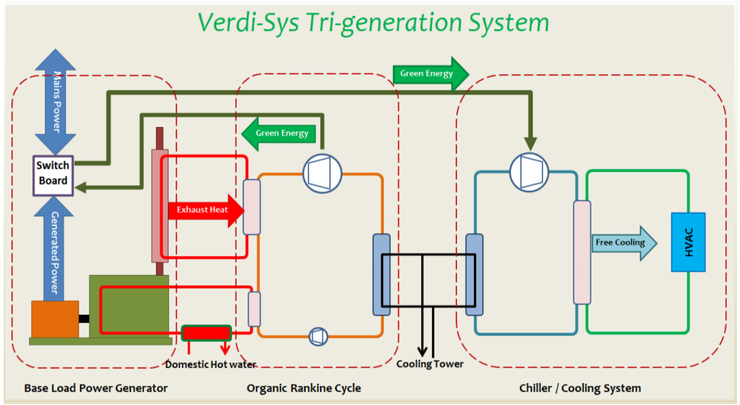
Noise Mitigation in an Organic Rankine Cycle (ORC) Turbine Bypass Line

Organic Rankine Cycle



ORC Operation Cycle

Waste Heat → **Electricity**

Testing Conditions

- ORC is housed in 23.5’ x 8’ x 8.5’ shipping container
- Corrugated weathering steel structure
- Small dimensions and corrugated surfaces lead to high reverberation

Possible Challenges

- Designing a solution within the dimensions of the system
- Reliable noise measurement in confined operating space
- Mechanical failures resulting in time delays

Problem Definition

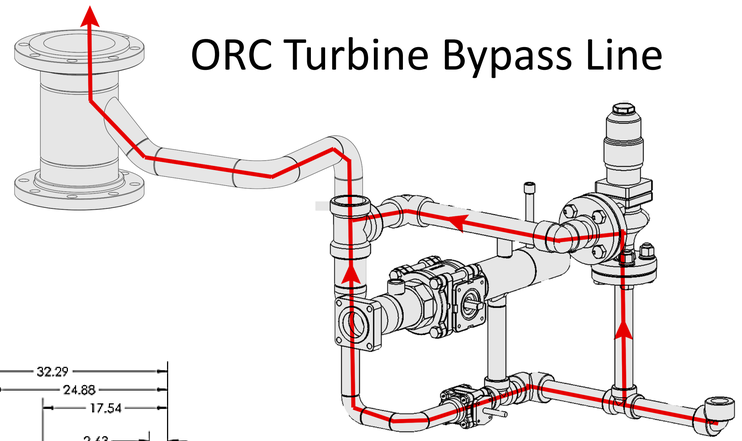
Organic Rankine Cycles (ORC) are required to operate in a transient bypass mode to filter refrigerant past turbine for safe operation, this process generates an unacceptably loud noise.

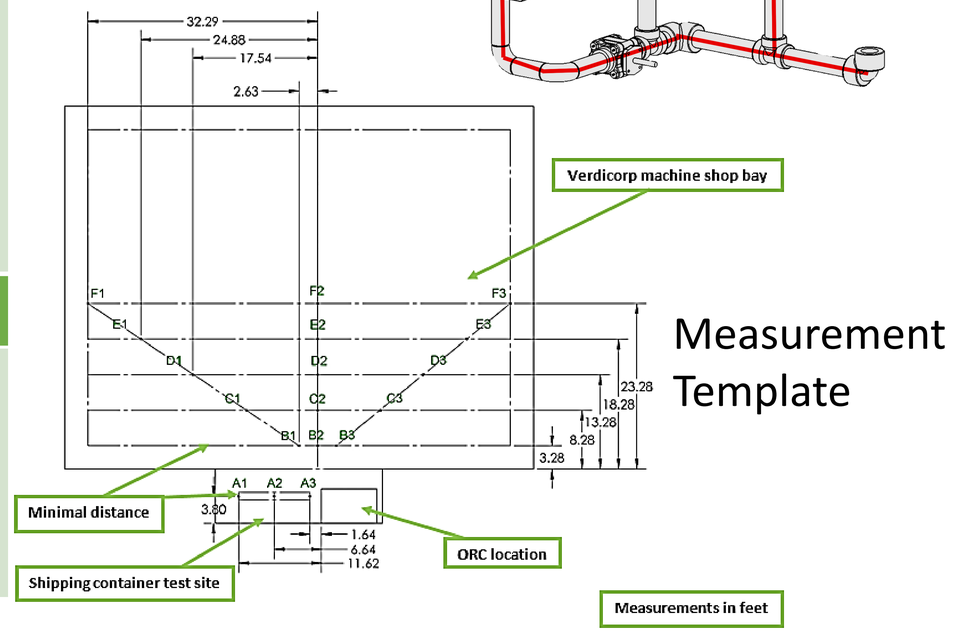
Noise Expose Limits

112 dB	<1 *min*
109 dB	<2 *min*
106 dB	<4 *min*
103 dB	7.5 min
100 dB	15 min
97 dB	30 min
94 dB	1 hour
91 dB	2 hours
88 dB	4 hours
85 dB	8 hours

- ORCs turn on and off throughout the operating times and produces continuous noise
- The noise from the ORC has resulted in residential complaints
- Noise induced hearing loss (NHLS) accounts for 1/9 recorded work illnesses
- Can result in tinnitus permanently or for 16-48 hours after exposure

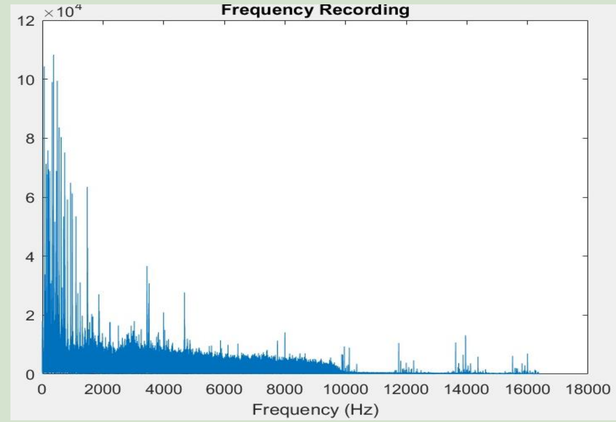
Dampening of the noise can improve safety, performance, and health of employees across the wide regions where these ORCs are installed.

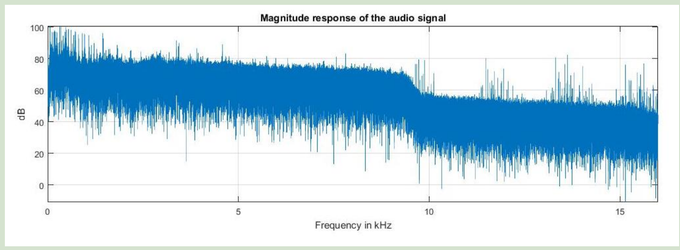




Measurement Template

Data Analysis





- Discrete Fourier transform (DFT) converts time domain samples to frequency spectrum
- Hanning function applied to average frequency spectrum (focus on specific instances of continuous source)

Future Work

- Measure ORC Noise Level in transient and steady state
- Analyze measurements
- Concept Selection based on dB and frequency ranges
- Prototype generation
- Verdicorp in-house manufacturing

References

- “Occupationally-Induced Hearing Loss,” *Centers for Disease Control and Prevention*, Jun-2014. [Online]. Available: http://www.cdc.gov/niosh/docs/2010-136/default.html.
- “National Institutes of Health,” National Institutes of Health. [Online]. Available: https://www.nidcd.nih.gov/health/noise-induced-hearing-loss.

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