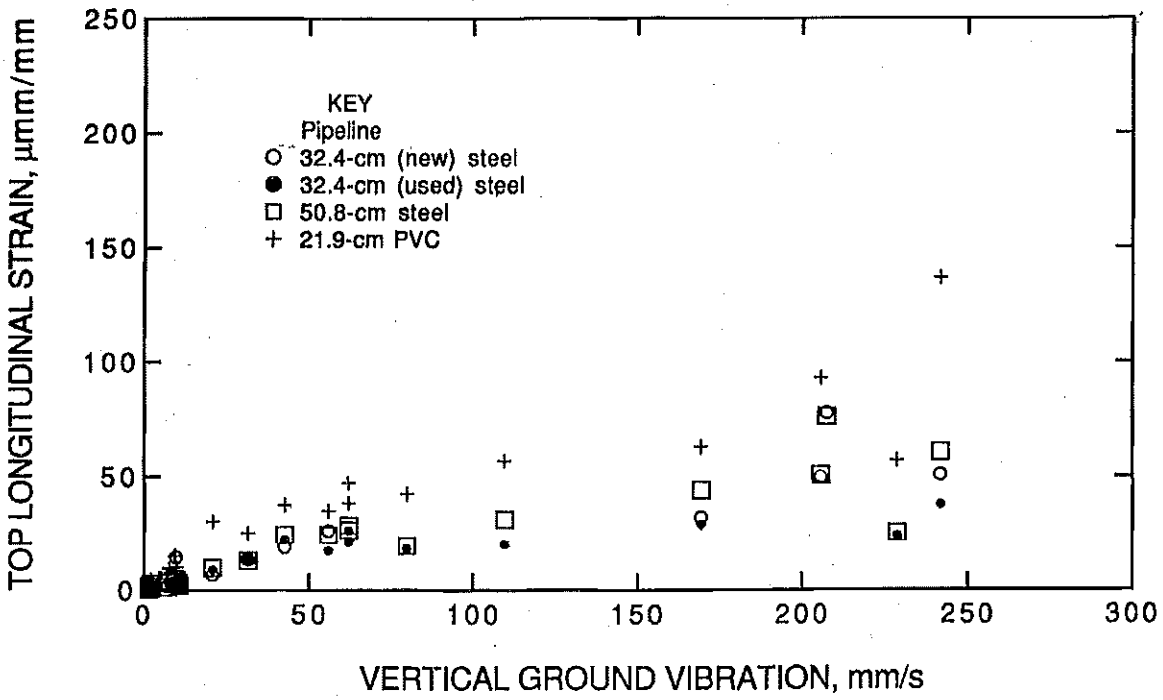
Circumferential strain versus vertical ground vibration.

Figure 20



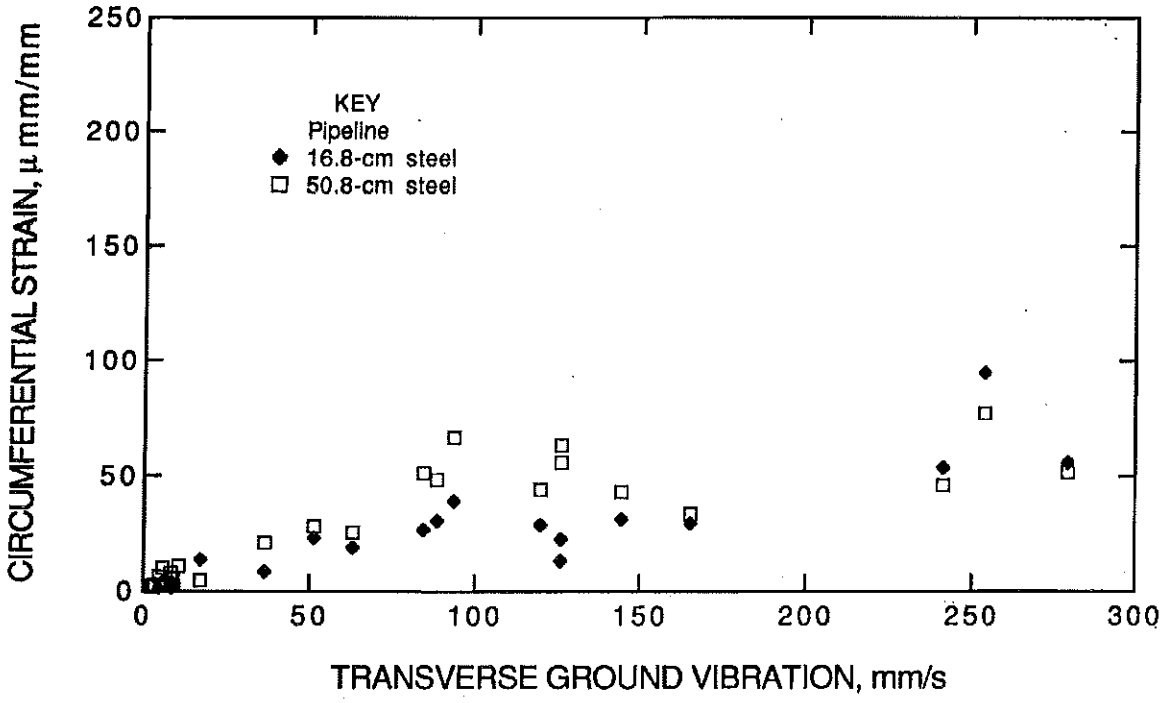
Front longitudinal strain versus radial ground vibration.

Figure 21



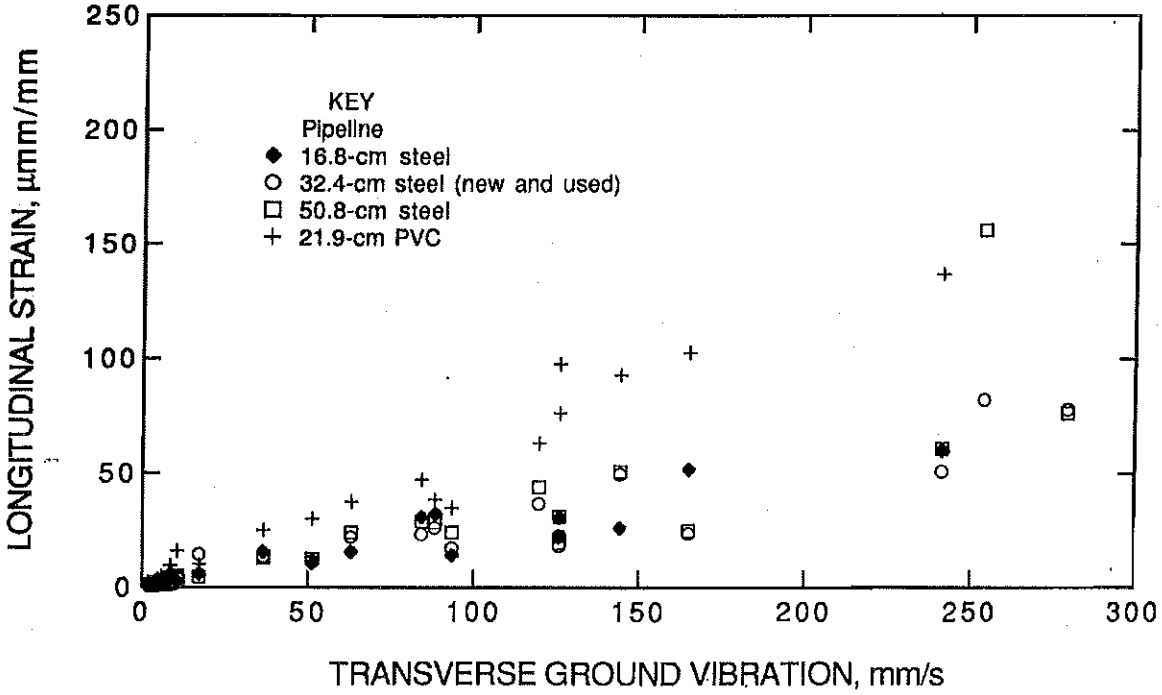
Top longitudinal strain versus vertical ground vibration.

Figure 22



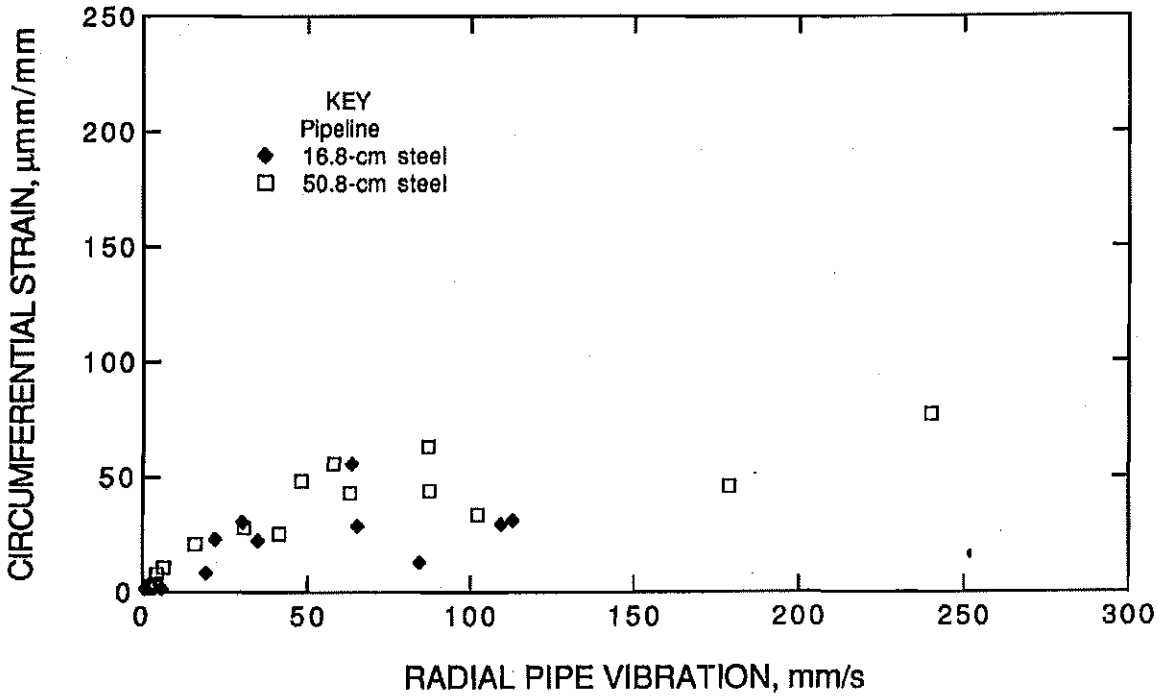
Circumferential strain versus transverse ground vibration.

Figure 23



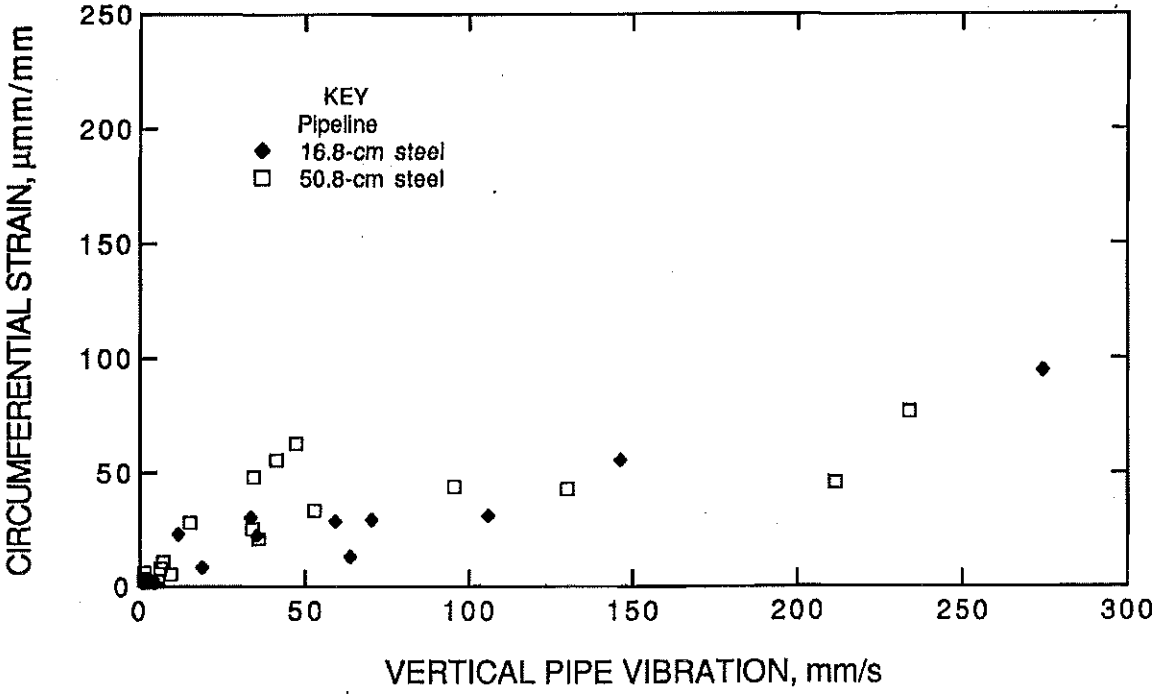
Longitudinal strain versus transverse ground vibration.

Figure 24



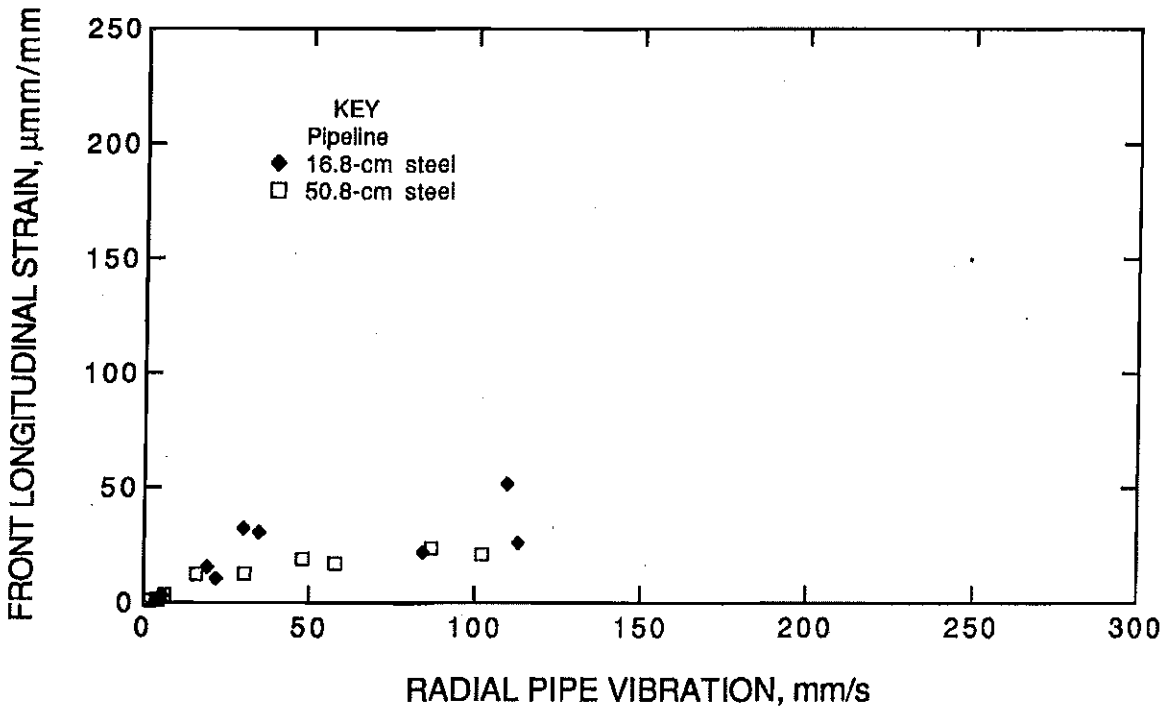
Circumferential strain versus horizontal pipeline vibration response normal to axes.

Figure 25



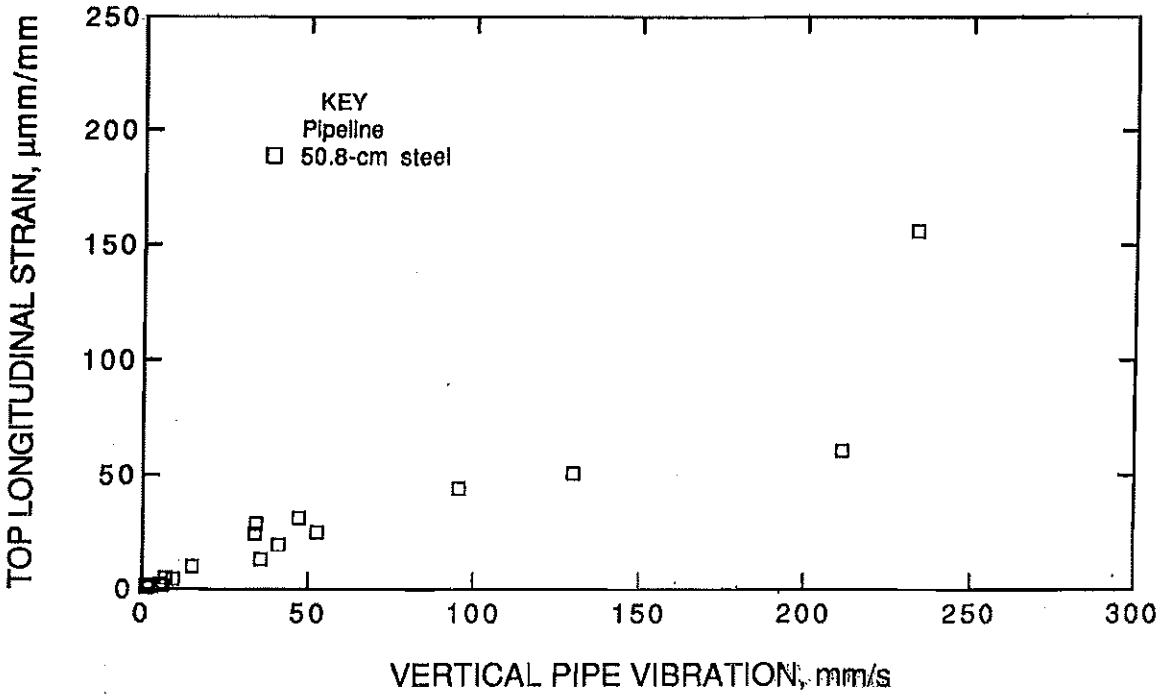
Circumferential strain versus vertical pipeline vibration response.

Figure 26



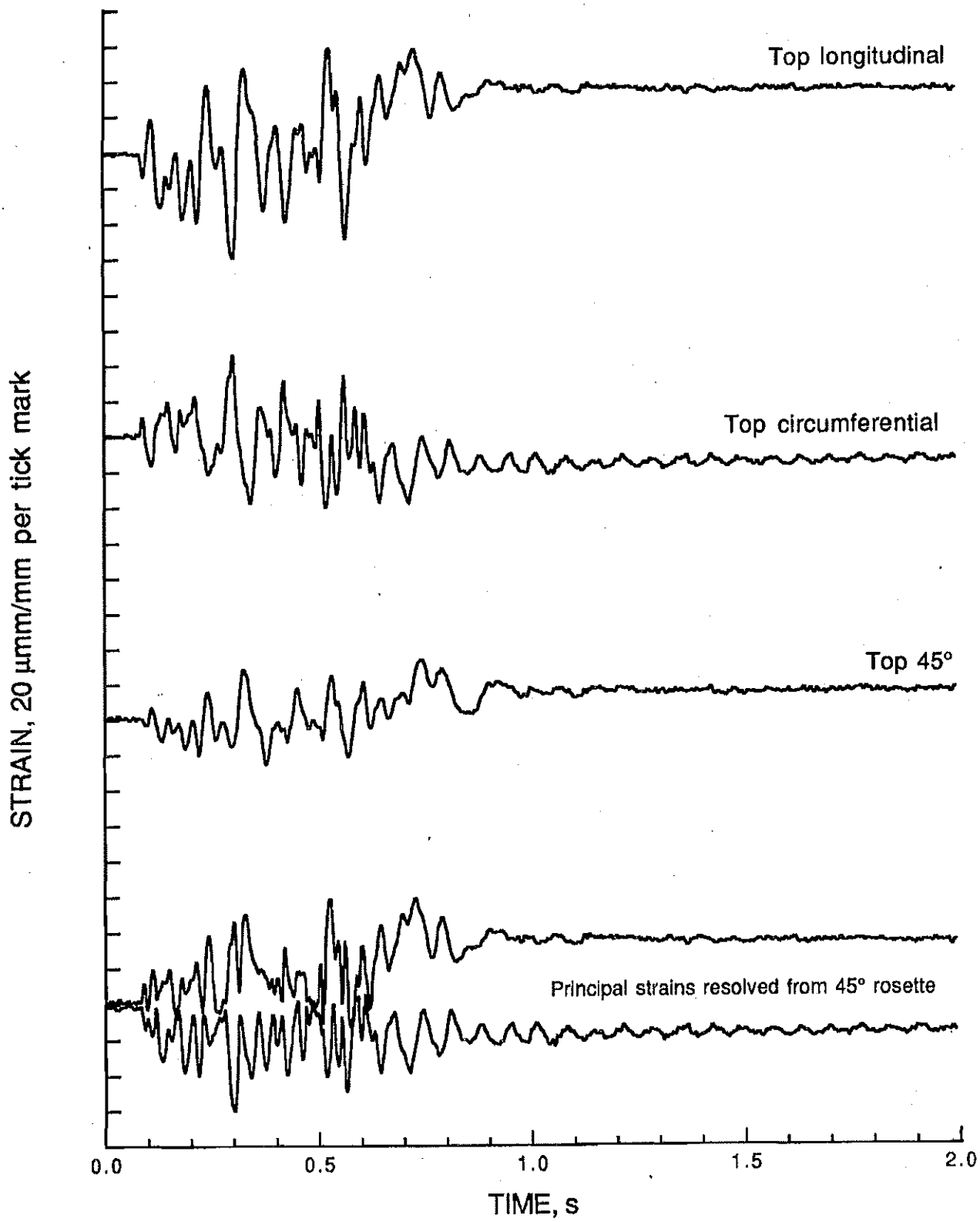
Front longitudinal strain versus horizontal pipeline vibration response.

Figure 27



Top longitudinal strain versus vertical pipeline vibration response.

Figure 28



Principal strain analysis for blast 25.

Figures 29 and 30 show the maximum strains and computed stresses using the SwRI values of 203 GPa (29.5 $\times 10^6$ lb/in^2) for Young's modulus and 0.3 for Poisson's ratio and based on the simplified biaxial equations. Also shown are the large-pipe SwRI measurements for these 0.4 scaled data and the SwRI prediction line extrapolated to large scaled distances. Generally, it is risky to use scaled distance plots to compare two sets of data with such different absolute distances. If comparisons are valid, the USBM data would be represented by a shallower slope than the SwRI prediction (rock versus soil), as already discussed. Close in, USBM stresses are relatively low except for the final blast (blast 31) just beneath the pipes and at a scaled distance of 0.98 m/kg$^{0.4}$. There was no question that permanent deformation of pipes and ground occurred with this final blast, and it is reasonable that responses were more similar to those found by SwRI than were the earlier, more distant, strictly elastic case USBM measurements. This blast is discussed in more detail later in the report in the section "Final Blast."

Circumferential or hoop stresses produced by internal pressurization can be easily calculated from the thin-walled cylinder equation:

$$\text{Stress} = PD/2t,$$

where P = pressure, Pa,

D = inside diameter,

and t = wall thickness, in consistent units.

Table 4 lists pipeline specifications and hoop stresses produced by internal pressurization. As the table shows, the pressurization-induced circumferential or hoop stresses for the two larger steel pipes are close to 72 pct of yield strengths (and would be exact if D was equal to the outside rather than inside diameters). The pressure used in the PVC pipe is considerably lower, probably because of the O-ring slip joints. Also in table 4 are both stresses and strains equivalent to 18 pct of yield strength. This 18-pct level is used by some transmission companies as an informal guideline for transient environmental effects such as traffic over a pipeline beneath a highway.

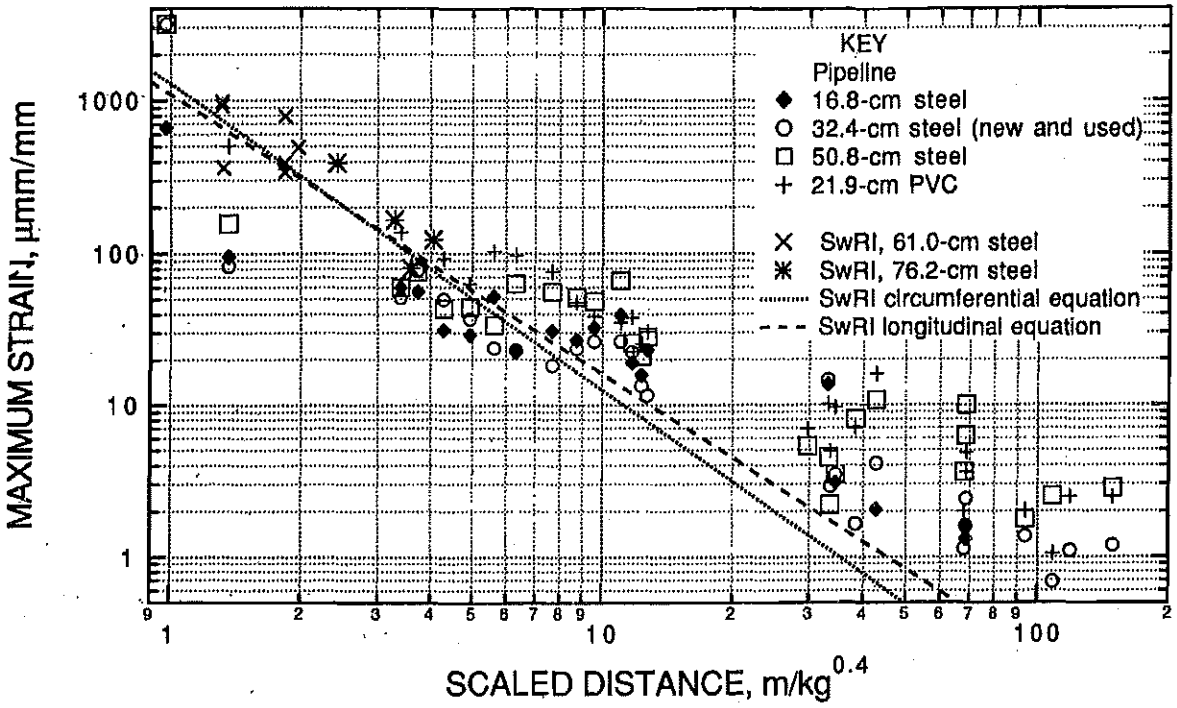
The minimum biaxial strain values in table 4 (last column) were calculated from the full biaxial stress-strain equation and represent the worst case assumption that the two strain components peak at the same time, are the same sense, and are the same peak amplitudes. They are minimums in that they are the lowest (most restrictive) values that correspond to the 18 pct of SMYS stress. More discussion of this 18-pct criterion follows in the section "Blasting Criteria for Steel Pipes."

Table 4.—Pipeline stresses

Pipe outside diam, cm	SMYS,[1] MPa	MAOP,[2] MPa	Hoop stress from internal pressurization, MPa	72 pct of SMYS, MPa	18 pct of SYMS, MPa	Minimum microstrain[3] at 18 pct of SMYS
Steel:						
16.8	290	3.86	64.2	209	52	179
32.4	241	6.82	167	174	43	150
32.4[4]	290	8.18	200	209	52	179
50.8	386	7.23	270	278	70	239
PVC:						
21.9	48	1.10	13.2	35	NAp	NAp

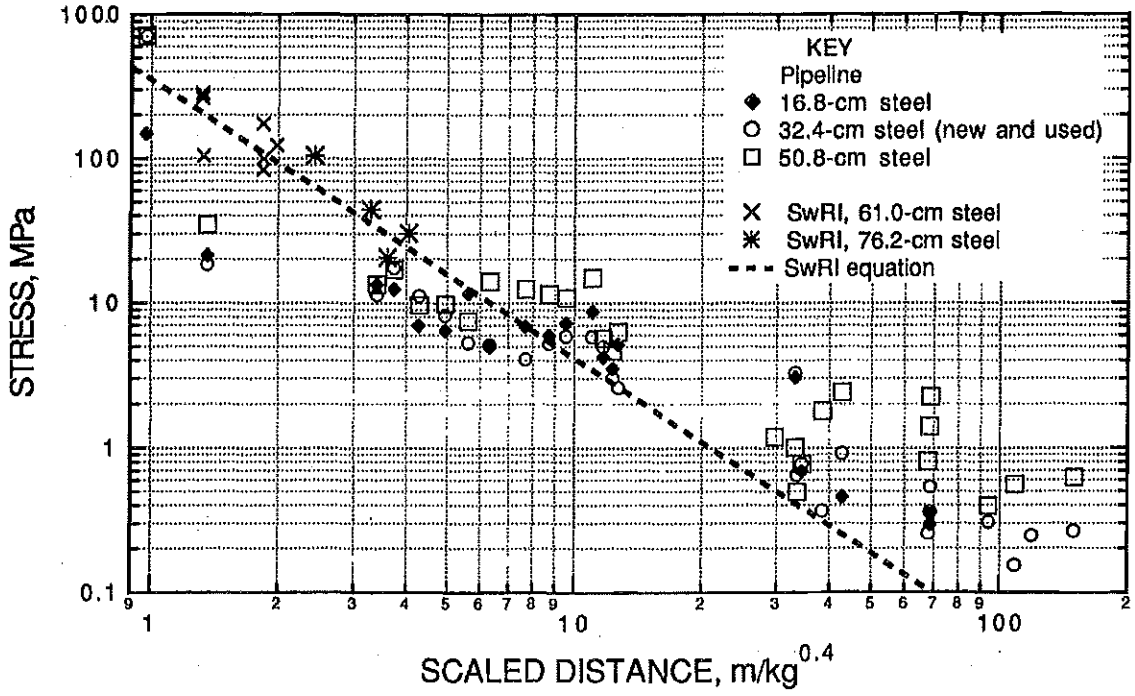
NAp Not applicable.
[1]SMYS = specified minimum yield strength (1 MPa = 145 lb/in^2).
[2]MAOP = maximum allowable operating pressure.
[3]Minimum strain that would produce stress equal to 18 pct of SMYS based on worst case biaxial equation prediction.
[4]New. All other pipes were used.

Figure 29



Maximum strains versus 0.4 scaled distance.

Figure 30



Maximum stresses versus 0.4 scaled distance.

SETTLEMENT

All transit survey data are given in appendix C. From elevation data, analyses were made of center-post settlement and maximum possible resulting strains based on Dowding's bending equation (*12*), as ground vibrations increased to over 600 mm/s. These results are given in tables 5 and 6 and figures 31 and 32, respectively. For this worst case analysis, the assumption was made that elevation changes did result only from vibrations, and not from natural compaction; water intrusion, the simple passage of time, or other causes. This is a significant assumption as clay soils are not particularly susceptible to vibration-induced settlement. To do justice to the settlement issue, a careful and controlled study is needed. Settlement and strains for vibrations below about 120 mm/s are small and irregular enough to be attributed to measurement scatter and normal "settling-in." The next two levels, up to 240 mm/s, appear to be more significant, with strains approaching 20 pct of those resulting directly from blasting vibrations (figures 18 to 27). The highest vibration, exclusive of blast 31, produced about 650 mm/s and appears associated with a significant increase in both settlement and predicted strains. However, at 12 to 55 μmm/mm, all strains were an insignificant fraction of an 830-μmm/mm level corresponding to the theoretical yield for Grade B pipe.

WELL AND TELEPHONE CABLE

For the well, three characteristics were evaluated: casing cement bond, zone isolation to control fluid migration, and casing integrity. The initial cement bond logs showed greater than 90 pct bonding to the well wall including the Coal VII and VI Seams. After the 120-mm/s blast at a distance of 124 m, some bonding loss was found for two zones of gray sandy shale. Overall, bonding was better than 85 pct and zone isolation was still maintained.

Another bond log after 240 mm/s (blast at 51 m) showed additional loss in one of these same shale zones. However, bonding was still better than 90 pct in intervals of 3 m directly above and below this zone, and zone isolation was maintained. The final test after all the blasting showed a total bond loss. The closest blast had been blast 29 at about 17 m, which produced a particle velocity of over 600 mm/s. In all cases, the well maintained pressure and the casing was undamaged.

Table 5.—Accumulative pipe settlement[1] of center upright post, millimeters

Maximum vibrations, mm/s	Steel				PVC,
	16.8-cm	32.4-cm	[2]32.4-cm	50.8-cm	21.9-cm
77.2	−0.91	−4.88	−0.305	−2.13	ND
120.9	0	−2.13	4.27	−0.91	3.05
103.6	4.00	0.91	7.01	1.22	7.62
166.6	7.32	5.49	11.3	6.10	11.3
241.8	5.79	4.57	11.6	8.84	9.75
647.7	30.8	32.0	41.1	37.8	38.4

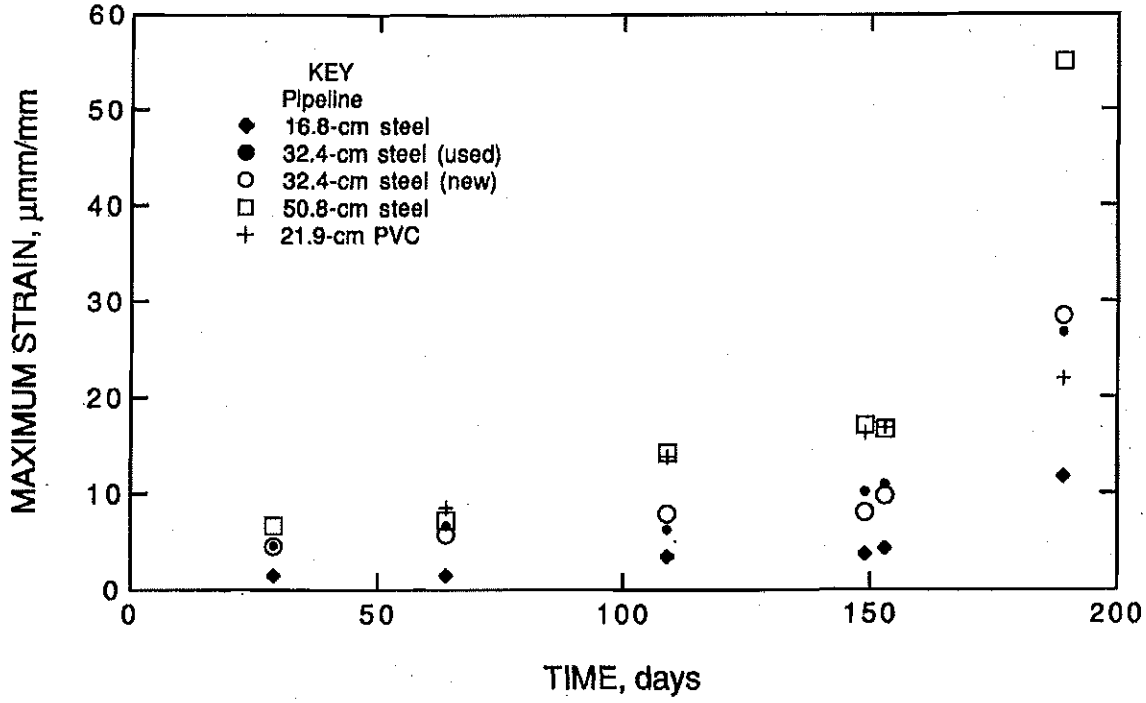
ND No data.
[1]Measurement accuracy is ±0.8 mm at the survey-to-midpoint upright distance of 53 to 55 m.
[2]New. All other pipes were used.

Table 6.—Maximum possible accumulative strain from vibration-induced settlement of pipes, micromillimeters per millimeter

Maximum vibrations, mm/s	Steel				PVC,
	16.8-cm	32.4-cm	[1]32.4-cm	50.8-cm	21.9-cm
77.2	1.5	4.6	4.5	6.7	8.5
120.9	1.5	6.6	5.7	7.2	8.5
103.6	3.5	6.3	7.9	14.2	13.8
166.6	3.7	10.1	8.0	17.0	16.2
241.8	4.3	10.9	9.7	16.6	16.8
647.7	11.7	26.7	28.4	55.0	21.9

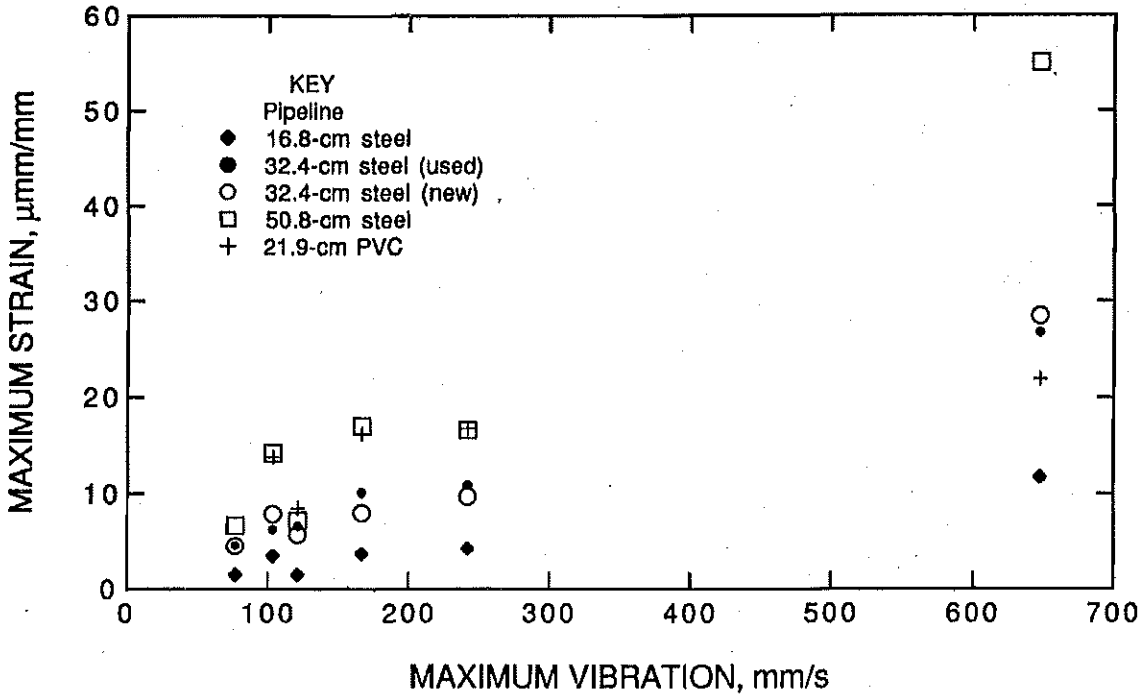
[1]New. All other pipes were used.

Figure 31



Strain from settlement versus time.

Figure 32



Strain from settlement versus vibration amplitude.

Indiana Bell's tests on the fiber-optic telephone cable found no breaks and an attenuation slightly lower after blast 29 than before (13.2 dB versus 13.9). This slight difference was attributed to warming from sunshine on both the equipment and exposed fiber ends. Admitting that the blast at over 600 mm/s had no immediate effect on the fiber optic, the Indiana Bell technicians could not guarantee that damage of an unspecified nature would not show up later. The buried copper coaxial cable was also undamaged by the blasting.

FINAL BLAST

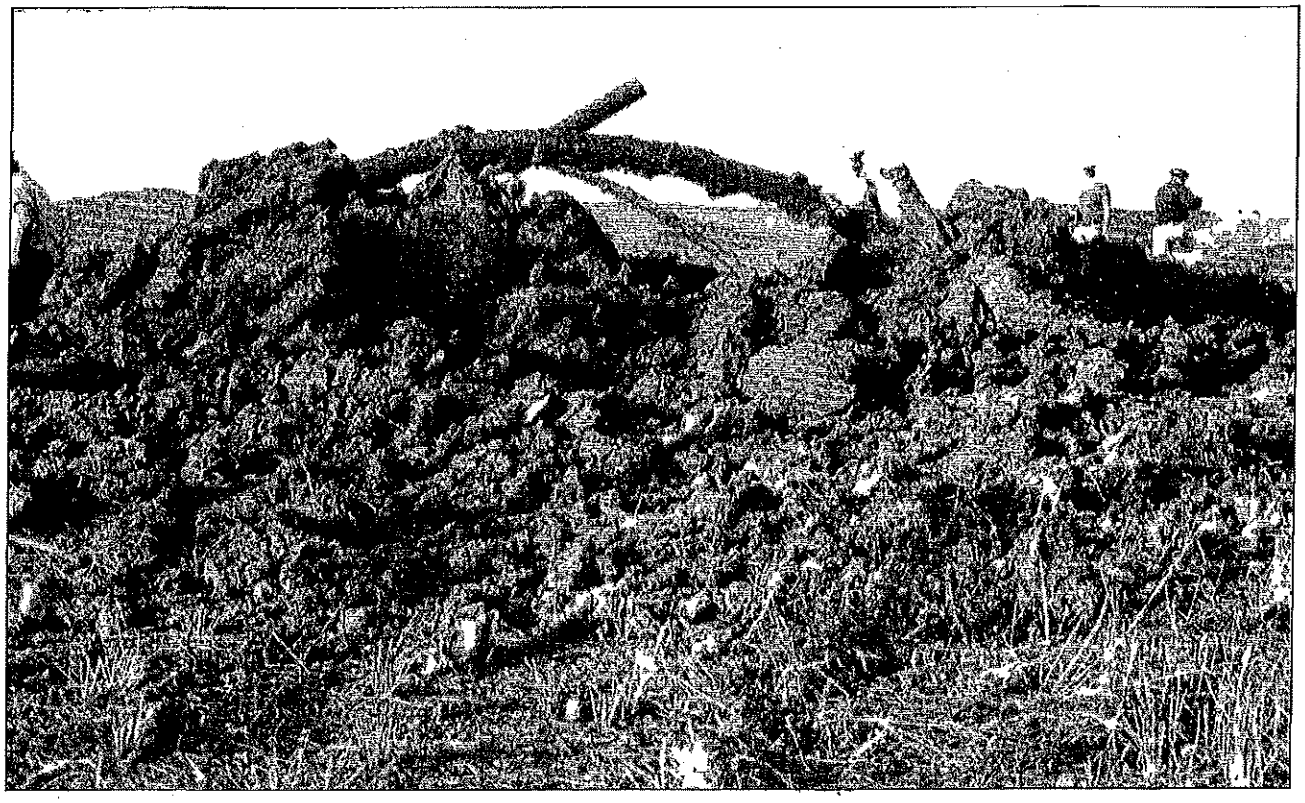
Following production blasts 29 and 30 next to the fenced-in pipeline field (figure 1), a single row of four blastholes was drilled between the individual pipes to complete the testing program (blast 31). Figure 33 shows the results, with the severely bent but unbroken 16.8-cm pipe and the new 32.4-cm pipeline arching above the highwall swell. The largest pipe, the water-filled 50.8-cm pipe, was uplifted, parted, and fell back down, and the used 32.4-cm pipe was cleanly broken. The PVC pipe simply came apart at the O-ring joints. This blast produced severe uplift, with the explosive being below rather than next to the pipes. The distance listed in table 2 for blast 31 is the horizontal or surface projection; the true distance from each pipe to the closest explosive column top was 5 to 6 m.

This blast was clearly different from the previous 30, producing permanent ground and pipe strain. Vibration levels were above 900 mm/s, although not meaningful for this situation, representing non-elastic responses. Strains shown in table 6 are possibly underestimates, as pipeline movement eventually parted the signal wires. All pipes lost pressure. The two unbroken pipes sheared off the end uprights as the center uplift pulled the ends closer. Pressure was then lost at the upright joints.

Strain values and computed stresses from this blast are included in figures 16, 17, 29, and 30 for comparison with the SwRI prediction equations, as discussed in the section on stress. They were not included in the strain-versus-velocity plots (figures 18 to 28) because they were not true elastic wave particle velocities.

Following blasting, Texas Gas Transmission Corp. removed samples from the four steel pipes and tested them for strengths. All pipes had yield strengths above design minimums (table 7). In particular, the two that did not rupture from shot 31 had considerable margins, suggesting a significant factor of safety in the SMYS specifications.

Figure 33



Uplifted pipes following blast 31.

Table 7.—Postblast tests of steel pipe by Texas Gas Transmission Corp., megapascals

Outside diameter, cm	SMYS[1]	Measured strengths	
		Yield at 5-pct elongation	Ultimate tensile
16.8	290	456	610
32.4	241	267	354
32.4[2]	290	436	521
50.8	386	417	494

[1]SMYS = specified minimum yield strength (1 MPa = 145 lb/in^2).
[2]New. All other pipes were used.

ANALYSES OF FINDINGS

The last mining cycle brought the production blasting within 15 m of the closest pipeline (blast 29). There was little backbreak and no apparent permanent ground displacement at this minimum distance of 44 hole diameters. Vibration levels were 635 mm/s for this blast on the ground surface and 234 to 274 mm/s on the two instrumented pipelines, with no loss of pipe integrity (pressure drops). Figures 18 through 28, showing measured strains, are composites from two types of blasts, parting and overburden, different azimuthal directions, and five pipelines of two different materials. It is not surprising that considerable scatter exists in the summary figures, and a pipe-by-pipe analysis reduces this scatter. Also in common with other studies, there were problems with continual use of strain gages and electronics in an unfriendly environment for an extended period of time. Generally, circumferential strains were higher than longitudinal by a rough factor of 2 for the lower vibration levels and were comparable or lower in amplitude at high vibrations (table 3). PVC pipe strains were slightly higher, probably because of their lower stiffness and more faithful conformance to ground displacement.

BLASTING CRITERIA FOR STEEL PIPES

Criteria are needed for blasting near pipelines that will ensure that damage will not occur and yet be reasonable with regard to resource recovery and other requirements for blasting. The pipeline industry itself must deal with this problem whenever blasting is needed for repair, replacement, or installation of an adjacent new pipeline. "Damage" is defined here as any failures leading to pressure or product loss and any plastic deformation (yield or permanent bending).

The Enron standard (*6*) specifies allowable stresses of 6.9 MPa for electrically welded and 3.45 MPa for gas-welded or mechanically joined steel pipes. Corresponding strains are 30.8 and 15.4 μmm/mm, considerably less than many measured values in table 3.

The previously mentioned criterion of 18 pct of yield strength is applied to transient excitation such as traffic on a highway crossing a buried pipeline. If this is adopted as a blasting criterion, the stresses and strains listed in table 4 would apply. It is not unreasonable to allow such a criterion for blasting, as it is unlikely that a pipeline would simultaneously be subjected to traffic stress and high-level blast vibration.

Internal pressurization at the MAOP produces circumferential stresses corresponding to about 72 pct of yield or the SMYS (table 4). The addition of a maximum dynamic stress of 18 pct brings this total to 90 pct. Esparza's SwRI final report includes five yield theories for biaxial states of stress (*5*). He says "many engineers tend to use the distortional energy criteria, sometimes called the Huber-Hencky-Mises Theory, as they believe it is the most accurate." The appropriate yield equation is then given as

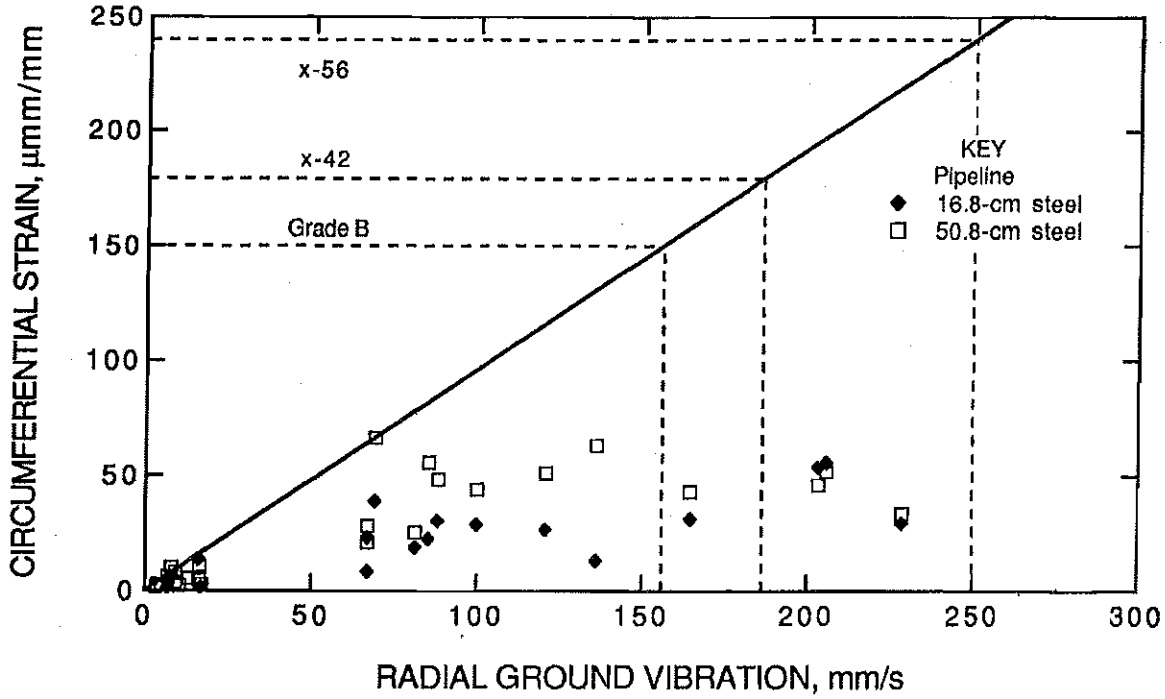
$$\left(\frac{\sigma_c}{\sigma_y}\right)^2 + \left|\frac{\sigma_c}{\sigma_y}\right|\left|\frac{\sigma_l}{\sigma_y}\right| + \left(\frac{\sigma_l}{\sigma_y}\right)^2 = 1,$$

where σ_c, σ_l and σ_y = circumferential, longitudinal, and yield stresses, respectively.

For a total circumferential stress of 90 pct of SMYS ($\sigma_c = 0.9\sigma_y$), the equation gives a maximum total longitudinal stress (σ_l) of 0.18 or, again, 18 pct of SMYS. This means that both stresses are limited to 18 pct of SMYS.

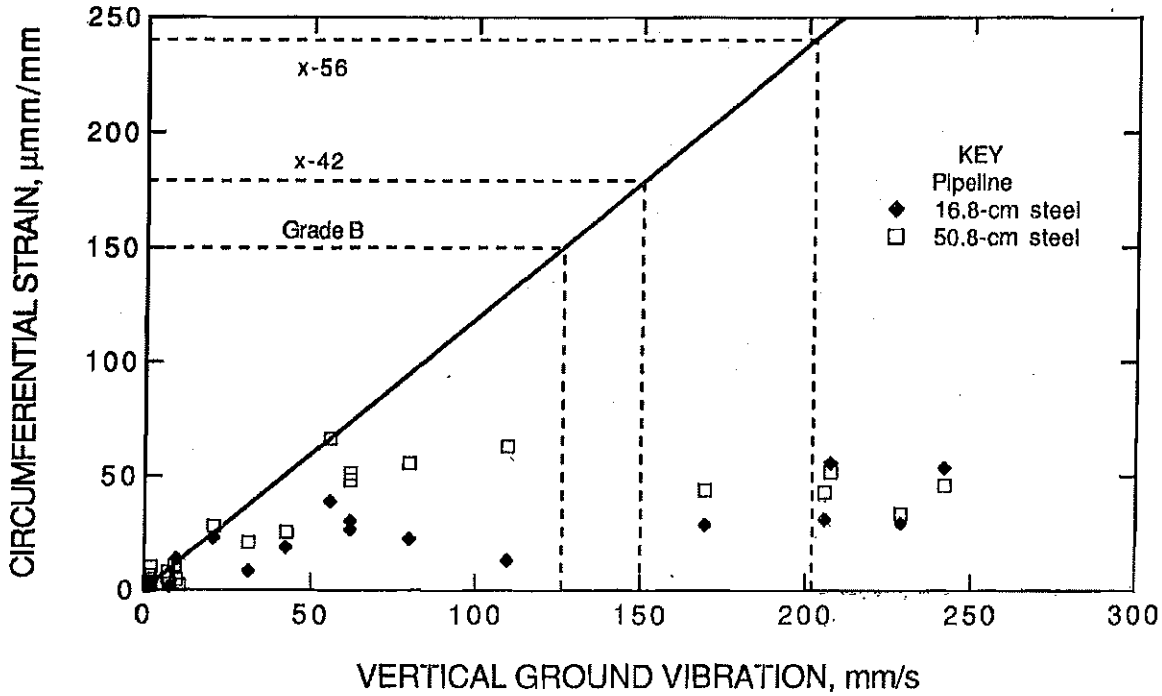
An initial estimate of a safe-level criterion for blasting is possible from the particle velocity strain comparisons from figures 18 to 23 and extrapolating particle velocities corresponding to 150 to 239 μmm/mm from table 4. The vibration amplitudes corresponding to Grade B, X-42, and X-56 pipelines are then 127, 150, and 200 mm/s, respectively, for vertical vibrations and slightly higher for radial. These are shown in figures 34 and 35.

Figure 34



Radial velocity criteria based on maximum circumferential strain and grade of pipe.

Figure 35



Vertical velocity criteria based on maximum circumferential strain and grade of pipe.

It is important to consider if this approach is conservative. The 18-pct criterion allowed for traffic still includes a safety factor; the SMYS itself has a safety factor in that it is a "minimum"; and the blast data are well contained by the maximum value envelopes. Strains are calculated as worst case biaxial. Furthermore, the low frequency (and potentially higher strain-producing vibration) found here (5.6 Hz) is about as low as could be expected for such close-in blasting (*16*). On the other hand, the pipeline may not yet be fully coupled after only 6 months in the ground. The soil over the pipelines was softer than nearby undisturbed ground even after 6 months, despite the use of standard installation procedures. The problem of incomplete coupling and reduced responses at higher vibration amplitudes was addressed by developing an envelope of maximums by extrapolating strains from lower level responses (figures 34 and 35). Any additional work on pipeline responses from blasting should include consideration of improved or ideal coupling, or alternatively, a simple and practical way of directly monitoring pipe response under backfilled conditions.

All the analyses in this study are based on elastic waves and the total absence of any permanent ground deformations or block movements into the pipeline vicinity. Distances between pipes and blasting must be sufficiently large to preclude direct blast-produced ground cracks, on the order of 100 blasthole radii. For a typical large surface mine blast, this would be about 16 m (52 ft). Blasting for construction, excavation, and new pipeline installation would likely be within this range, and there the concerns of Oriard and Kiker (*9-11*) and SwRI analyses (*4-8*) would apply.

BLASTING CRITERIA FOR PVC PIPELINE

Unlike the steel pipeline, the PVC pipe at the specified maximum pressure experienced far less hoop stress than 72 pct of SMYS (table 4). It is likely that there is some other limiting factor, such as the O-ring couplings. The strain corresponding to the maximum operating pressure 1.1 MPa (160 lb/in^2) is 4,800 μmm/mm, a fraction of the yield failure strain of 17,500. Again, a rough estimate of particle velocity is possible from the strain figures and a doubling for circumferential strain, which was not monitored on the PVC pipe. Assuming a maximum environmental strain equal to 5 pct of that produced by pressurization, or 1.35 pct that of yield, and the worst case maximum strain envelope (from figure 20), the corresponding strain would be 240 μmm/mm and velocity would be about 250 mm/s. Because of the lack of actual circumferential strains and uncertainty about failure modes for PVC pipe, this level should be further reduced until more data are available. Again, a 125-mm/s (5-in/s) criterion seems reasonable. Possibly, users of PVC pipe have an environmental criterion similar to the 18-pct SMYS suggested for steel.

CONCLUSIONS

This report describes a study of full-scale blasting near pressurized pipelines. Although particle velocities of over 600 mm/s were sustained without loss of pipe integrity, it is recommended that 125 mm/s measured at the surface is a safe-level criterion for large surface mine blasts for Grade B or better steel pipelines. The same criterion is recommended for SDR 26 or better PVC pipe. The basis for this recommendation is that the pipes can tolerate a dynamic load equal to 18 pct of SMYS. It is suggested that this criterion not be applied at construction sites if experience has shown that higher or lower particle velocities are tolerable or appropriate. Also, no adjustment is believed needed for pipeline age, assuming the protective coating is intact, unless the pipeline is known to be at higher risk from previous damage or other causes. The same safe-level criterion also appears applicable, at a minimum, to vertical wells and telephone lines.

ACKNOWLEDGMENTS

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REFERENCES

1. Siskind, D. E., and M. S. Stagg. Response of Pressurized Pipelines to Production Size Mine Blasting. Paper in Proc. 9th Annu. Symp. on Explosives and Blasting Research (San Diego, CA, Jan. 31-Feb. 4, 1993). Int. Soc. Explos. Eng., 1993, pp. 129-148.

2. O'Rourke, M., and L. R. Wang. Earthquake Response of Buried Pipeline. Paper in Proc. ASCE Geotechnical Engineering Division Specialty Conference, Earthquake Engineering and Soil Dynamics (Pasadena, CA, June 19-21, 1978). Am. Soc. Civ. Eng., 1978, pp. 720-731.

3. Huff, W. L. Essex-Diamond Ore Research Program; POL Storage and Distribution Facilities Test, ESSEX V, Phase 3. U.S. Army Eng. Waterw. Exp. Stn., Struct. Lab., Vicksburg, MS, Rep. WES TR SL-79-6, Sept. 1979, 101 pp.

4. Westine, P. S., E. D. Esparza, and A. B. Wenzel. Analysis and Testing of Pipe Response to Buried Explosive Detonation. Southwest Res. Inst., Rep. for Pipeline Research Committee, Am. Gas Assoc., July 1978, 173 pp.

5. Esparza, E. D., P. S. Westine, and A. B. Wenzel. Pipeline Response to Buried Explosive Detonations, v. II—Technical Report. Southwest Res. Inst., Final Rep., A.G.A. Project PR-15-109, SwRI Project 02-5567 for Pipeline Research Committee, Am. Gas Assoc., Aug. 1981, 249 pp.

6. Enron Gas Pipeline Group. Allowable Blasting Near Buried Pipelines, Engineering Standards 7155. Enron Corp., Houston, TX, Apr. 1988, 12 pp.

7. Esparza, E. D. Pipeline Response to Blasting in Rock. Southwest Res. Inst., Final Rep., A.G.A. Project PR 15-712, SwRI Project 06-1609 for Pipeline Research Committee, Am. Gas Assoc., Sept. 1991, 68 pp.

8. Lambeth, A. Blasting Adjacent to In-Service Gas Pipelines. Proc. American Gas Association Transmission/Distribution Conference, Operating Section Proceedings (Orlando, FL, May 17, 1993). Am. Gas Assoc., 1993, pp. 455-467.

9. Oriard, L. L. (Lewis L. Oriard, Inc.). Personal communication, Jan. 7, 1993. Available from D. E. Siskind, USBM, Twin Cities Res. Cent., Minneapolis, MN.

10. ___. Personal communication, Jan. 20, 1993. Available from D. E. Siskind, USBM, Twin Cities Res. Cent., Minneapolis, MN.

11. Kiker, J. L. (Kiker Technical Services, Inc.). Personal communication, Jan. 15, 1993. Available from D. E. Siskind, USBM, Twin Cities Res. Cent., Minneapolis, MN.

12. Dowding, C. H. Blast Vibration Monitoring and Control. Prentice-Hall, 1985, pp. 169-171.

13. Peck, R. B., A. J. Hendron, and B. Mohraz. State of the Art of Soft Ground Tunneling. Paper in Proc. First North American Rapid Excavation and Tunneling Conf. (Chicago, IL). Soc. Min. Eng., 1972, pp. 259-286.

14. Linehan, P. W., A. Longinow, and C. H. Dowding. Pipeline Response to Pile Driving and Adjacent Excavation. Paper in J. Geotech. Eng., v. 118, No. 2, Feb. 1992, pp. 300-316.

15. Siskind, D. E., and M. S. Stagg. Blast Vibration Measurement Near and on Structure Foundations. USBM RI 8969, 1985, 20 pp.

16. Siskind, D. E., S. V. Crum, R. E. Otterness, and J. W. Kopp. Comparative Study of Blast Vibrations From Indiana Surface Coal Mines. USBM RI 9226, 1989, 41 pp.

17. Wiss, J. F., and P. Linehan. Control of Vibration and Blast Noise From Surface Coal Mining (contract J255022, Wiss, Janney, Elstner, and Assoc., Inc.). USBM OFR 103(2)-79, 1978, v. 2, 280 pp.; NTIS PB 299 888.

APPENDIX A.—SOUTHWEST RESEARCH INSTITUTE STUDIES

The extensive studies of blasting near pipelines by Southwest Research Institute (SwRI) for the Pipeline Research Committee of the American Gas Association (*4-7*) were primarily for construction blasting for the installation of new pipelines next to existing ones. The original SwRI comprehensive "final report" authored by Westine and others in 1978 (*4*) was superseded by a more comprehensive report by Esparza and others in 1981 (*5*), which included additional tests, analyses, and revised stress prediction equations.

SwRI EXPERIMENTAL RESULTS

Six series of tests involved pipelines and blasting in soil (*5*). Pipeline sizes and other test parameters are listed in table A-1. The two smallest pipes were approximately 1/8- and 1/4-scale models of a 61-cm (24-in) diameter pipeline. Those two and the 40.6-cm pipe were specially installed for the study (test series A). The 61- and 76.2-cm pipelines were located in Kansas City, MO, and Madisonville, KY, respectively, with only the latter pipeline pressurized (to 2.76 MPa, 400 lb/in^2) during the blasting tests (series B and C). Except for the in-service Madisonville pipeline, all tests were on relatively short pipe sections of 2.1 to 13.7 m. For all tests, the pipe lengths were at least twice the distance to the explosive charge.

Test series D and E studied lines and grids of charges oriented parallel and at various angles to the pipelines. The distances in table A-1 correspond to the closest charge, with each individual charge so small as to be a point source. Only a few of the grid tests used delays between charges of 3 to 6 ms.

The two-media tests (series F) had small point charges in holes in a 3- by 3- by 0.9-m-thick concrete slab 0.9 m from a test section of pipeline. This was intended to simulate blasting in rock, which was also addressed more seriously by SwRI in a followup study (*7*).

None of the SwRI tests approximated mine or quarry blasting, both of which have larger and more distant explosives, are fired in rock, and have mostly rock travel paths for the vibrations. Strain and vibration records from SwRI tests were very highly damped (e.g., 30 pct) with only one to two cycles of motion at extremely long periods of 60 to 250 ms, despite the closeness of the blasts. Some of the strain and vibration measurements had only one pulse and no rebound at all, suggesting permanent ground strain rather than elastic waves. SwRI ground vibrations were measured off to the side or on the opposite side of the blast from the pipe rather than above, next to, or on the pipelines. The authors avoided measuring in the disturbed ground but at the cost of an easy comparison with directly measured strains and vibrations. Because some directionality is possible for all blasts and likely for those done with multiple charges, this monitoring procedure could have contributed to the vibration amplitude scatter.

Only a few SwRI measurements involved pipelines under internal pressurization, mainly test C in table A-1. This large pipeline in Madisonville, KY, is rated at 414 MPa (60,000 lb/in^2) specified minimum yield strength (SMYS) and was being operated at a reduced pressure of 2.76 MPa (400 lb/in^2) during the blasting tests. A maximum allowable operating pressure (MAOP) of 6.8 MPa (990 lb/in^2) for this pipeline would produce circumferential stresses of about 290 MPa, corresponding to about 70 pct of SMYS. Blasting-induced stresses ranged up to 103 MPa (15,000 lb/in^2) from particle velocities of roughly 500 mm/s (20 in/s), without damage. This represents about 25 pct of the pipeline's SMYS to be added to stresses from pressurization. The pipe-to-charge distance was 2.74 m, and the actual measured velocities were 1,831 mm/s at 1.83 m and 358 mm/s at 3.66 m. It is not known if the pipe would have failed if it had been operating at MAOP.

Table A-1.—SwRI pipeline blasting experiments in soil (5)

Test	Pipe diam, cm	Pipe wall, mm	Distance range, m	Charge size, kg
A. Point source	7.5	1.50	0.23-3.35	0.014 -0.50
	15.1	2.36	0.30-6.86	0.014 -1.82
	40.6	13.1	0.30-0.91	0.014 -0.027
B. Point source	61.0	7.92	1.83-3.96	2.27 -6.82
C. Point source	76.2	8.74	2.74-4.57	1.36 -2.27
D. Line of charges ...	7.5	1.50	0.45-4.57	[1]0.0153-0.182
	15.1	2.36	0.45-4.57	[1]0.0153-0.182
E. Grid of charges ...	15.1	2.36	0.45-1.22	[2]0.025 -0.153
F. 2-media tests	15.1	2.36	1.52-3.35	0.114 -0.182

[1]Weight of explosive per hole, seven holes in a line.
[2]Weight of explosive per hole, three rows of four holes.

SwRI THEORETICAL ANALYSES OF VIBRATION

The SwRI authors derived relationships for ground motion and strains based on similitude theory, theoretical energy, conservation of mass and momentum, π theorem, and shock front propagation (*5*). Because the authors used empirical vibration data to define the equations' terms, it is not clear how predictions from these equations differ from the USBM's traditional and relatively simple charge weight scaling. The SwRI authors call any charge weight scaling other than cube root scaling "dimensionally illogical." The SwRI equations are complex, contain some difficult terms and parameters difficult to measure, and sometimes predict unrealistic amplitudes. Their equation, in its original U.S. customary units is

$$\left[\frac{U}{c}\right]\left[\frac{p_o}{\rho c^2}\right]^{0.5} = \frac{0.00617\left[\frac{W_e}{\rho c^2 R^3}\right]^{0.852}}{\tanh\left[26.0\left[\frac{W_e}{\rho c^2 R^3}\right]^{0.3}\right]}.$$

For easy comparison with the referenced reports, all units in the following discussions are being kept in the authors' original measurement system. A similar equation was also derived for displacement. Equation parameters are

U = peak radial ground particle velocity, ft/s,

R = standoff distance, ft,

W_e = explosive energy release, ft-lb,

ρ = mass density of soil or rock, lb-s^2/ft^4,

c = seismic P-wave velocity in soil or rock, ft/s,

and p_o = atmospheric pressure, lb/ft^2.

The explosive energy release (W_e) requires some calculation. For example, ANFO is 912 cal/g, which is equivalent to 1.28×10^6 ft-lb/lb (SwRI uses 1.52×10^6). Multiplication by the amount of explosive (in pounds) gives the appropriate W_e value. Mass density (ρ) and propagation velocity (c) are not typically known with any precision or even adequately defined for this analysis. For the SwRI tests, they pertain to the soil. For more distant blasts (e.g., >10 m), it is not clear if they would pertain to the surface soil or the medium that provides most of the vibration propagation path. Most situations will include a mixture of rock and surface soil.

Predictions from this SwRI equation were compared with measurements from single-charge blasts reported in USBM RI 9226 (*15*). Particle velocities were reasonably close for ρ and c of 2.7 g/cm^3 (5.23 lb-s^2/ft^4) and 3,000 m/s (10,000 ft/s), respectively, but far too low for soil-type values of these two parameters. The plot of the SwRI equation velocity parameter also suggests two range regimes with a shallower propagation slope for the distant tests (left side) than for the close-in tests (right side) in their figure 64 (*5*). This again suggests a different strain mechanism close in or at least a different seismic wave type.

SwRI authors also derived simplified versions of their propagation equations for cases where

$$6 \times 10^{-5} < \frac{W_e}{\rho c^2 R^3} < 6.4 \times 10^{-2}.$$

Few, if any, mining-type blasts fall within this range because of their relatively large distance (R); therefore, the simplified equations appear applicable only to construction blasts.

SwRI THEORETICAL ANALYSIS OF STRESS AND STRAIN

Two types of pipeline responses can occur, out-of-round deformation (ovaling) and bending, represented by circumferential and longitudinal strains, respectively. The circumferential strain is a measure of pipe deformation by ovaling. SwRI developed an equation for pipe ovaling natural frequency:

$$T = 8.11\sqrt{\frac{\rho_s\, R r^4}{E h^3}},$$

where T = period ($1/f$),

ρ_s = soil density,

R = standoff distance,

r = pipeline radius,

E = Young's modulus,

and h = pipe thickness.

The above equation assumes perfect ground-to-pipeline coupling. It also assumes that all the ground between the source and the pipeline contributes to the pipe's natural frequency, that is, all the ground within the distance specified by the R term. This equation must apply to only close-in cases (e.g., <10 m). It is not reasonable to expect a pipe's response period to increase without limit for increasing R, nor for the ground at 100 m or more distance to contribute to the stiffness of a ground-pipeline system. The SwRI authors also say that the equation "may not apply for media with a significant elastic constant (perhaps rock)" (*5*). Applying this equation to the USBM's pipelines gives long periods of 6 to 50 s for even the closest blasts at 15 m.

Others (*2, 13*) subscribe to the assumption that a buried pipeline is relatively flexible and therefore will deform with the medium. If so, the dominant period of the motion is only a function of the wave propagation effects of the surrounding medium and the excitation motion itself. Interaction of delays will affect the excitation motion and is a function of delay interval, location, and the propagation medium.

The SwRI-developed strain relationships were based on theoretical considerations and contained constants that the authors said could not be explicitly evaluated. This required a statistical fit approach to their experimental data. Their resulting equations were

$$\epsilon_{cir} = 4.78\ \chi^{0.805},$$

$$\epsilon_{long} = 1.98\ \chi^{0.735},$$

where, for point sources,

$$\chi = \frac{nW}{\sqrt{Eh}\ R^{2.5}}.$$

The terms in the χ equation are as follows:

n = equivalent energy release (nondimensional, equals 1 for ANFO),

W = charge weight, lb,

E = modulus of elasticity, lb/in^2, typically 29.5 $\times 10^6$ for steel,

h = pipe wall thickness, in,

and R = distance between pipe and charge, ft.

For stress determination, SwRI used the biaxial stress-strain equation as a reasonable approximation for the relatively thin-walled pipes:

$$\sigma_1 = \frac{E}{1-\nu^2}\left(\epsilon_1 + \nu\epsilon_2\right),$$

where ν = Poisson's ratio,

and 1 and 2 = either the circumferential or longitudinal directions.

Depending on the particular strains used, such as maximums or real-time, the computed stresses can be true values or worst case maximums, analogous to pseudo vector sums in vibration analysis. Using the biaxial equation, SwRI produced a stress prediction equation:

$$\sigma = 4.44\ E\ \chi^{0.77},\ \text{lb/in}^2,$$

which they report provides a good match for both circumferential and longitudinal stresses, having standard errors of about 34 pct.

In addition to point sources, SwRI developed strain and stress equations for lines and grids of charges. These required some adjustments to the charge (W) and distance (R) parameters in the χ equation. With a minor exception, all these arrays used simultaneous initiation and, therefore, were not comparable to traditional delayed mining-type blasts.

SwRI authors also developed an adjustment factor for the strain and stress prediction equations to account for charge depths. Their concern was with the amount of soil backing up and stiffening the pipeline. This depth factor (F) is added to the χ equation, which then becomes

$$\chi = \frac{nW}{\sqrt{EhF}\ R^{2.5}}.$$

The F factor is determined as follows:

$$F = 1 \text{ for } R/H \le 4,$$

$$F = \left[\frac{H}{R} + \frac{\rho_p h}{\rho_s R}\right] \text{ for } R/H > 4,$$

where R = actual charge-to-pipeline distance, ft,

H = amount of soil behind pipe along same line as R, ft,

ρ_p = pipe material density,

ρ_s = soil density (density units are arbitrary),

and h = pipe wall thickness, ft.

They also warn that this factor is based on only four measurements with 20-lb charges at 70 to 200 ft and should be used very cautiously for stresses greater than the values corresponding to $\chi = 10^{-6}$ (σ = 3,142 lb/in²).

A sensitivity analysis was performed by the SwRI authors that shows some of the problems with their prediction equations. They found parameters R and W strongly influencing strains and stresses (and these parameters will also strongly influence vibration amplitudes). However, ρ and c had no influence at all on strains and are not included in either the strain or the stress prediction equations. By contrast, the complete vibration prediction equation given previously does include both ρ and c, as do the simplified versions. For vibrations, a doubling of c in the SwRI equation roughly doubles computed peak particle velocity, making it about as strong an influence as charge weight W. Using a simplified and approximate relationship for ground displacement, the SwRI authors were able to eliminate the dependence of stresses on ρ and c. This differs from many USBM and other studies that generally found particle velocity amplitudes unrelated (or, at best, weakly related) to these parameters. By contrast, frequency, and therefore by inference, displacement, was found to be strongly dependent (*15*). The reason for this disparity between blasting experience and SwRI predictions is not clear, as strains should in some way be proportional to particle velocity amplitudes or, at the very least, to displacements.

Based on the comprehensive 1981 SwRI report (*5*), the Enron Gas Pipeline Group published a standard for allowable blasting near buried pipelines (*6*). They used the SwRI stress equation along with the depth adjustment factor F. The Enron standard also provided two safe-level criteria of 6.9 MPa (1,000 lb/in²) for welded pipeline and 3.45 MPa (500 lb/in²) for jointed or acetylene welded pipelines. The reason for these particular and very restrictive limits was not specified.

SwRI EVALUATION OF BLASTING IN ROCK

A highway construction project enabled SwRI to collect data on pipeline response that are more applicable to traditional millisecond delayed rock blasting (*7*). This study of two large pipelines involved larger sized charges, larger pipeline-to-blast distances (table A-2), and delays between charges of 25 ms for 21 production blasts. The pipes were placed in trenches that were backfilled with sand and coarser material. Production blasting was in rock as was virtually all of the seismic wave travel path.

Table A-2.—SwRI pipeline blasting experiments in rock (*7*)

Pipe diam, cm	Pipe wall, mm	Distance range, m	Charge sizes, kg
30.65	9.53	25 -59	4.5-9.09
76.2	11.9	1.2-43	4.5-9.09

The resulting strain records have the appearance of elastic wave responses with many cycles of motion, in contrast to the results of the previous highly damped and close-in soil tests. Unfortunately, this appearance could be due to the multiple delayed charges and not to the elastic versus plastic responses. The one exception showing subdued response was from a blast at only 1.2 m, which, like the soil tests, appeared to produce soil permanent deformation strains. Stresses were computed from strain measurements and compared with the stress prediction equation previously presented for point sources in soil. Charge weights used were the amounts per delay because the delay intervals were long compared with the pipeline natural frequencies. This time relationship also justified using the point source rather than the array source equation. No depth factor (F) was used.

Stresses obtained were considerably less than those from the soil tests; in many cases they were single digit microstrains and barely larger than record noise. SwRI authors attribute this difference primarily to the larger distances. They also suggest an effect from the partitioning of explosive energy between fragmentation and vibrations, more relief for the rock blasting, and the use of delays in the rock tests. However, an alternative explanation is that the soil tests were so close as to involve nonelastic and permanent deformation responses while the rock blasting tests are more representative of responses to elastic waves. This possibility was presented in the earlier discussion of SwRI vibration monitoring in the main text (*5*).

SwRI recommends that the soil prediction equation also be used for rock cases with a free face parallel to the explosive array. The soil tests provide an almost perfect upper bound on the scatter from the rock blasting tests. It is likely that the measurements from the rock blasting tests are more realistic than the measurements from the soil tests for evaluating surface mine and quarry blasting, although still only addressing small charge weights.

Alan Lambeth presented a paper at the 1993 American Gas Association Conference, which contained some new pipeline monitoring data and an analysis based on the modified version of the SwRI stress prediction equation (*8*). The monitoring was done on an out-of-service 61-cm pipeline with 1.6- to 12.5-kg charges at distances of 3.4 to 7.6 m. Again, there is a question of close proximity and whether elastic waves or plastic deformation were measured. Lambeth's paper showed no strain or vibration time histories to provide an evaluation of this question. Lambeth's stress amplitudes did reasonably agree with the SwRI prediction curve (*5*) for close-in blasts in soil.

Desiring to provide a universal blasting criterion, Lambeth started with the SwRI stress prediction equation version that includes the soil backing factor (F). To this, he added additional adjustments for powder factor, larger distances, skill of the blaster, and confinement, to predict a stress upper bound.

$$\sigma = F_c F_p F_L \; 4.44E \left[\frac{W \; F_w n_s/900}{\left(E \; t \; F_h\right)^{0.5} \; R^{2.5}} \right]^{0.77},$$

where F_c = confinement factor,

F_p = powder factor,

F_L = large-distance factor,

E = Young's modulus, lb/in^2,

W = maximum charge, lb,

F_w = "who is blasting factor,"

n_s = specific energy of explosives, cal/g (ANFO = 900),

t = pipe wall thickness, in,

F_h = soil backing factor,

and R = distance, ft.

The confinement factor (F_c), is 1.0 for blasting with free faces and 2.0 if movement is restricted.

Powder factor (PF) is also assumed to relate to vibrations. When in the range of 2.0 to 3.5 lb/yd^3, there is no penalty (F_p = 1). If PF is >3.5, then F_p = PF/3.5. If PF is below 2.0, than $F_p = (2/PF)^{0.5}$. While it is possible that high powder factors can increase vibrations, penalties for low values are less justified. Weak rock can be effectively blasted with low powder factors, with specific powder factors chosen for appropriate fragmentation and throw. Both the confinement factor (F_c) and charge weight (W) already account for the amount of energy and relief. Extensive studies of blast parameters for mining found these confinement factors to be of no significance to ground vibration, although important for airblast (*17*).

The large-distance factor (F_L) was developed from Lambeth's analysis of USBM measurements. It is unity for distances under 200 ft and [0.009 (R - 200) + 1] for greater distances. This factor increases without bounds (e.g., 1 for 200 ft, 4.6 for 600 ft, 10 for 1,200 ft). Possibly it cancels out some of the excess distance attenuation represented by the $R^{-1.925}$ factor elsewhere in the equation (based on $F_h \approx H/R$; see below). A more direct approach would be to drop the F_L correction and use a more appropriate attenuation exponent.

The "who is blasting" factor (F_w) assigns a small penalty of 1.2 if someone other than the pipeline company is responsible for the blasting.

The soil backing factor (F_h) comes into use when the charge depth is more than five times the pipe depth and was previously given in the SwRI report discussion. This multiplying factor increases indefinitely with increasing charge depth. For cases of potential permanent ground strain (close-in blasts), a good backing may constrain differential pipeline movement. However, its need is not evident in the more distant elastic-wave-only cases. At the same time, SwRI authors and those adapting the SwRI analyses have assumed perfect ground-to-pipeline coupling, which is not necessarily true because coupling can be highly variable. Although a free-surface multiplying factor of two times is justified from dynamics theory, there is no rationale for an unbounded factor. For the USBM tests, described in table A-3, the depth ratios are about 10, and the corresponding stress increase factor from this F_h term is about 2.43.

Lambeth's version of the SwRI stress equation was tested on three of the largest USBM blasts, and the results were compared with measured values. Using the various adjustment factors, the predicted stresses greatly exceeded the measured values (based on worst case stress-strain conversions), the extrapolated worst cases based on ideal coupling, and theoretical stresses computed from Dowding's equations (*12*) (table A-3). Eliminating the questionably applicable factors gives more comparable results. For example, a blast 21 prediction with F_F, F_L, and F_h equal to unity gives 25.8 MPa. This is exactly the USBM value for a worst case extrapolation from the measured strains, assuming they represent an ideal-coupled pipeline (table A-3). A similar computation for blast 29 was only about two times too high.

Table A-3.—Predicted stresses for three USBM blasts based on the SwRI equations, megapascals[1]

Blast	Predicted stresses		Stresses from measured strains		Calculated stresses	
	Full equation	$F_p, F_h, F_L = 1$	Actual maximums	Extrapolated from envelope	Bending	Ovaling
21 . . .	208	25.8	9.15	26	51	126
25 . . .	232	59	16.5	65	73	147
29 . . .	1,360	346	40.0	154	135	226

[1]MPa = 10^6 N/m^2.

Lambeth's paper (*8*) included some stress criteria for pipelines. One criterion, from a 1981 pipeline research committee panel, recommended that total stresses from pressurization and blasting should not exceed the MAOP stress envelope plus whatever adjustments are judged appropriate for the individual pipeline. Since stress from pressurization is usually limited to 72 pct of MAOP, the blasting plus adjustment part could equal the remaining 28 pct in the absence of other stresses. For a Grade B pipe with a SMYS of 240 MPa (35,000 lb/in^2), this would be 67.6 MPa (9,800 lb/in^2). Lambeth also mentioned an allowable additional stress of 55.2 MPa (8,000 lb/in^2) on a 61-cm (24-in) pipeline based on additional circumferential stresses from external load (transients) compared with the slow loading rate of internal pressurization (grade unspecified).

In reviewing the draft of this USBM RI, Lambeth stated the F_h should not be used in conjunction with F_L, since F_L was developed empirically from the USBM data and the F_h factor could not be applied because of insufficient data. As a result, F_L already includes the effects of charge depth and backing. However, Lambeth's stress prediction equation does include both factors (*8*).

Summarizing Lambeth's study, his experimental values appear to correspond only to close-in blasts and his adjustments to the SwRI prediction equation appear unjustified from blasting studies. They produce unrealistic stress values when applied to large-size mining-type blasts.

APPENDIX B.—VIBRATION AND STRAIN DATA

The following data table summarizes the peak values of all the USBM and key Vibronics, Inc., measurements. Blank spaces mean no reliable reading was obtained. This Cricket Graph table was used to summarize all the collected data and also to produce the plots comparing the various parameters of vibration and strain. Following the table is a key to column headings.

Shot	Date	Hour_Min	20_GV_V	20_GV_R	6_GV_V	6_GV_R	MB_R	MB_V	MB_T
1	31892	1107	9.3				13.08	7.06	8.76
2	32092	1110	1.5	1.7	1.42				
3	32092	1343	5.28	3.94	4.42				
4	32092	1353	6.22	4.29	3.33				
5	40292	1715	1.55	3.81	1.19	3.05			
6	40292	1740	15.24	30.48	11.68	22.1			
7	40292	1841	1.22	1.8	1.07				
8	42992	1124			1.27		7.62	1.98	
9	42992	1920	1.32		0.81	0.91	6.1	1.42	
10	60292	1120					3.86	1.45	
11	60292	1721							
12	60592	1115							
13	60592	1124	2.11	2.18	0.66		2.92	1.6	
14	60592	1407	1.4	1.3	0.99		2.36	1.45	
15	60592	1714	34.29	48.01	33.53	30.23	88.14	50.8	
16	61092	923	35.81	16	19.05	19.3	67.06	30.99	
17	80392	1413							
18	80592	1114			4.57	5.84	17.09	7.52	
19	80692	1455	6.91	6.3	5.59	4.6	16.51	5.59	
20	80692	1709	47.24	86.87	63.75	84.33		97.28	
21	80692	1804	52.58	102.11	70.36	109.47	147.83	130.56	
22	80792	1818	35.81		35.31	34.8		79.76	44.2
23	91692	1108	121.41		105.92	113.03	125.98	205.74	
24	91892	1433							
25	91892	1054					187.96	209.8	
26	91992	1425			59.18	65.28	97.79	169.42	
27	92192	1209					65.28		
28	102192	1255							
29	102392	1118			274.32				184.15
30	102492	1554			146.3	63.5	205.74	219.96	222.5
31	102492	1625			2252.98	1653.54			

Shot	Alpha_S_R	Alpha_S_V	Alpha_S_T	PVC_TL	PVC_FL	20_S_TL	20_S_TC	20_S_FL	20_S_FC
1	13.08	7.06	8.76	6.9	4	4.3	5.3		
2	3.81	1.52	3.3	2.45		0.73	2.81	0.73	
3	10.41	10.67	7.87	4.9	3	2.2	2.2	1.5	
4	9.14	7.11	8.38	6.98	3.62	1.54	7.98	1.04	
5	9.14	2.03	7.11	2	1.59	0.6	3.62	0.95	
6	67.06	20.83	51.31	30.3	8.61	9.8	28	12.5	
7	5.08	1.52	3.05	1.04		0.45	2.5	0.63	
8	7.87	2.03	5.84	4.81		2.94	10	2.54	3.76
9	6.86	1.52	4.83	3.62		1.77	6.25	1.59	2.45
10	4.32	1.52	5.33						
11	69.09	55.88	93.47	35		24.2	66.4	16.7	
12	120.9	61.98	84.33	47.3		26.5	51.3	29.1	
13	3.3	1.02	2.54	2		1	1.77	1.18	
14	3.81	1.02	1.78	2.45					
15	83.31	61.98	88.39	38.5		28.6	48.3	19	
16	60.96	31.5	36.58	25.3		12.8	20.9	12.4	4.35
17	16.26	5.08	17.27	10.1		4.49	4.22	3.67	
18	16.26	7.52	8.64	9.61		3.36	2.72	3.45	2
19	14.22	9.14	10.67	15	15.9	4.76	10.7	3.4	
20	136.14	109.73	125.98	57.1	97.5	31.1	63	24	25.8
21	166.62	119.89	156.46	57.1	102.5	24.9	33.5	21.3	
22	85.34	67.06	125.98	42.6	76.2	19.5	55.8	17.2	13.1
23	164.59	144.27	144.27	92.9		50.8			43.2
24									
25	168.66	241.81	231.65	137		60.8	46		31.1
26	93.47	148.34	119.89	63		44	44		
27	81.28	42.67	62.99	37.6		24.3	25.4		
28									
29	227.58	237.74	156.46		499	156	77		
30						76.1	51.6		
31						3169	490		

Shot	12_N_S_TL	12_O_S_TL	12_O_S_FL	6_S_FC	6_S_TC	6_S_FL	AS_20_R	AS_20_V	AS_20_T
1									
2	1.18								
3	2.9								
4	1.63								
5	1.13	0.77							
6	6.6	8.7	11.5	9.1	23	10.5			
7	0.63	0.54	0.68						
8	2.4		2.04			1.59			
9	1.59	1.4	1.54		1.31				
10									
11	26	17.2	14.1	12.7	39	14			
12		21	23.4	19.6	26.7	31			
13	1.18	0.91	1.36						
14	1.09								
15		26.1	23.7	12.8	30.5	32.4			
16	13.3	13.3	10.1	8.4		15.6			
17	14.4		5.17	13.6		5.98			
18		3.45	2.72	1.45		3.08			
19		4.08	3.63			2.04			
20		19.9	22.7	13.1		22.2			
21		23.6	19.5	29.5		51.7			
22		18.1	17.7	22.7		30.8	57.91	41.15	33.02
23	49.6			16.2	31.1	26.3	62.99	130.05	148.34
24									
25	50.8	37.6		38	53.5	59.9	178.82	211.33	79.25
26	32	28.8	36.7	20.5	28.8		87.38	95.5	67.06
27	18.8	22.2	17.7	14.3	18.8	15.6	41.15	34.04	39.62
28									
29	82			41.2	94.8		239.78	233.68	103.63
30	77.5			22.1	55.8				
31	3140			499	664				

Shot	Distance	Kg_delay	20_S_45	SR4_1_R	SR4_1_V	SR4_1_T	SR4_2_R	SR4_2_V	SR4_2_T
1	338	435							
2	1064	135							
3	381	435							
4	436	435							
5	869	588							
6	180	751							
7	933	218							
8	802	464							
9	847	539							
10	756	626							
11	146	639							
12	125	773							
13	920	301							
14	951	181							
15	131	689							
16	192	959							
17	387	465							
18	506	828							
19	552	600							
20	88	731							
21	88	964		228.6	88.9	165.1	188.72		241.30
22	116	884							
23	67	964		139.7	88.9	279.4			
24									
25	50	839	32.5	203.2	165.1	241.3	647.70	276.86	190.50
							368.30	125.73	228.60
26	74	872	21	88.9	76.2	152.4	665.48	812.80	736.60
27	158	668	9.97	63.5	25.4	101.6			
28									
29	20	839	68	584.2	444.5	254			
30	52	706	27.8	152.4	152.4	279.4			
31	14	743	2035	889	698.5				

Shot	B&K_R	B&K_V	B&K_T
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21	167.64		185.42
22	100.08		114.81
23	60.96		60.96
24			
25	520.70		191.26
	530.86	207.52	
26	982.98	3200.40	
27			
28			
29			
30			
31			

Key to Column Headings, Appendix B

Date.....31892.00000 is March 18, 1992

Hour_Min....1107.000 is 11:07 on 24-h clock

20_GV_V....Vertical vibration of 50.8-cm (20-in) pipe, mm/s

20_GV_R....Radial vibration of 50.8-cm (20-in) pipe, mm/s

6_GV_V.....Vertical vibration of 16.8-cm (6-in) pipe, mm/s

6_GV_R.....Radial vibration of 16.8-cm (6-in) pipe, mm/s

MB_R.....Radial ground vibration above 50.8-cm (20-in) pipe, mm/s

MB_V.....Vertical ground vibration above 50.8-cm (20-in) pipe, mm/s

MB_T.....Transverse ground vibration above 50.8-cm (20-in) pipe, mm/s

Alpha_S_R..Radial ground vibration above point midway between 50.8-cm (20-in) steel pipe and PVC water pipe, mm/s

Alpha_S_V..Vertical ground vibration above point midway between 50.8-cm (20-in) steel pipe and PVC water pipe, mm/s

Alpha_S_T..Transverse ground vibration above point midway between 50.8-cm (20-in) steel pipe and PVC water pipe, mm/s

PVC_TL.....Top longitudinal strain of PVC pipeline, μmm/mm

PVC_FL.....Front longitudinal strain of PVC pipeline, μmm/mm

20_S_TL....Top longitudinal strain of 50.8-cm (20-in) steel pipe μmm/mm

20_S_TC....Top circumferential strain of 50.8-cm (20-in) steel pipe μmm/mm

20_S_FL....Front longitudinal strain of 50.8-cm (20-in) steel pipe μmm/mm

20_S_FC....Front circumferential strain of 50.8-cm (20-in) steel pipe μmm/mm

12_N_S_TL..Top longitudinal strain of new 32.4-cm (12-in) steel pipe μmm/mm

12_O_S_TL..Top longitudinal strain of old 32.4-cm (12-in) steel pipe μmm/mm

12_O_S_FL..Front longitudinal strain of old 32.4-cm (12-in) steel pipe μmm/mm

6_S_FC.....Front circumferential strain of 16.8-cm (6-in) steel pipe μmm/mm

6_S_TC.....Top circumferential strain of 16.8-cm (6-in) steel pipe μmm/mm

6_S_FL.....Front longitudinal strain of 16.8-cm (6-in) steel pipe μmm/mm

AS_20_R....Alpha-Seis monitoring of radial vibration of 50.8-cm (20-in) pipe, mm/s

AS_20_V....Alpha-Seis monitoring of vertical vibration of 50.8-cm (20-in) pipe, mm/s

AS_20_T....Alpha-Seis monitoring of transverse vibration of 50.8-cm (20-in) pipe, mm/s

Distance...Vector distance from top of closest blasthole to 16.8-cm (6-in) pipeline, m

Kg-delay...Maximum charge weight per 8-ms delay

20_S_45....Top 45° angle strain of 50.8-cm (20-in) steel pipe, μmm/mm

SR4_1_R....Strong-motion monitoring of radial vibration above 16.8-cm (6-in) pipe, mm/s

SR4_1_V....Strong-motion monitoring of vertical vibration 16.8-cm (6-in) pipe, mm/s

SR4_1_T....Strong-motion monitoring of transverse vibration 16.8-cm (6-in) pipe, mm/s

SR4_2_R....Strong-motion monitoring of radial vibration above and between two 32.4-cm (12-in) pipes

SR4_2_V....Strong-motion monitoring of vertical vibration above and between two 32.4-cm (12-in) pipes

SR4_2_T....Strong-motion monitoring of transverse vibration above and between two 32.4-cm (12-in) pipes

B&K_R.....Radial ground vibration above 50.8-cm (20-in) pipe, mm/s

B&K_V.....Vertical ground vibration above 50.8-cm (20-in) pipe, mm/s

B&K_T.....Transverse ground vibration above 50.8-cm (20-in) pipe, mm/s

APPENDIX C.—SURVEY DATA[1] FOR FIVE PIPELINES

Date	East upright			Center upright			West upright		
	North	East	Elev	North	East	Elev	North	East	Elev
16.8-cm STEEL									
4-8.....	0.628	0.470	0.696	0.771	0.498	0.559	0.789	0.274	0.144
5-7.....	0.619	0.470	0.682	0.776	0.480	0.562	0.791	0.271	0.144
6-11....	0.622	0.480	0.682	0.777	0.491	0.559	0.779	0.281	0.142
8-5.....	0.614	0.469	0.685	0.794	0.496	0.546	0.824	0.293	0.114
9-14....	0.618	0.484	0.675	0.779	0.479	0.535	0.791	0.286	0.105
9-18....	0.603	0.476	0.671	0.780	0.517	0.540	0.797	0.315	0.113
10-24..	0.618	0.472	0.583	0.804	0.538	0.458	0.817	0.300	0.065
10-26..				2.959	-2.385	0.273	0.839	0.474	0.113
32.2-cm STEEL (USED)									
4-8.....	0.672	0.416	0.714	0.071	0.939	0.299	0.396	0.223	0.988
5-7.....	0.660	0.404	0.702	0.054	0.945	0.315	0.383	0.221	0.988
6-11....	0.648	0.428	0.692	0.047	0.946	0.306	0.377	0.232	0.982
7-5.....	0.673	0.432	0.691	0.055	0.952	0.296	0.411	0.223	0.962
9-14....	0.659	0.439	0.675	0.038	0.947	0.281	0.400	0.225	0.948
9-18....	0.658	0.446	0.674	0.045	0.974	0.284	0.393	0.235	0.952
10-24..	0.688	0.445	0.579	0.065	0.964	0.194	0.421	0.249	0.910
10-26..	0.841	-0.207	0.392	0.820	-2.736	0.455	0.405	0.674	0.892
32.2-cm STEEL (NEW)									
4-8.....	0.741	0.459	0.656	0.771	0.970	0.608	0.271	0.362	0.589
5-7.....	0.723	0.431	0.647	0.757	0.968	0.609	0.276	0.367	0.597
6-11....	0.741	0.425	0.643	0.761	0.978	0.594	0.277	0.377	0.600
7-5.....	0.740	0.429	0.648	0.781	0.980	0.585	0.314	0.346	0.585
9-14....	0.731	0.430	0.638	0.749	0.979	0.571	0.284	0.372	0.569
9-18....	0.738	0.432	0.639	0.765	0.004	0.570	0.285	0.391	0.559
10-24..	0.775	0.413	0.540	0.805	0.008	0.473	0.318	0.394	0.506
10-26..				0.922	-3.849	2.859	0.287	0.585	0.553
50.8-cm STEEL									
4-8.....	0.102	0.291	0.049	0.220	0.261	0.423	0.470	0.756	0.637
5-7.....	0.108	0.314	0.047	0.220	0.276	0.430	0.462	0.754	0.643
6-11....	0.131	0.299	0.032	0.223	0.285	0.426	0.471	0.763	0.641
7-5.....	0.116	0.275	0.031	0.231	0.269	0.419	0.497	0.752	0.611
9-14....	0.130	0.313	0.017	0.220	0.274	0.403	0.477	0.716	0.594
9-18....	0.129	0.309	0.014	0.220	0.283	0.394	0.481	0.755	0.598
10-24..	0.171	0.297	-0.092	0.271	0.302	0.299	0.518	0.766	0.540
10-26..	0.105	2.252	-1.685	-1.561	-5.930	0.487	0.577	0.831	0.573
21.9-cm PVC									
5-7.....	0.436	0.353	0.251	0.794	0.218	0.999	0.633	0.690	0.068
6-11....	0.364	0.356	0.245	0.794	0.176	0.989	0.650	0.737	0.072
7-5.....	0.310	0.369	0.251	0.826	0.128	0.974	0.658	0.719	0.048
9-14....	0.268	0.328	0.237	0.808	0.146	0.962	0.626	0.737	0.029
9-18....	0.246	0.301	0.236	0.812	0.165	0.967	0.633	0.744	0.032
10-24..	0.403	0.276	0.143	0.866	0.146	0.873	0.627	0.762	-0.037
10-26..	0.242	1.11	0.125	-0.112	-2.823	0.933			

[1]As measured by Amax Coal Co.; relative elevations in feet.