Acoustic Monitoring

Environmentally Friendly But Economically Invaluable

Presentation Overview

- Background on Acoustic Monitoring (AM)
- Background on Components
- Understanding the Equipment
- Benefits to End Users
  - Supporting Evidence
- Recommended Approach
- Conclusion

Background On Acoustic Monitoring (AM)

1970s – Use of Low Frequencies and Airborne Noise

1980s – AM Sensors developed using high frequency for crack detection. BP used AM for gas Leak Detection

1990s - Intrinsically Safe device developed with BP being the champion. Score Diagnostics developed correlation for liquid using AM.

2000s – Score Diagnostics developed Midas Meter® for quantifications onsite.

Background On AM Cont.

An Intrinsically Safe (IS) device that detects AM from leaking components.

AM is the generation of transient elastic waves “turbulence” produced by redistribution of stress in a material.

Acoustic Monitoring (AM)

The device relies on the flow of media to generate the AM signal.

Detection varies based on the size of the component and pressure differential.

Background on Components

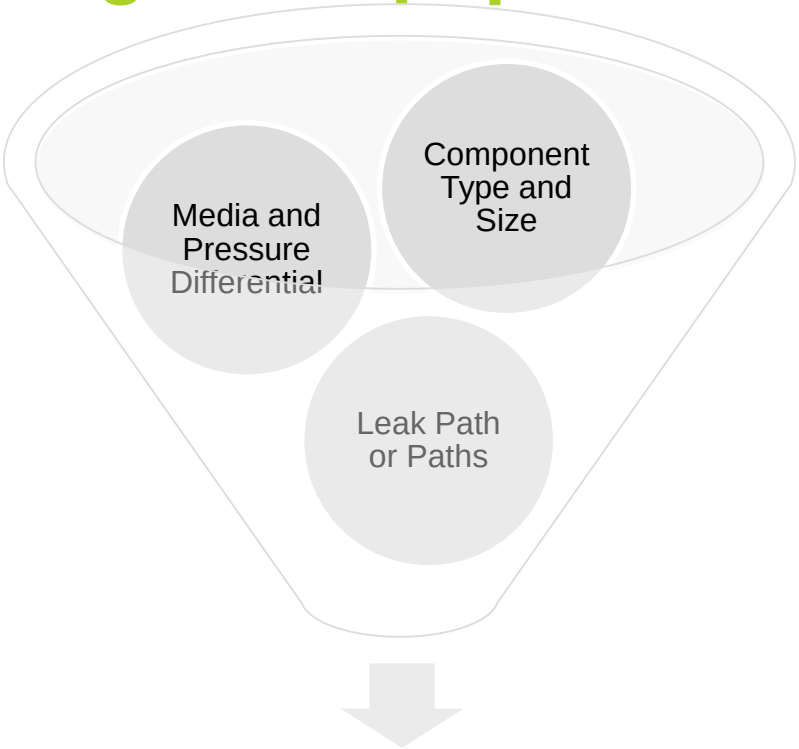
Gate Valve	• A gate valve opens by lifting a round or rectangular gate/wedge out of the path of the fluid. The distinct feature of a gate valve is the sealing surfaces between the gate and seats are planar, so gate valves are often used when a straight-line flow of fluid and minimum restriction is desired.
Globe Valve	• A globe valve, different from ball valve, is used for regulating flow in a pipeline, consisting of a movable disk-type element and a stationary ring seat in a generally spherical body.
Ball Valve	• A ball valve is a form of quarter-turn valve which uses a hollow, perforated and pivoting ball (called a "floating ball") to control flow through it. It is open when the ball's hole is in line with the flow and closed when it is pivoted 90-degrees by the valve handle.
Butterfly Valve	• A butterfly valve can be used for isolating or regulating flow. The closing mechanism takes the form of a disk. Operation is similar to that of a ball valve, which allows for quick shut off. Butterfly valves are generally favored because they are lower in cost compared with other valve designs as well as being lighter in weight, meaning less support is required.
Plug Valve	• Plug valves have cylindrical or conically tapered "plugs" which can be rotated inside the valve body to control flow through the valve. The plugs in plug valves have one or more hollow passageways going sideways through the plug, so that fluid can flow through the plug when the valve is open.

Background on Components Cont.

Bellows Valve	• The bellow is a critical component and forms the heart of the bellow seal valves. To avoid any twisting of the bellow the valve must have a stem with linear movement only. This can be achieved using a so-called sleeve-nut at the yoke portion of the valve bonnet.
Control Valve	• Control valves are used to control conditions such as flow, pressure, temperature and liquid level by fully or partially opening or closing in response to signals received from controllers that compare a "setpoint" to a "process variable" whose value is provided by sensors that monitor changes in such conditions. Control valve is also termed as the Final Control Element.
Motor-operated Valve (MOV)	• The (MOV) is an important item of plant and piping systems. These valves are generally of large size and are used for different applications such as pump discharge etc. Motor-operated valves are often called on-off valves, as the motors serve the purpose of fully opening or fully closing valves in pipelines.
Air-operated Valve (AOV)	• An air-operated valve is a type of power operated valve that uses air pressure against a piston or diaphragm to produce linear or circular movement to operate a valve. Types are 2-way, 3-way and 4-way. The 2-way air-operated valves can be either normally closed or normally opened
Pressure Relief Valve	• The relief valve is designed or set to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressures that exceed their design limits.

Background On Components Cont.

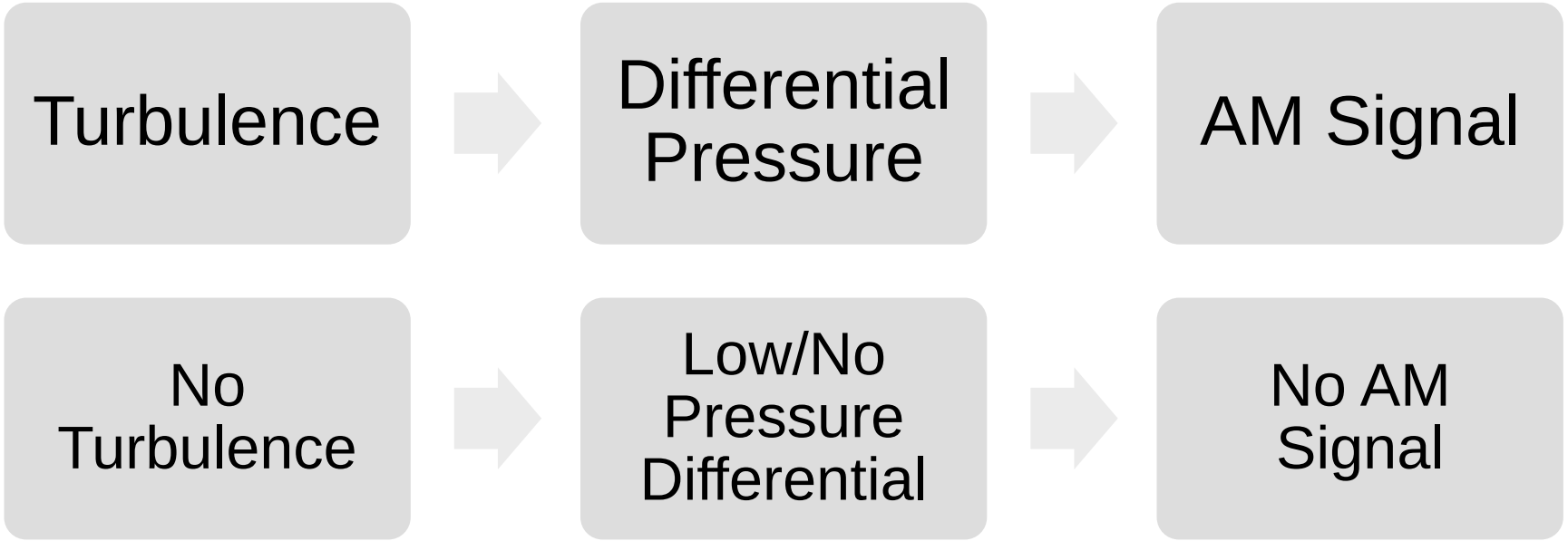
Understanding the Equipment



Turbulence

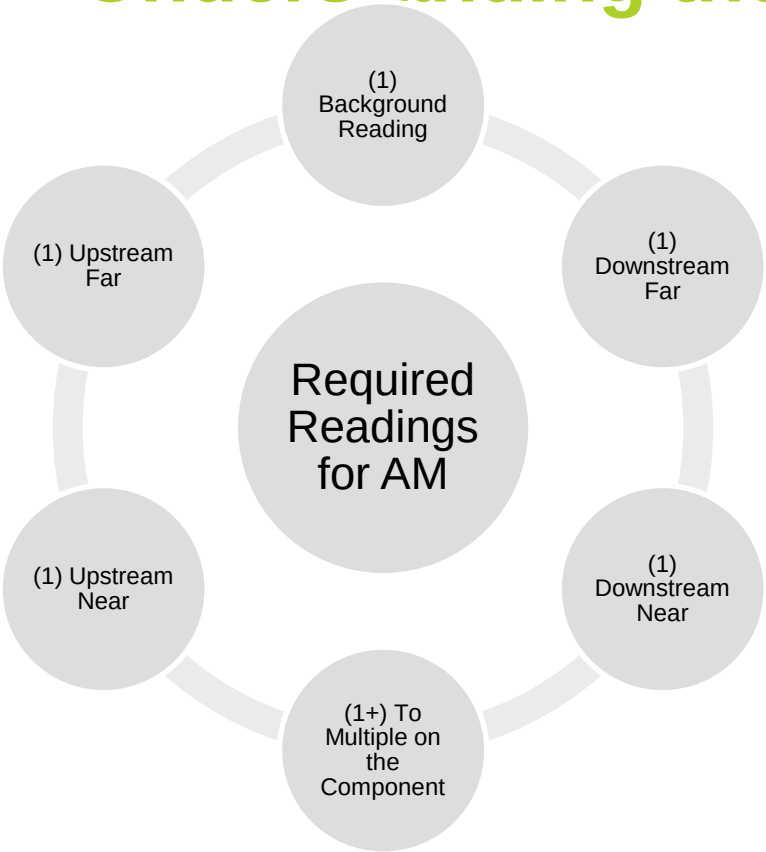
Media = Gas, Liquid or Steam

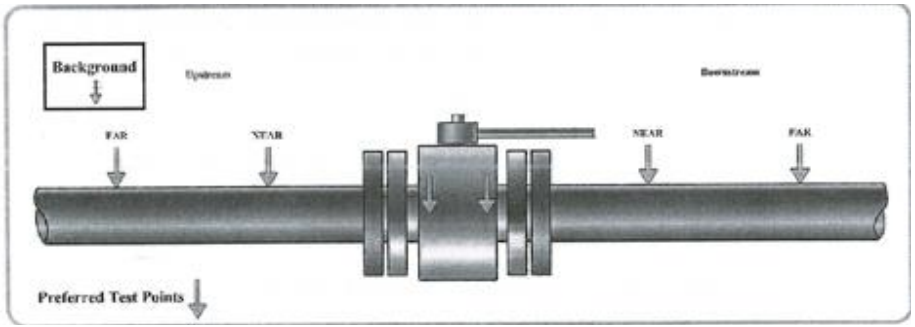
Understanding the Equipment Cont.



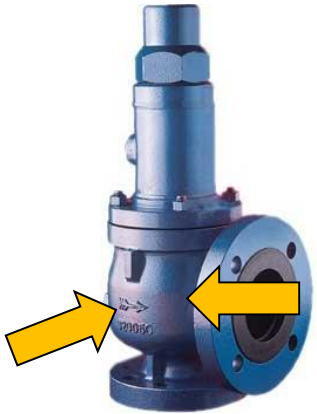
Turbulence is recorded in decibels (dB)

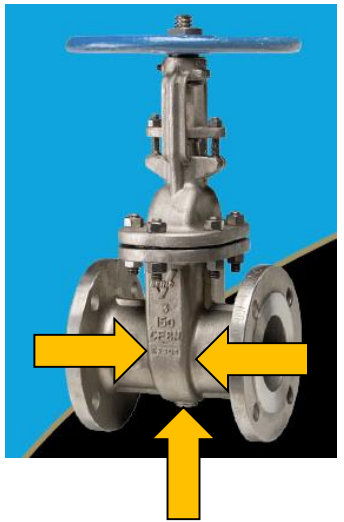
Understanding the Equipment Cont.





Understanding the Equipment Cont.



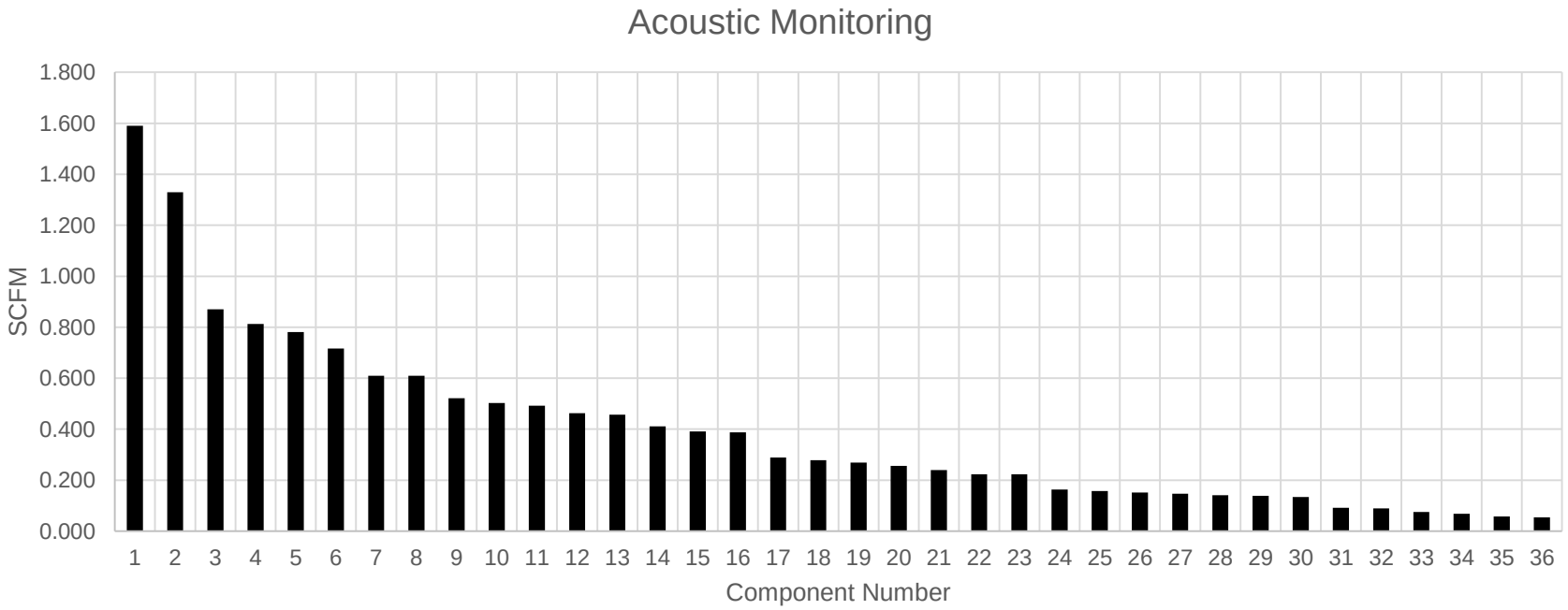


Monitoring Locations

Benefits to End Users

Facility Management	•Increase on Overall Revenue •Increase on Overall Production
Procurement	•Negotiating Power for Vendors •Better Manufactured Equipment
Environmental, Health and Safety	•Decrease in Overall Emissions •Increase in Safety and Health for all employees and surrounding communities.
Engineering	•Better AML management through data collection •Better Production Quality
Reliability and Maintenance	•Potential Increase in longer run times •Decrease in repairs having to be conducted during normal operations.

Benefits to End Users (Supporting Evidence)



36 Leaking Component/144 Total Components = 25% Leaking

Benefits to End Users Cost per Year (Supporting Evidence) Cont.

Component #	Inlet Size	Estimated Leakage SCFM	US GPH	US GPD	$2.55/ Gal/Day	Cost/Yr.
1	8.00	1.590	713.64	17127.35	$ 43,674.75	$ 15,941,283.95
2	3.00	1.330	596.94	14326.65	$ 36,532.97	$ 13,334,533.27
3	3.00	0.8700	390.48	9371.57	$ 23,897.50	$ 8,722,589.20
4	6.00	0.8130	364.90	8757.57	$ 22,331.81	$ 8,151,109.41
5	3.00	0.7810	350.54	8412.87	$ 21,452.82	$ 7,830,278.49
6	6.00	0.7160	321.36	7712.69	$ 19,667.37	$ 7,178,590.82
7	6.00	0.6090	273.34	6560.10	$ 16,728.25	$ 6,105,812.68
8	6.00	0.6090	273.34	6560.10	$ 16,728.25	$ 6,105,812.68
9	1.50	0.5220	234.29	5622.94	$ 14,338.50	$ 5,233,553.64
10	1.50	0.5030	225.76	5418.28	$ 13,816.60	$ 5,043,060.37
11	4.00	0.4920	220.82	5299.78	$ 13,514.45	$ 4,932,774.69
12	4.00	0.4630	207.81	4987.40	$ 12,717.87	$ 4,642,021.58
13	1.50	0.4570	205.12	4922.77	$ 12,553.06	$ 4,581,865.67
14	4.00	0.4110	184.47	4427.26	$ 11,289.51	$ 4,120,671.56
15	4.00	0.3910	175.49	4211.82	$ 10,740.14	$ 3,920,152.16
16	3.00	0.3880	174.15	4179.51	$ 10,657.74	$ 3,890,074.36
17	3.00	0.2890	129.71	3113.08	$ 7,938.37	$ 2,897,503.80
18	3.00	0.2780	124.77	2994.59	$ 7,636.21	$ 2,787,218.11
19	2.50	0.2690	120.74	2897.65	$ 7,389.00	$ 2,696,984.40
20	3.00	0.2560	114.90	2757.61	$ 7,031.91	$ 2,566,647.04
21	3.00	0.2400	107.72	2585.26	$ 6,592.41	$ 2,406,231.44
22	2.00	0.2230	100.09	2402.14	$ 6,125.45	$ 2,235,790.14
23	2.00	0.2230	100.09	2402.14	$ 6,125.45	$ 2,235,790.14
24	2.00	0.1630	73.16	1755.82	$ 4,477.35	$ 1,634,232.25
25	2.00	0.1570	70.47	1691.19	$ 4,312.54	$ 1,574,076.49
26	2.00	0.1520	68.22	1637.33	$ 4,175.20	$ 1,523,946.56
27	1.50	0.1470	65.98	1583.47	$ 4,037.85	$ 1,473,816.79
28	1.50	0.1410	63.29	1518.84	$ 3,873.04	$ 1,413,661.03
29	1.50	0.1390	62.39	1497.30	$ 3,818.11	$ 1,393,609.06
30	1.50	0.1340	60.14	1443.44	$ 3,680.77	$ 1,343,479.28
31	1.50	0.0916	41.11	986.71	$ 2,516.11	$ 918,378.36
32	1.00	0.0892	40.04	960.86	$ 2,450.18	$ 894,316.01
33	1.00	0.0748	33.57	805.74	$ 2,054.64	$ 749,942.14
34	1.00	0.0684	30.70	736.80	$ 1,878.84	$ 685,776.00
35	0.75	0.0572	25.67	616.15	$ 1,571.19	$ 573,485.17
36	0.75	0.0535	24.01	576.30	$ 1,469.56	$ 536,389.11
		Total:	**6369.21**	**152861.09**	**$ 389,795.77**	**$ 142,275,457.82**

Benefits to End Users Ton per Year

(Supporting Evidence) Cont.

Component #	Inlet Size	Estimated Leakage SCFM	Tons/Yr (98% Combustion Eff.) Diesel ($C_{16}H_{34}$)	Tons/Yr (98% Combustion Eff.) Gasoline "Isooctane" (C_8H_{18})	Tons/Yr (98% Combustion Eff.) Propane (C_3H_8)	Tons/Yr (98% Combustion Eff.) Methane (CH_4)
1	8.00	1.590	4.98	2.51	0.97	0.35
2	3.00	1.330	4.17	2.10	0.81	0.30
3	3.00	0.8700	2.73	1.38	0.53	0.19
4	6.00	0.8130	2.55	1.29	0.50	0.18
5	3.00	0.7810	2.45	1.23	0.48	0.17
6	6.00	0.7160	2.24	1.13	0.44	0.16
7	6.00	0.6090	1.91	0.96	0.37	0.14
8	6.00	0.6090	1.91	0.96	0.37	0.14
9	1.50	0.5220	1.64	0.83	0.32	0.12
10	1.50	0.5030	1.58	0.80	0.31	0.11
11	4.00	0.4920	1.54	0.78	0.30	0.11
12	4.00	0.4630	1.45	0.73	0.28	0.10
13	1.50	0.4570	1.43	0.72	0.28	0.10
14	4.00	0.4110	1.29	0.65	0.25	0.09
15	4.00	0.3910	1.23	0.62	0.24	0.09
16	3.00	0.3880	1.22	0.61	0.24	0.09
17	3.00	0.2890	0.91	0.46	0.18	0.06
18	3.00	0.2780	0.87	0.44	0.17	0.06
19	2.50	0.2690	0.84	0.43	0.16	0.06
20	3.00	0.2560	0.80	0.40	0.16	0.06
21	3.00	0.2400	0.75	0.38	0.15	0.05
22	2.00	0.2230	0.70	0.35	0.14	0.05
23	2.00	0.2230	0.70	0.35	0.14	0.05
24	2.00	0.1630	0.51	0.26	0.10	0.04
25	2.00	0.1570	0.49	0.25	0.10	0.03
26	2.00	0.1520	0.48	0.24	0.09	0.03
27	1.50	0.1470	0.46	0.23	0.09	0.03
28	1.50	0.1410	0.44	0.22	0.09	0.03
29	1.50	0.1390	0.44	0.22	0.08	0.03
30	1.50	0.1340	0.42	0.21	0.08	0.03
31	1.50	0.0916	0.29	0.14	0.06	0.02
32	1.00	0.0892	0.28	0.14	0.05	0.02
33	1.00	0.0748	0.23	0.12	0.05	0.02
34	1.00	0.0684	0.21	0.11	0.04	0.02
35	0.75	0.0572	0.18	0.09	0.03	0.01
36	0.75	0.0535	0.17	0.08	0.03	0.01
		Total:	**44.48**	**22.43**	**8.66**	**3.15**

Recommended Approach

Step 1
- Component Identification List to be surveyed
- Piping & Instrument Diagrams (P&IDs)

Step 2
- Operation Interviews
  - Media, Pressure for Components to be surveyed
- Supply Component Information and Operations Information AM Operator.

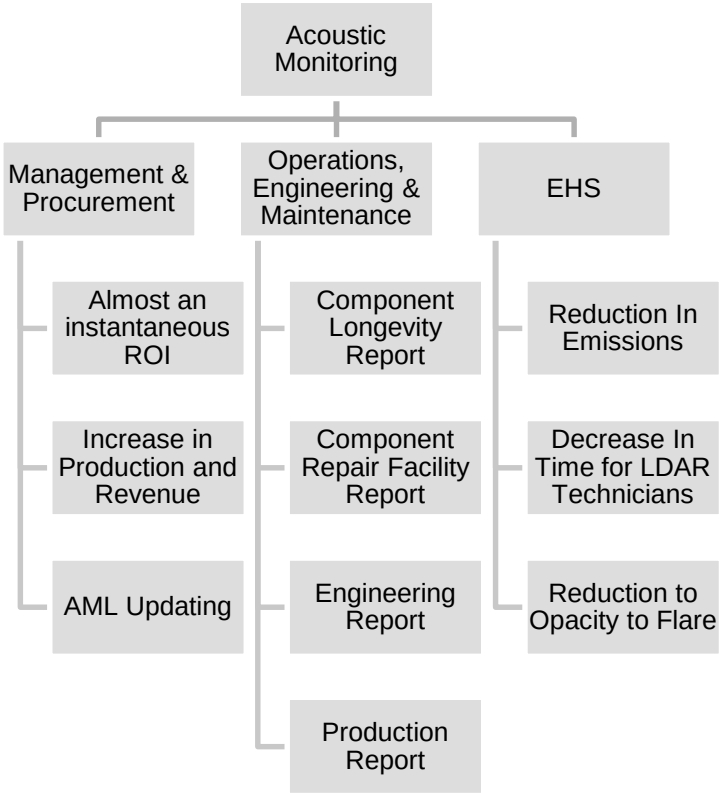
Step 3
- Facility (End User) walkthrough before AM survey for access to components to be surveyed
  - Scaffolding, Insulation, Temperature, Safety Sign Off
- Scheduling for “fully” closed seats on components to be surveyed with Operations

Step 4
- Facility walkthrough with End User Operator, End User Environmental and AM Operator
- AM survey started per scheduling performed in “step 3”

Step 5
- AM survey completion and all data reviewed before leaving the site
- Initial components found leaking supplied to End User Environmental and End User Operations

Step 6
- Initial Draft Report sent to End User
- Edits made on Draft Report
- Final Report Delivered

Conclusion



Net Positive Effect for a Properly Managed Acoustic Monitoring Program leads to a Corporate and Facility Wide Increased Production and Profitability!

Thank You!

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