Delivering the Nuclear Promise
Top Innovative Practice

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Acoustic Imaging to Improve Equipment Reliability and Cost Efficiency

2022 Top Innovative Practice Winner

Summary

To improve condition monitoring capabilities at Palo Verde Nuclear Station, an acoustic imaging device was identified and utilized to assess sound signatures within the plant that are indicative of minute leaks. The device has an array of highly sensitive microphones that can detect both audible and high frequencies humans can't hear. The device translates the audio frequencies into a visual heatmap overlaid with a digital image that pinpoints the area of leakage. Palo Verde has been utilizing the device to identify and repair numerous system leaks within plant systems including Safety Injection tanks (gas leaks), Feedwater Heaters (tube leaks), Instrument Air, Main Steam, and Steam Generation. The acoustic imaging device, used by experienced individuals, can readily identify low level leaks in a fast and efficient manner to quickly focus the station's repair efforts and restore the plant back to its optimal design configuration. EPRI has provided the industry with a number of guidance documents based on research done in the area of Acoustic Emission, including EPRI Technical Reports 3002009935 "Guidelines for the Use of Acoustic Emission and Passive Ultrasonic Techniques" and 3002020843 "Acoustic and Ultrasound Technology and Program Guide."

Innovation

The use of acoustic imaging has resulted in a change of business practices at Palo Verde associated with leak identification and repair. The technology was adapted from other industries and brought to Palo Verde in 2015. However, changes in design and functionality of modern products have enabled the station to utilize the technology for several purposes including leak identification on plant systems. The use of the technology has expedited identification and repairs saving countless hours of time to identify both high energy and low energy leaks.

This process is far more efficient than other technologies, including smoke tests and helium detection. These methods required meticulous care going from tube to tube in heat exchangers, mapping and documenting findings. With the acoustic imagers an entire tube sheet can be assessed quickly to visually identify sources of leakage, expediting repairs and saving precious hours of power production.

Safety

The acoustic imaging technology and its use at Palo Verde have positively impacted margin to safety as plant components can be surveyed from afar, assessing the danger prior to approaching potentially degraded high energy systems. This also minimizes dose as personnel can now survey system components without contact

and from areas that are significantly lower dose. Personnel spend less time performing the activity also reducing dose.

Cost Savings

Systems such as Safety Injection, Main Steam, Instrument Air and Steam Generation are very large systems with a significant number of potential leak points. The technology allows for a quick survey of the entire system in an expeditious manner allowing for quick identification and repair and expeditious restoration of power production.

In contrast to other methods, acoustic imaging allows incidences to be resolved within one shift verses 5-7 shifts of investigation, planning, scheduling, contracting, and reporting. It also enables real time feedback to the engineering and maintenance staff. The speed and efficiency that have been gained has been estimated to be approximately $25k per incident with approximately 15 incidents a year at $345k per year of direct O&M savings or $1.7M over the expected five-year life of the instrument. Unaccounted for in this estimation is the reduction in lost power production as the events are often in series with critical path activities necessary for restoration to full power operations.

Transferability

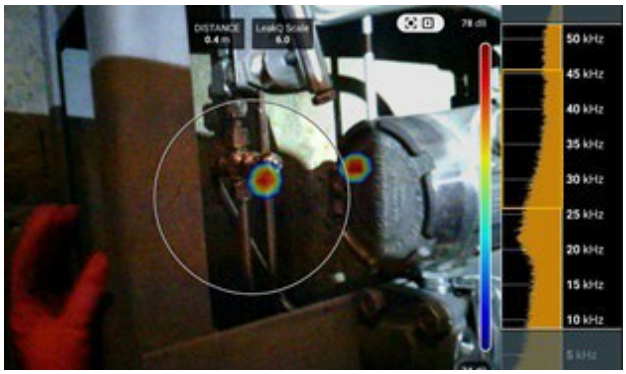
Acoustic imaging can be used at any plant in the fleet. It is inexpensive, easy to use and effective.

Team Members

- Sandy Polus, Engineer II, Strategic Engineering (APS)
- Brennon Shay, Engineer II, Strategic Engineering (APS)
- Keith Heinert, Engineer Sr, Field Mechanical (APS)
- Ricky Burge, Engineer Sr, Field Mechanical (APS)

Graphic 1 - Acoustic Imager

Graphic 2 - Safety Injection Tank Nitrogen Leak



Graphic 3- Low Pressure Feedwater Heater Tube Leak