AkerSolutions™

Preferred partner

High Frequency Noise from Variable Speed Drive Electric Motors

NAS 2015 - Trondheim

Kolbjørn Selvåg, M.Sc. Noise engineer, Multiconsult
Anders Krogvig, M.Sc. Noise engineer, Aker Solutions

Agenda

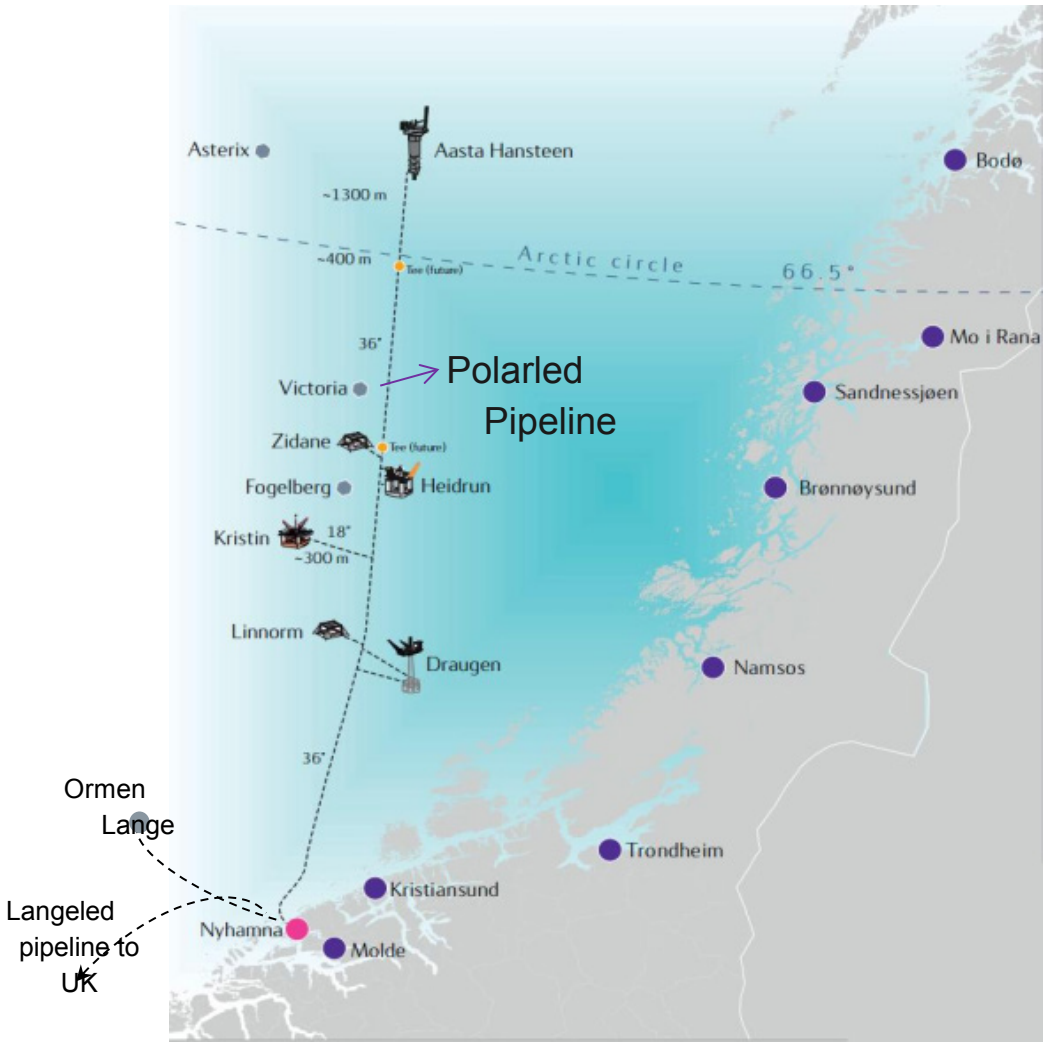
- Location of plant
- Location of VSD
- Noise environment
- Observed noise issue
- Evaluation of test results
- Noise reducing actions
- Conclusion

Nyhamna Gas Plant

- Subsea development 100 km offshore
- Nyhamna receiving facility
- Built by Norsk Hydro, commissioned 2007
- Export capacity: 70 M Sm3/d
- 20% of UK Gas consumption
- Design: Low community noise
- Operated by Norske Shell

AkerSolutions™

Nyhamna Gas Plant Expansion

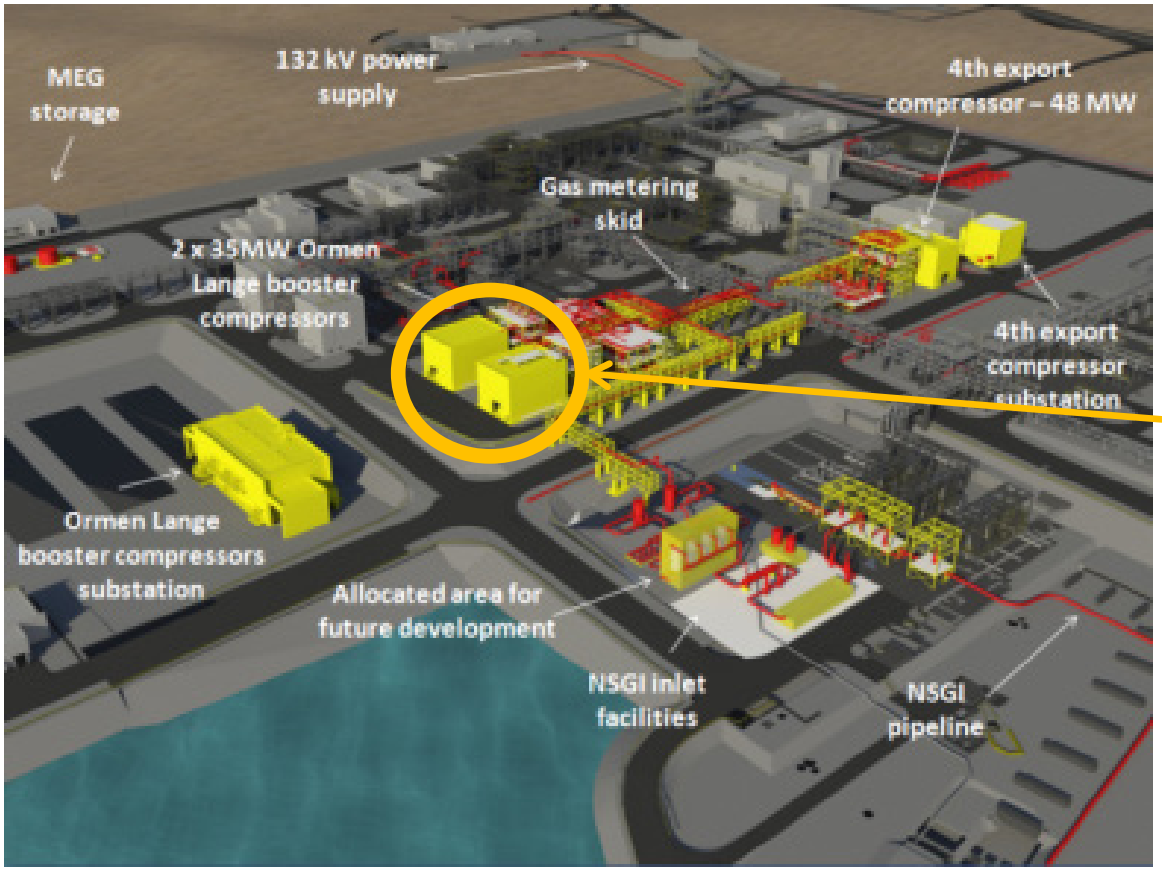


- Expansion responsible: Shell
- EPCm Contractor: Kværner Stord
- Subcontractors
  - AET (All disciplines except Civil)
  - Multiconsult (Civil)
- Engineering strategy: like for like
- 480 km 36” pipeline depth -1260 m
- Export capacity: 70 → 84 M Sm3/d

AkerSolutions™

Nyhamna Gas Plant

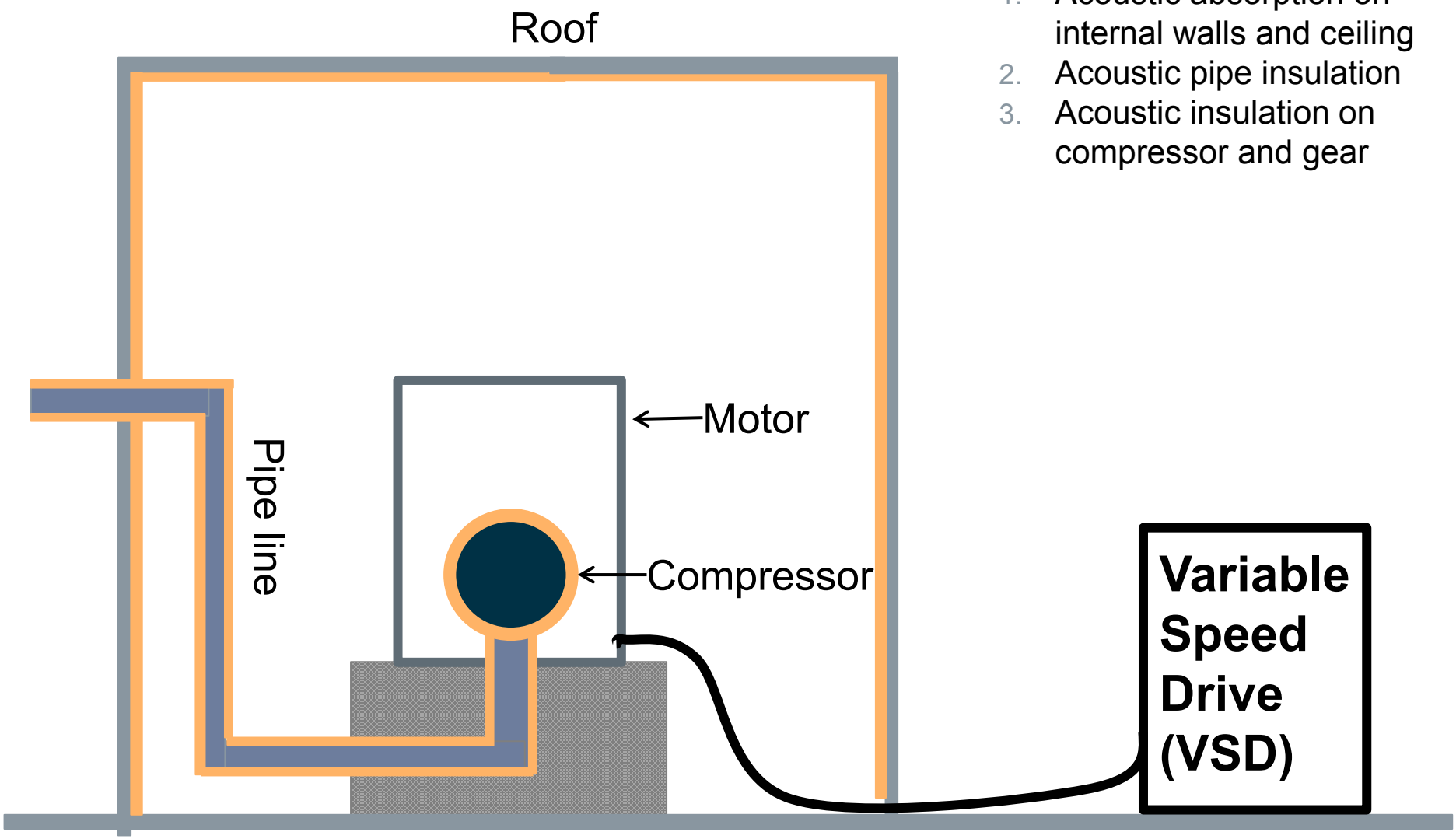
Nyhamna Gas Plant Expansion



- New facilities in yellow
  - Export Gas Compressor
  - **Booster Compressors**
  - Air Compressor
  - Substations (Utility)

AkerSolutions™

Booster Compressor Building

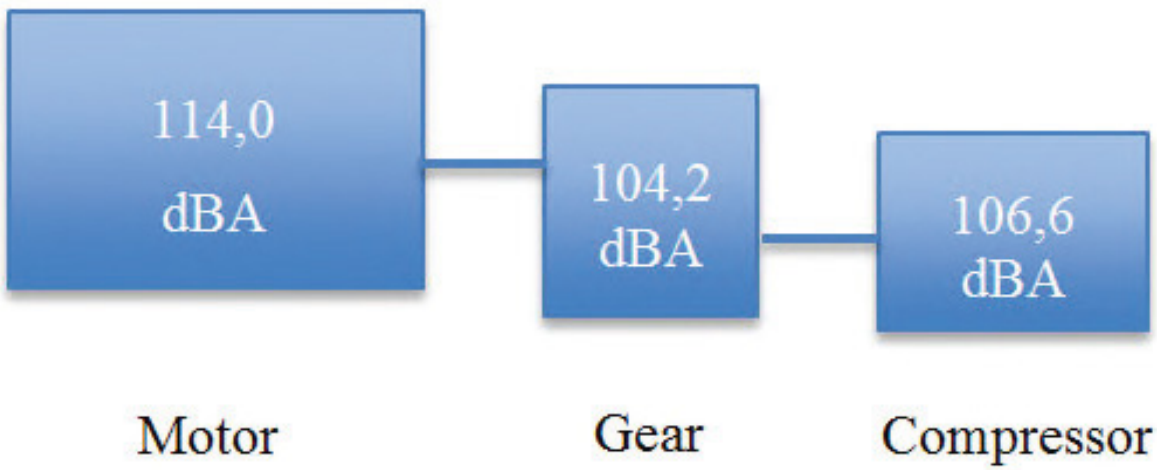


- **Noise Reducing Actions:**

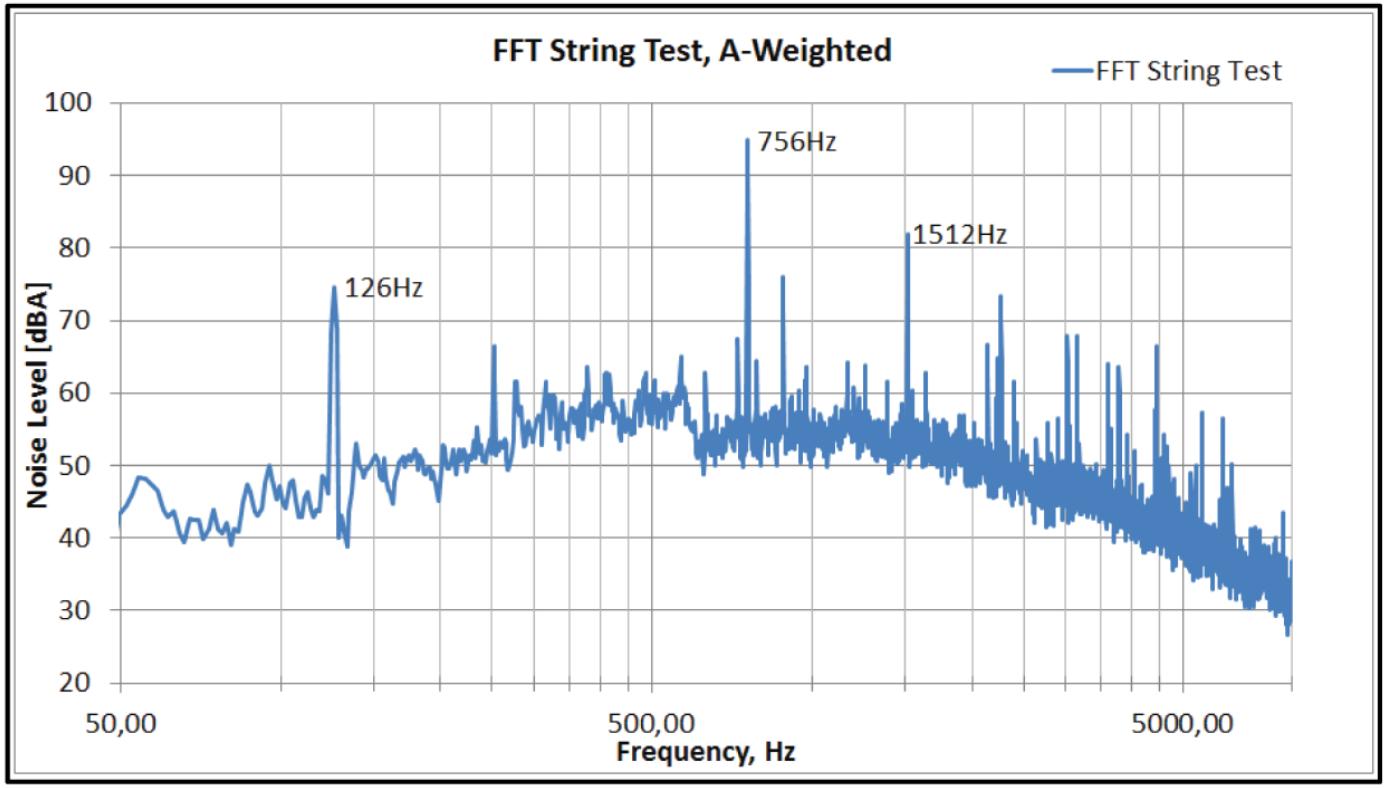
1. Acoustic absorption on internal walls and ceiling
2. Acoustic pipe insulation
3. Acoustic insulation on compressor and gear

AkerSolutions™

Measured Sound Power Levels from Booster Compr.

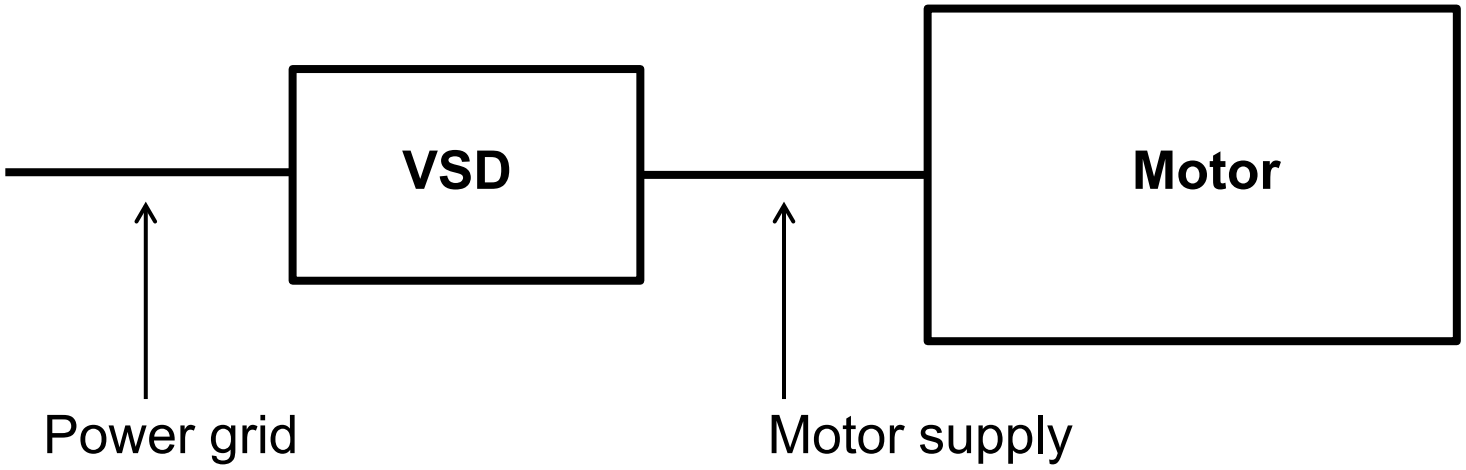


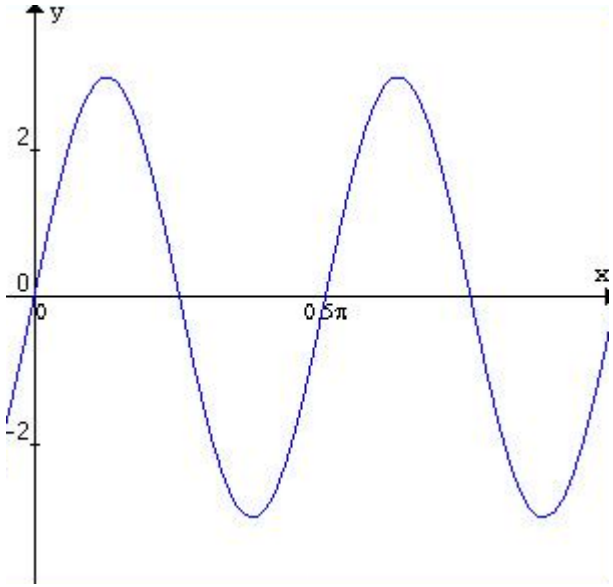
String Test - Motor Frequency Spectrum

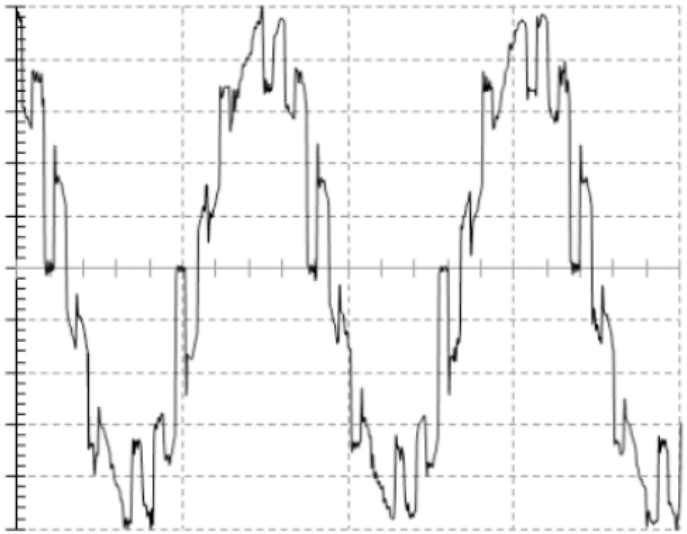


$$f_{LCI} = \frac{\text{RPM} \times \text{P}}{60} \qquad f_{LCI} = \frac{1890 \times 2}{60} = 63Hz \qquad LCIpeak1 = 63 \times 12 = 756Hz$$

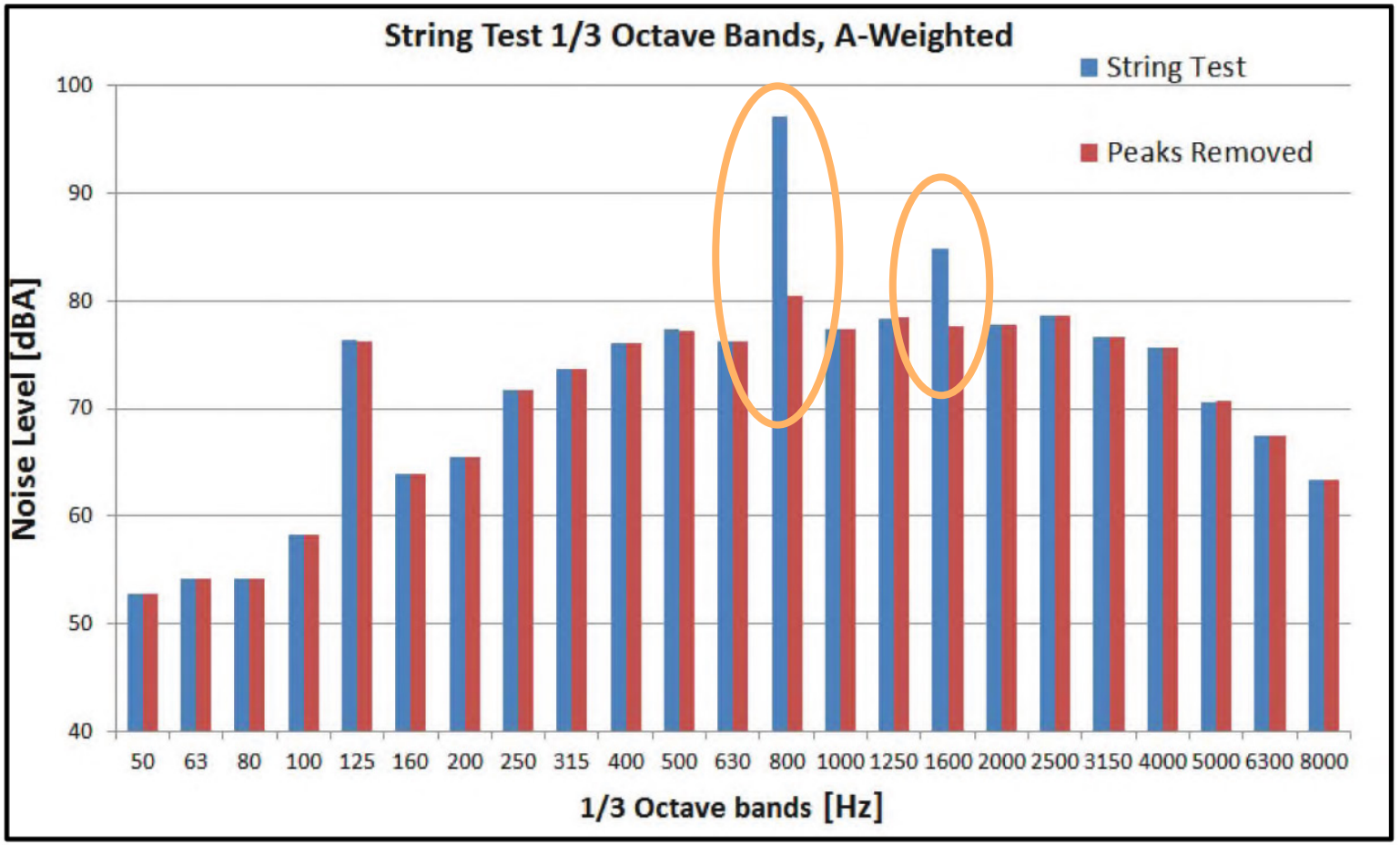
Block Diagram Motor and VSD







Removing the VSD contribution



Theoretical noise reduction: 9,1 dB

AkerSolutions™

Possible Noise Reducing Actions

1. Electric filter between VSD and Motor

    - Highest potential for noise reduction (9 dB)
    - Expensive and need extra space
    - Need to be purchased together with the compressor

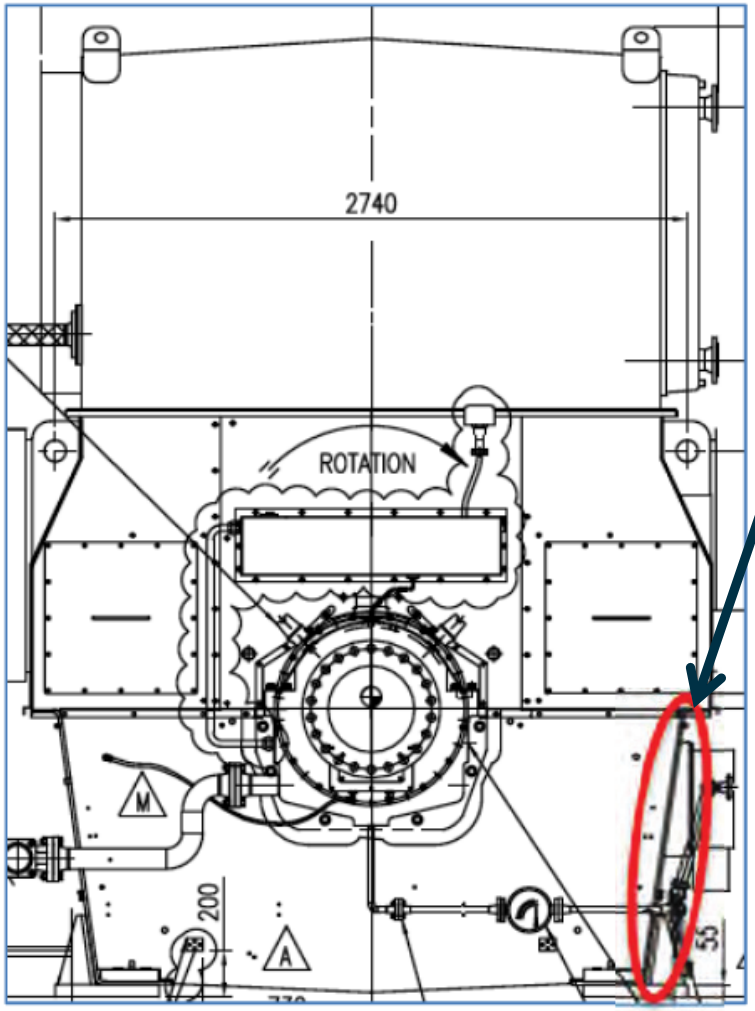
2. Modified or different type of VSD panel generating less fluctuations

    - High potential for noise reduction (4-6 dB)
    - Could cause increased energy loss
    - Need to be purchased together with the compressor

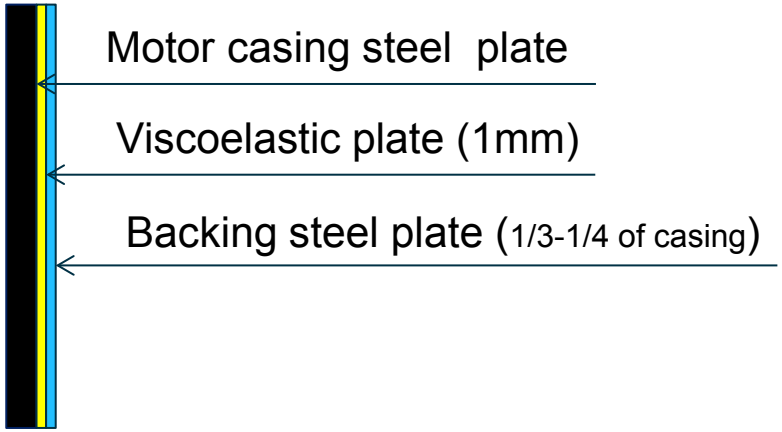
3. Viscoelastic plates on selected parts of motor

    - Limited potential for noise reduction (2dB)
    - Can be applied after motor is manufactured
    - Inexpensive and easy to apply

Recommended Noise Measure



- Noise Source
  - 44% of total motor noise emitted form lower part of motor (5% of the surface)
- Mitigating action
  - Viscoelastic plates



- Expected noise reduction: 2dB

AkerSolutions™

Conclusion

- Covering selected surfaces of VSD operated motors with viscoelastic plates could be a cost effective way of noise reduction.

Copyright and disclaimer

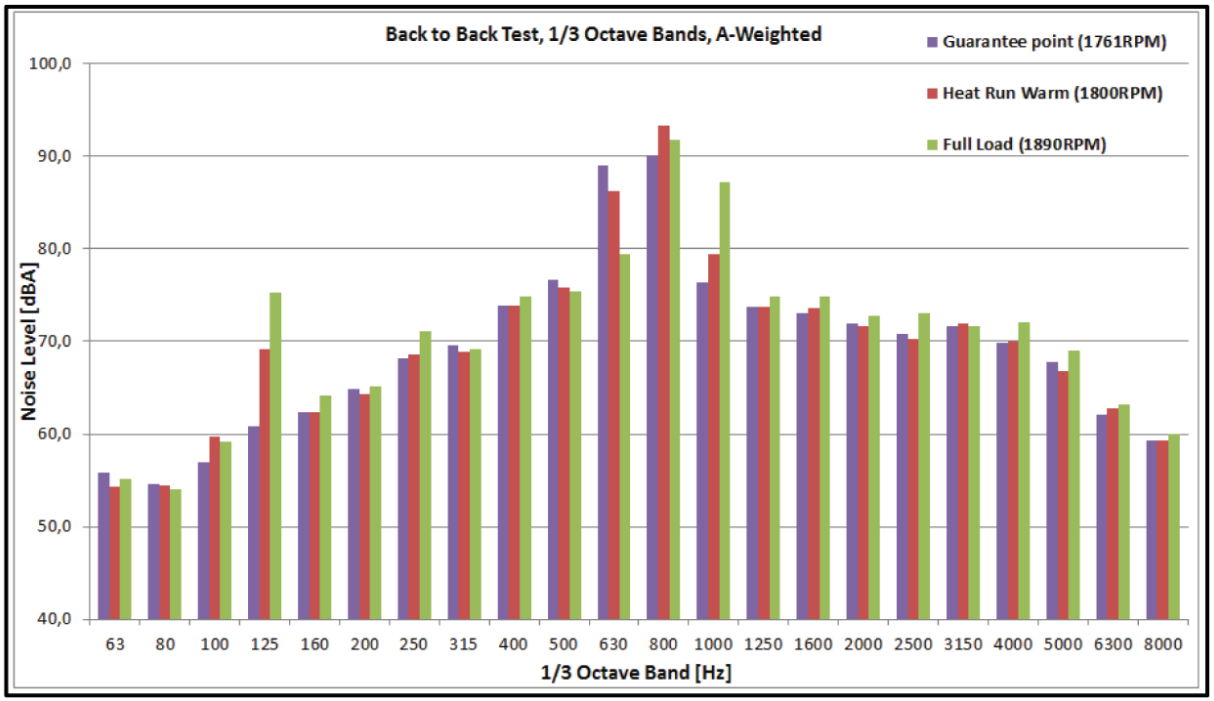
Copyright

Disclaimer

This Presentation includes and is based, inter alia, on forward-looking information and statements that are subject to risks and uncertainties that could cause actual results to differ. These statements and this Presentation are based on current expectations, estimates and projections about global economic conditions, the economic conditions of the regions and industries that are major markets for Aker Solutions ASA and Aker Solutions ASA's (including subsidiaries and affiliates) lines of business. These expectations, estimates and projections are generally identifiable by statements containing words such as "expects", "believes", "estimates" or similar expressions. Important factors that could cause actual results to differ materially from those expectations include, among others, economic and market conditions in the geographic areas and industries that are or will be major markets for Aker Solutions' businesses, oil prices, market acceptance of new products and services, changes in governmental regulations, interest rates, fluctuations in currency exchange rates and such other factors as may be discussed from time to time in the Presentation. Although Aker Solutions ASA believes that its expectations and the Presentation are based upon reasonable assumptions, it can give no assurance that those expectations will be achieved or that the actual results will be as set out in the Presentation. Aker Solutions ASA is making no representation or warranty, expressed or implied, as to the accuracy, reliability or completeness of the Presentation, and neither Aker Solutions ASA nor any of its directors, officers or employees will have any liability to you or any other persons resulting from your use.

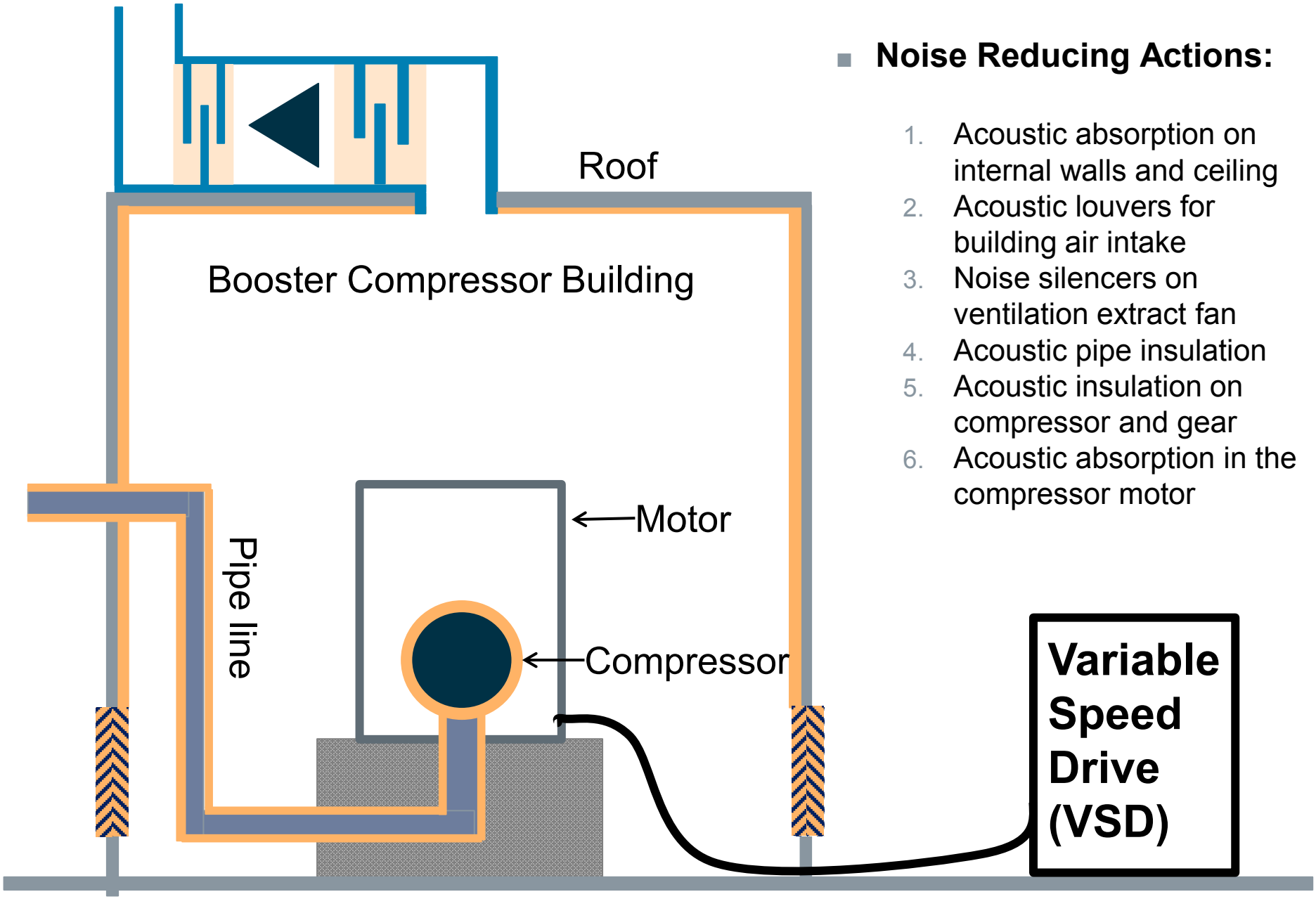
Aker Solutions consists of many legally independent entities, constituting their own separate identities. Aker Solutions is used as the common brand or trade mark for most of these entities. In this presentation we may sometimes use "Aker Solutions", "we" or "us" when we refer to Aker Solutions companies in general or where no useful purpose is served by identifying any particular Aker Solutions company.

Back to Back Test



RPM	$\mathbf{f_{LCI}}$ *[Hz]*	f_{peak} *[Hz]*	*1/3octave band [Hz]*
1890	63	756	800
1800	60	720	800
1761	58.7	704	630

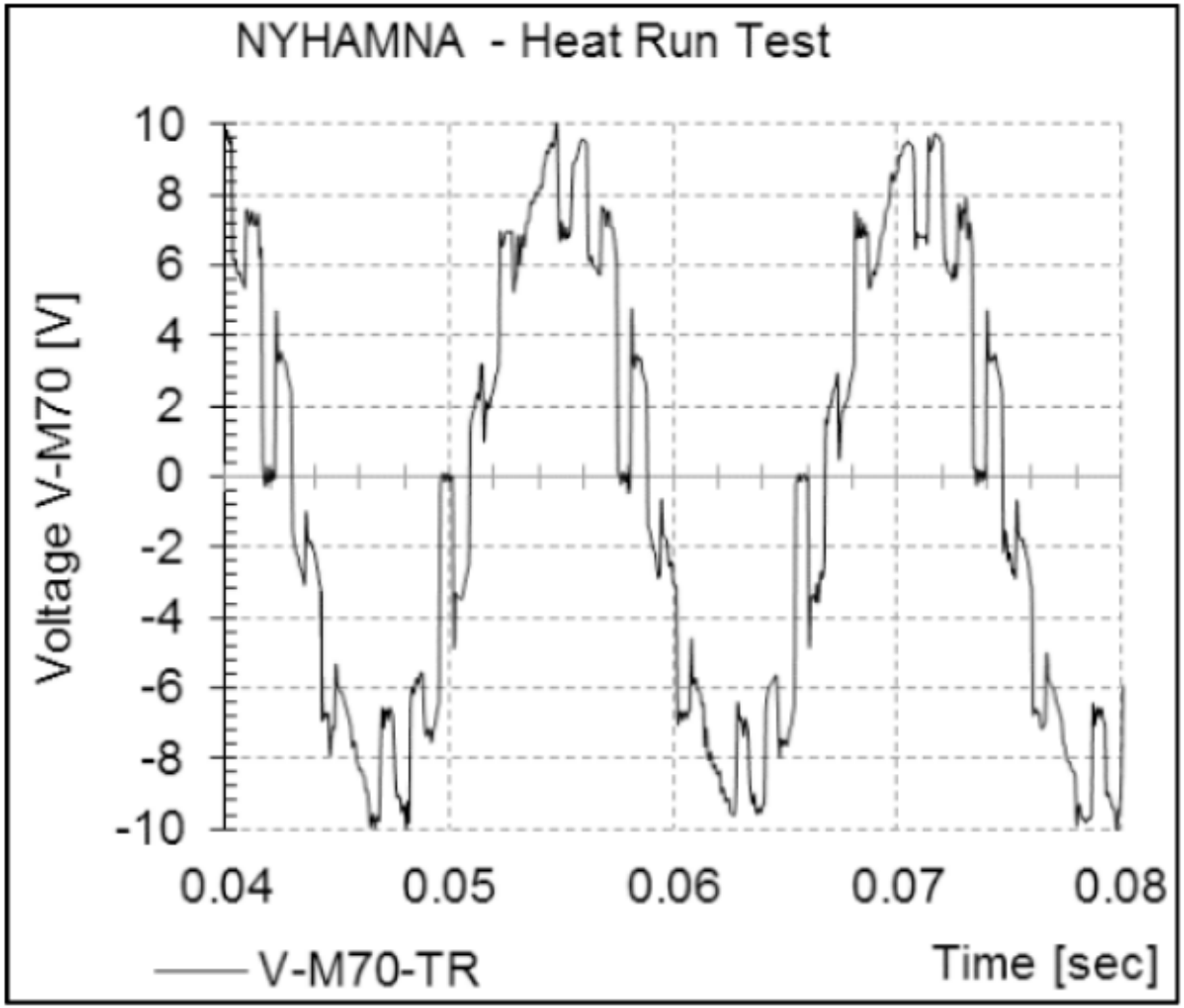
AkerSolutions™



- **Noise Reducing Actions:**

1. Acoustic absorption on internal walls and ceiling
2. Acoustic louvers for building air intake
3. Noise silencers on ventilation extract fan
4. Acoustic pipe insulation
5. Acoustic insulation on compressor and gear
6. Acoustic absorption in the compressor motor

AkerSolutions™


NYHAMNA - Heat Run Test
Voltage V-M70 [V]
10
8
6
4
2
0
-2
-4
-6
-8
-10
0.04
0.05
0.06
0.07
0.08
V-M70-TR
Time [sec]