Noise Mitigation in Regulator Stations

Belal Abdul-Hadi, Senior Station Engineer

Why Noise Mitigation Matters

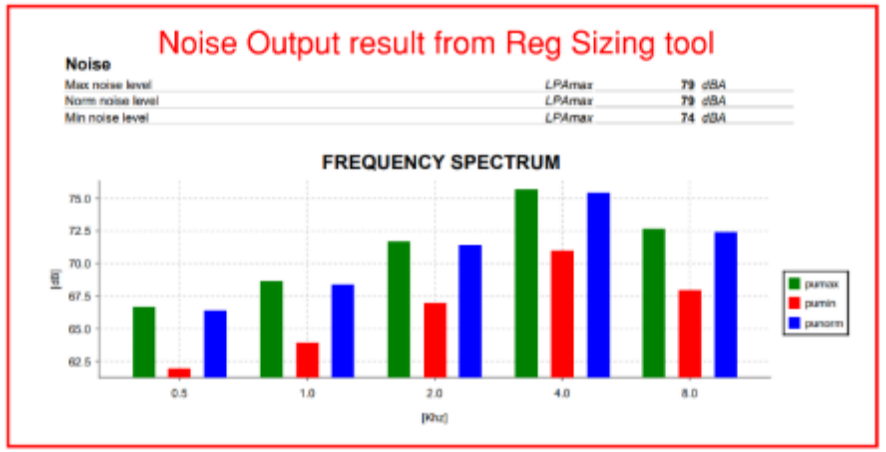
- Community Acceptance
- Ordinance Compliance
- Worker Safety

Primary Noise Sources

- Aerodynamic: (Major Contributor for District Regulator Stations)
  - Rapid Expansion
  - Turbulence at Regulator Trims
  - Orifices
  - Bends
- Structural
  - Vibration transmitted through pipe wall
- Mechanical
  - Regulator Motion
  - Auxiliary systems (odorizer, analyzers)

Noise Assessment Techniques

- Field measurements, Requires:
  - Calibrated meters,
  - Reference distance,
  - Steady environmental conditions
- Acoustic software modeling of a system base on:
  - Regulator type,
  - System parameters,
  - Station Geometry
- Diagnostics technique using spectral analysis to pinpoint frequencies/sources



Sound Pressure Level (SPL) & Noise Scale

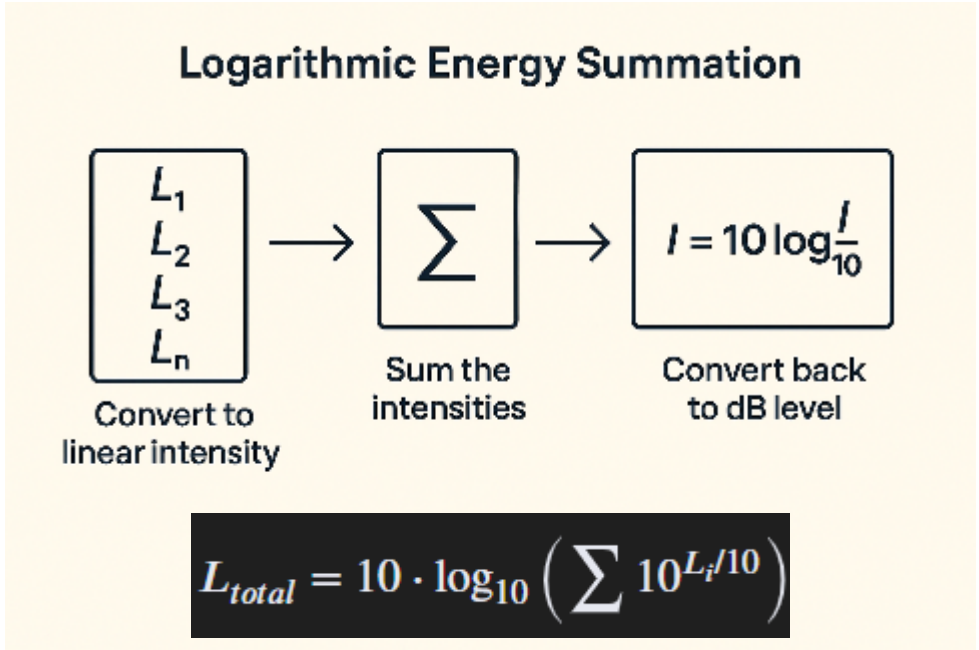
- Sound pressure level (SPL) has a logarithmic scale relative to the human ear and it is measured in “dB”

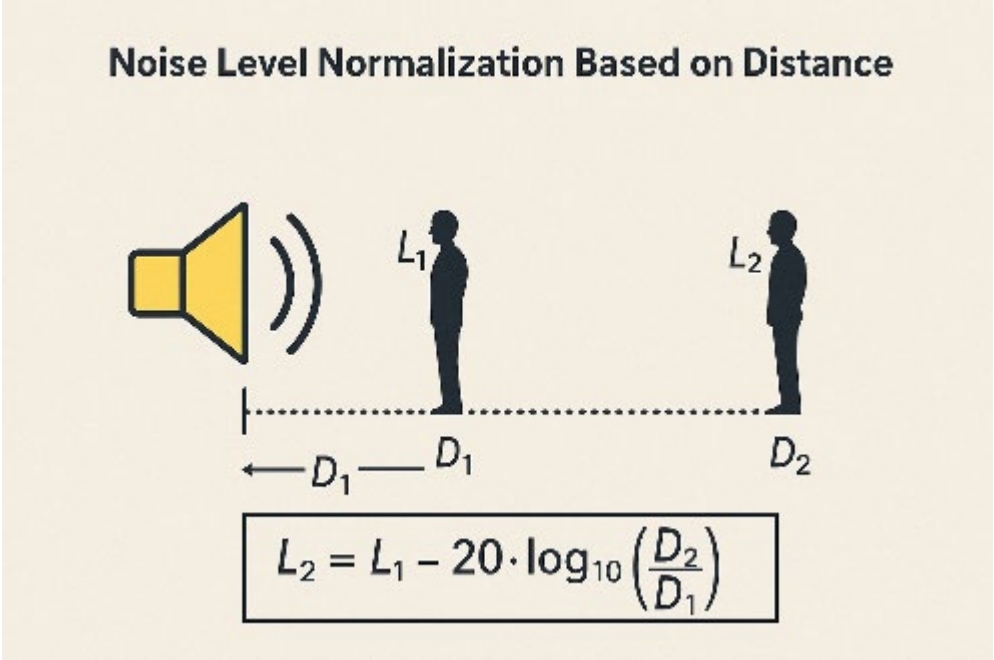
Note:

- Sound 10 times intense is perceived ~2× Louder
- The lowest level that a healthy human ear can hear is 60dB

Sound Addition & Noise Summation

- **Steps for noise addition:**
  1. **Normalize Noise Level by distance**
  2. **Use Logarithmic Energy Summation**





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Sound Level Addition (Field Way)

dBA	Example Source	Typical Distance	Notes
60	normal conversation	(3–10 ft)	Baseline ambient for "quiet areas"
70	odorizer pump	(3–10 ft)	Noticeably louder voice raised to communicate
80	Large portable air compressor; busy traffic curbside	(3–16 ft)	Hearing protection recommended for sustained exposure
90	Gas-powered lawnmower; diesel gen-set (small)	(16–33 ft)	OSHA action level exceeded over time; hearing protection required
100	Chainsaw; vent/relief event at distance	(33–82 ft)	Very loud—short exposures without hearing protection can be harmful
120	Emergency siren at close range;	(3–16 ft)	Pain threshold territory; immediate hearing protection essential
140	Jet engine near takeoff; explosive gas jet at nozzle	(3–6 ft)	Possible Instant ear damage; avoid proximity

Whenever the difference between two noise levels is greater than 10 dB the lower noise level source is negligible

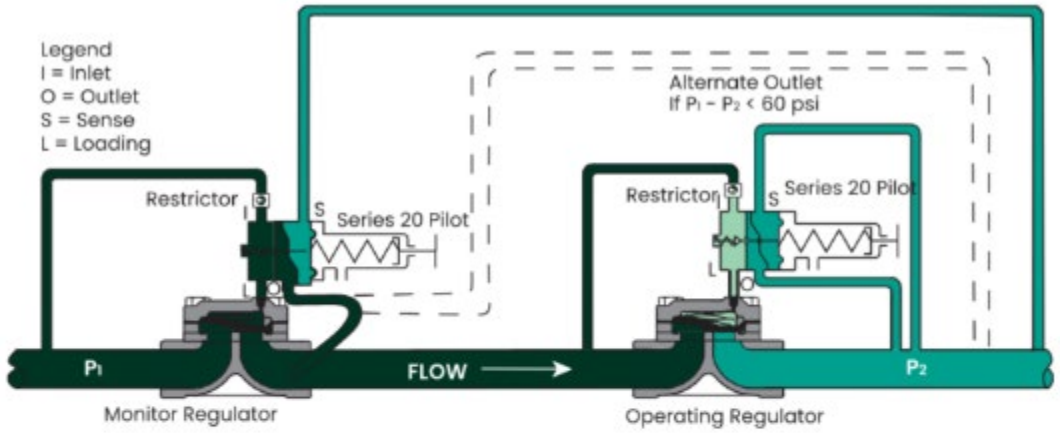
Difference	Add to louder source
0 dB	+3 dB
1 dB	+2.5 dB
2 dB	+2 dB
3 dB	+1.5 dB
5 dB	+1 dB
10 dB	+0 dB

Mitigation Strategies

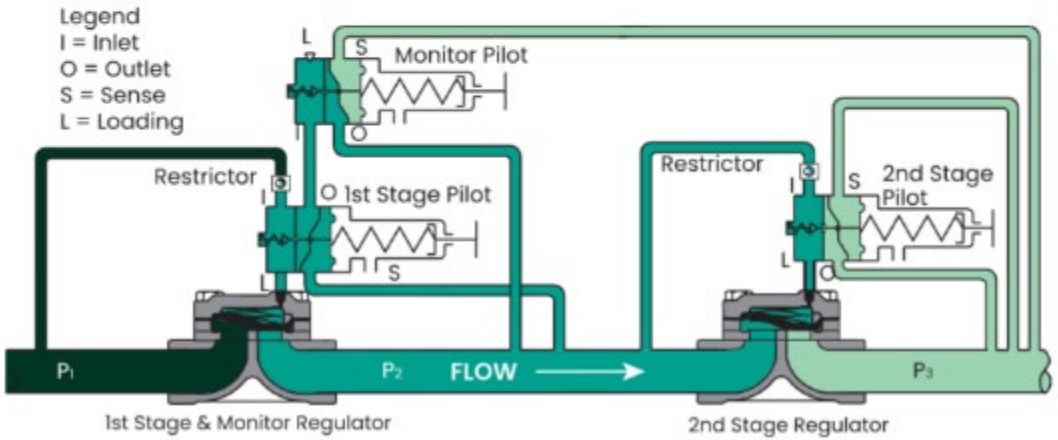
- Operational Mitigation
- Design Mitigation
- Interrupting Noise Propagation

Operational Mitigation

- **Noise level reduction through multi-stage pressure cut to avoid single large ΔP**



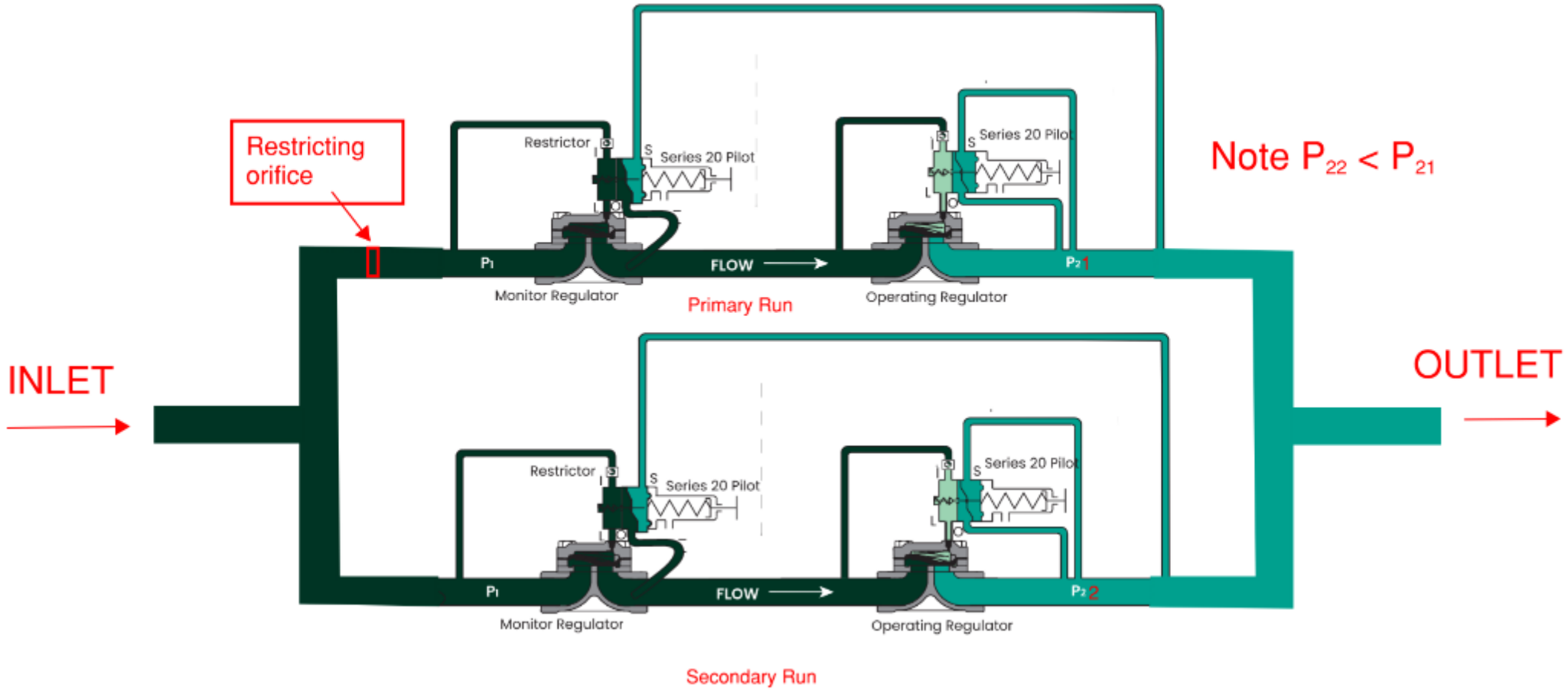
Standby monitor system



Working monitor system

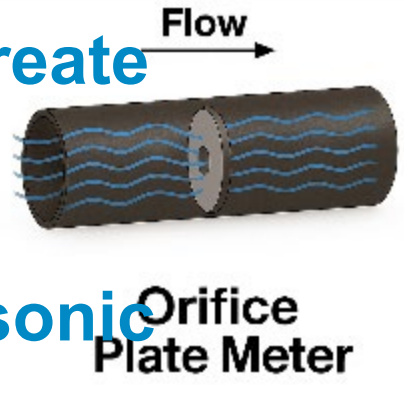
Operational Mitigation

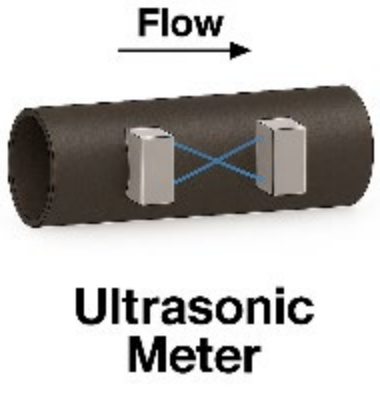
- **Load sharing: run multiple regulators at moderate openings**

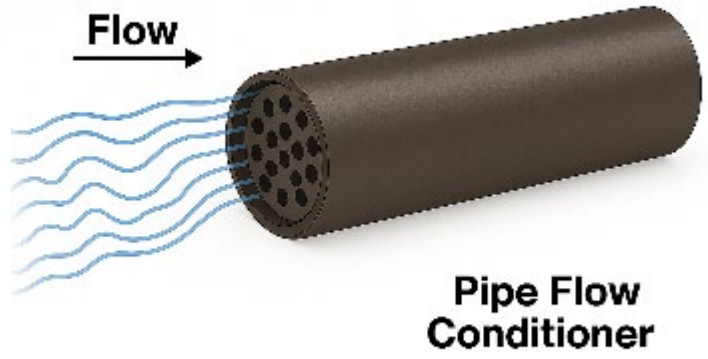


Design Mitigation

- Optimize geometry:
  - fewer turns,
  - larger bend radii,
  - Avoid rapid expansion,
  - flow conditioning
  - Avoid valves that create turbulence
  - Lean towards ultrasonic meters

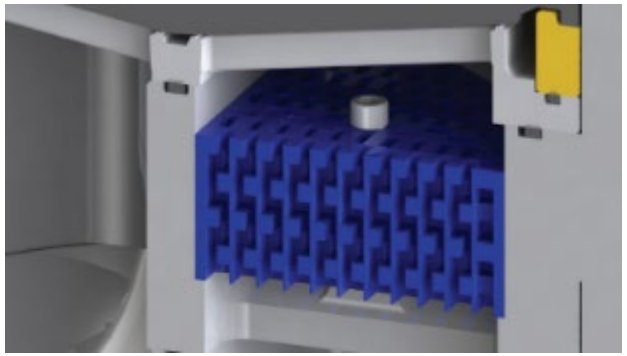


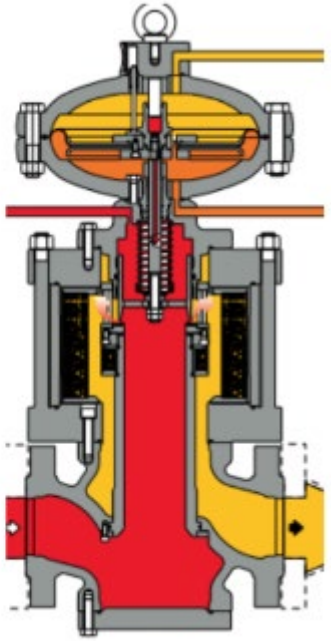




Design Mitigation

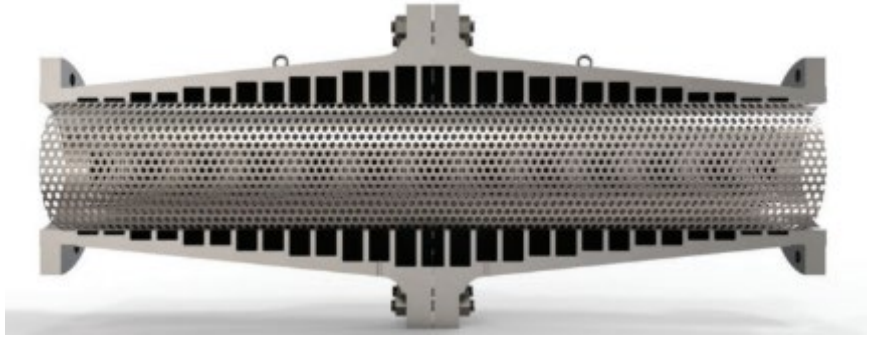
- **Regulators with internal noise silencers**

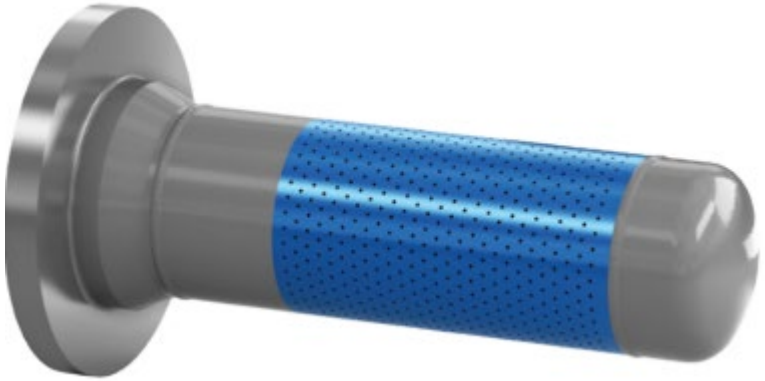


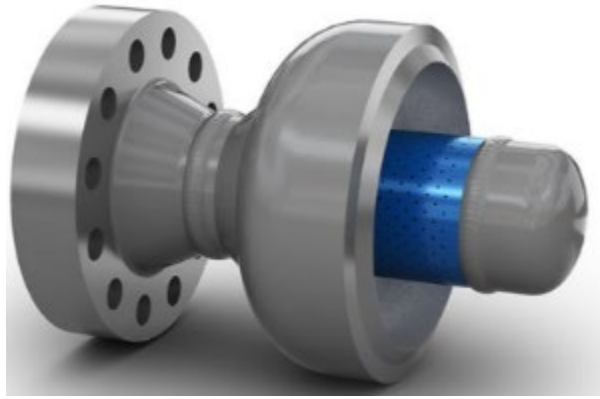


Design Mitigation

- Downstream diffusers
  - Reduce excessive aerodynamic noise generated downstream of a Large-pressure-cut regulators

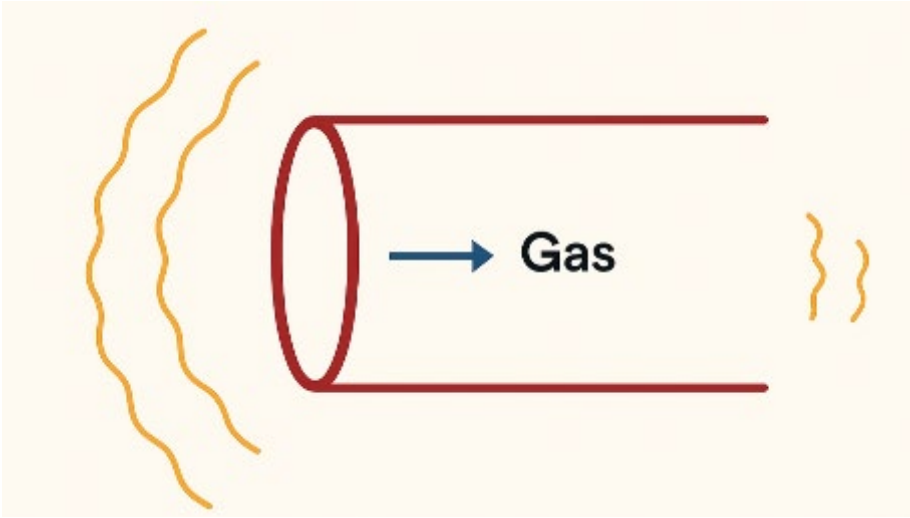






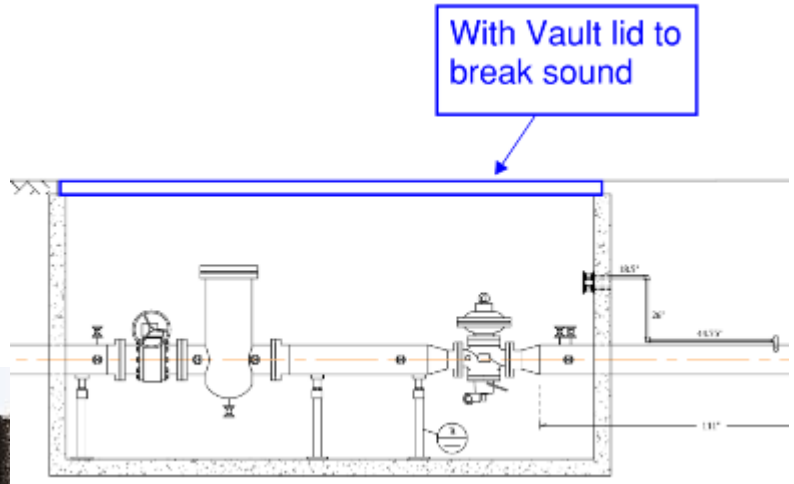
Design Mitigation

- Increase header wall thickness will:
  - Reduce noise from the outside of the pipe to the surrounding (smaller sound waves)
  - Less pipe wall motion/vibration



Interrupting Noise Propagation

- Underground vaults; bury headers where practical or Buildings (Most effective but costly)
- Acoustic barrier walls (close to source; line-of-sight break) (effective but costly)



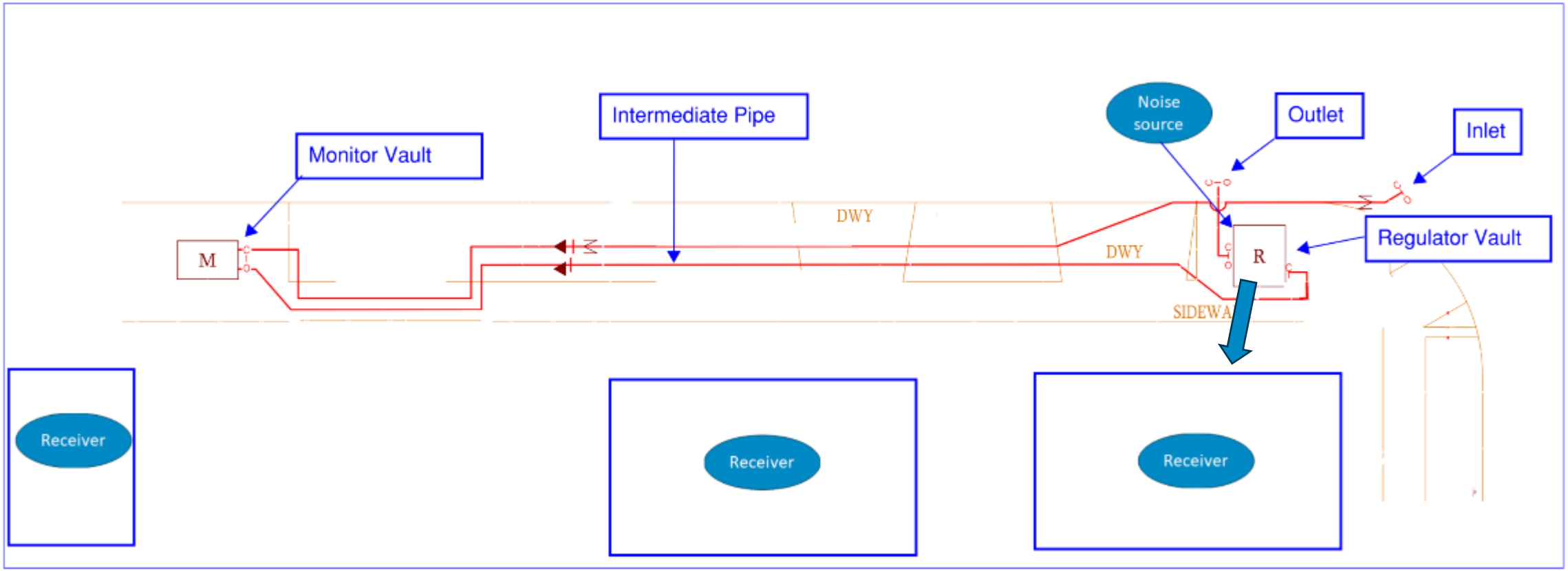
Soundproof Wall

Interrupting Noise Propagation

- Targeted acoustic insulation on noisy section
  - Pro
    - Can be added later (retrofit)
    - Lower cost per dB reduced
  - Con:
    - Adds maintenance complexity
    - Requires weather protection
    - Does not reduce internal vibration forces

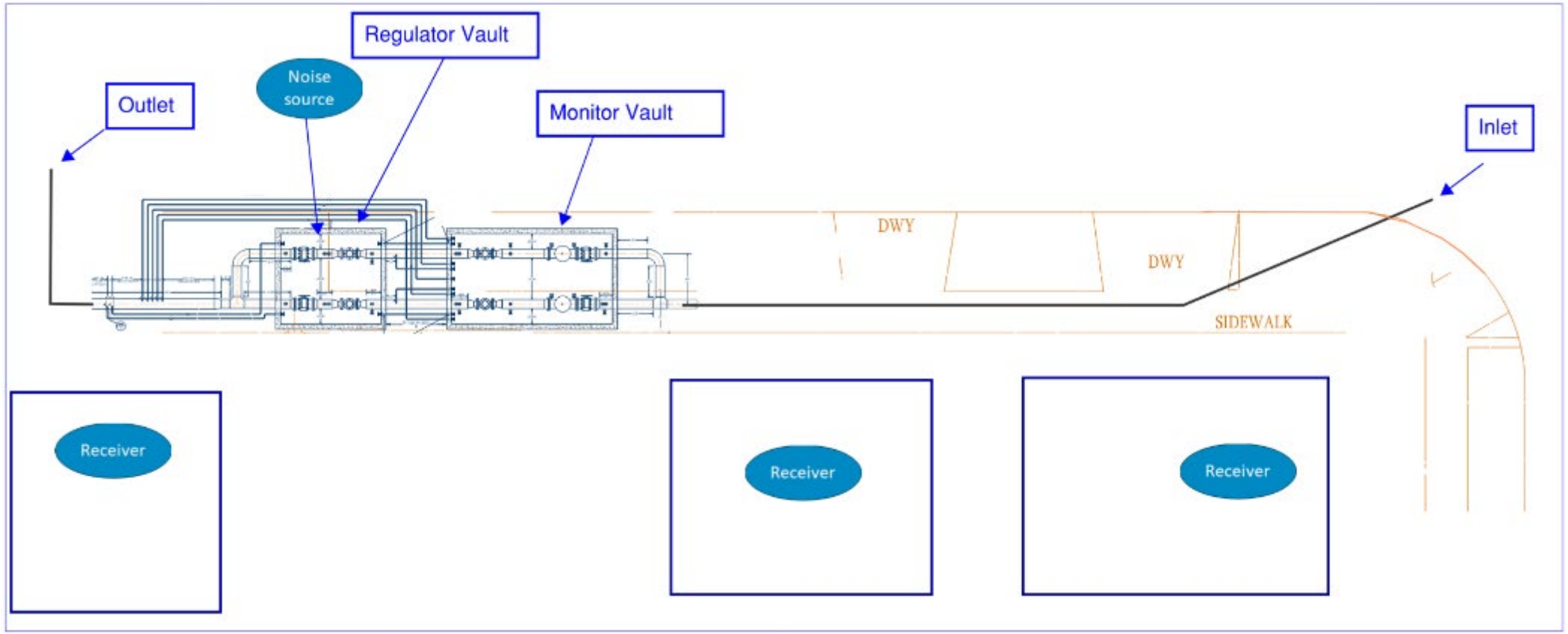
Case Discussion 1 (Noisy Below Ground)

- Station with noise complaints
  - Extensive multiple turns, expanders
  - Noise Source adjacent to residence



Case Discussion 1

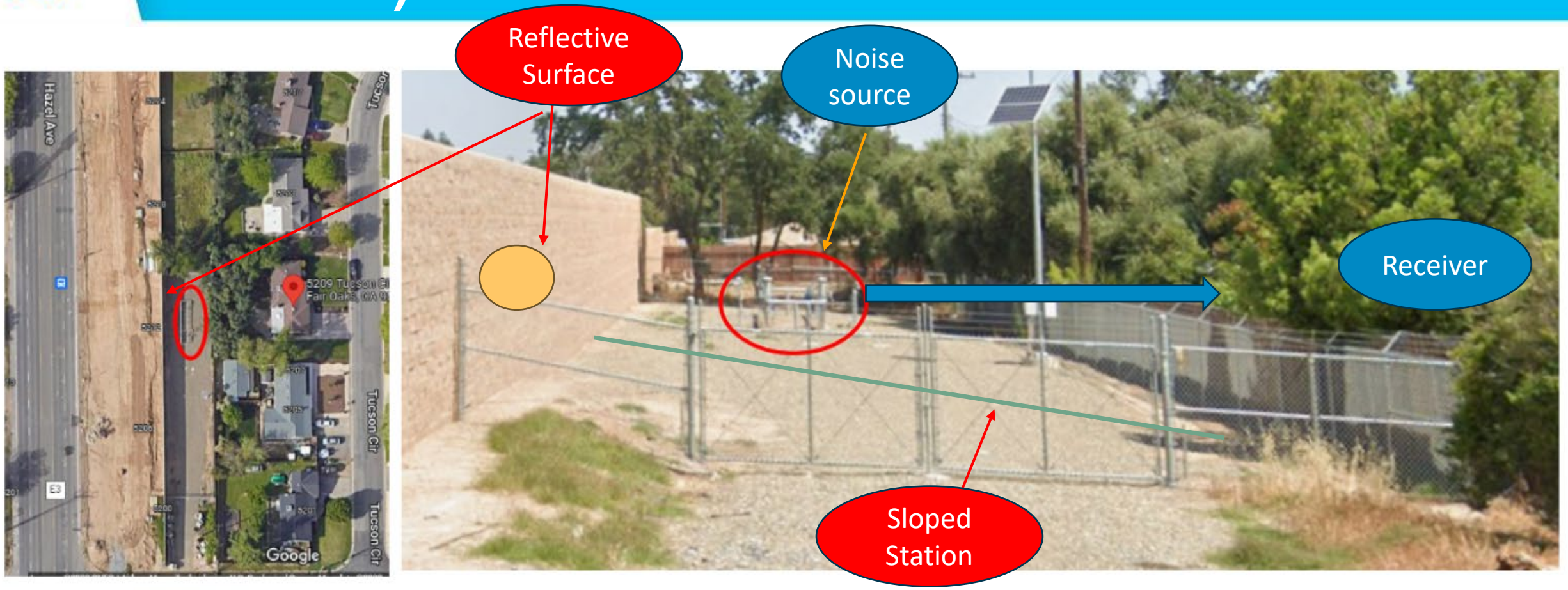
Reduced number of turns
Upsized intermediate and outlet header pipping
Upsized outlet sense-line header piping outside of vault
Located “Noisey” regulator vault in-front of vacant lot



Case Discussion 2 (Noisy Above Ground)

- How could have the noise generated by the above ground station been mitigate?
  - Clue: Mitigation strategy not mentioned in the earlier slides

Case Discussion 2 (Acoustically Active Above Ground)



Avoid stations against a reflective wall that bounces sound to the end receiver
Avoid installing above ground station on a cliff or slopped area that has direct line-of-site to the end receiver.

Questions ?

Belal Abdul-Hadi; b1aj@pge.com

Thank You

Belal Abdul-Hadi