DISCUSSION OF THE USE OF REMOTELY OPERATED MANIPULATORS AND VPN TECHNOLOGY FOR EDDY CURRENT TESTING FIELD PROJECTS

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Two applications of technology in support of eddy current inspections will be discussed.

Remotely Operated Manipulator Development and Deployment

Summary
The advantages of manipulator use in Balance of Plant Heat Exchanger (BOP HX) inspections have been recognized for several years. Inspection of components in radiologically controlled areas and increased production through automation were primary drivers leading to manipulator development and wider use. When a US utility required a replacement manipulator system due to obsolescence, system requirements were detailed, and a purchase specification was generated. During the manipulator design process, several design and flexibility options were incorporated into the system design. The manipulator system was delivered, and was utilized in a limited field trial for the client in the spring of 2012. Additionally, the system was deployed at several other US utility sites in the fall of 2012 and the spring of 2013. This presentation will detail design considerations, features and capabilities, general field experience from several deployments, and possible future capabilities and design revisions.

Discussion
The use of remotely operated manipulators is driven by numerous considerations and provides several benefits. The most obvious benefit is the ability to inspect heat exchangers that are not typically inspected due to environmental factors (high dose rates, high contamination areas, etc.). The use of a manipulator to perform these inspections reduces the time personnel must spend in an area from hours to minutes, thus reducing the impact of the hazard.

Manipulator use also increases productivity and accuracy when performing inspections. Retests due to mis-encoded tubes are reduced, saving valuable schedule time. The ability to operate acquisition stations nearly continuously, while using the same, or fewer, numbers of inspectors provides tangible benefits in work schedules and overall inspection cost.

Increased production provides additional benefits because more tubes can be inspected in the same amount of schedule time; increased sample sizes provide a clearer picture of component condition.

The combination of these factors makes manipulator use an easy choice for inspection projects in environmentally challenging areas, and for projects involving notable numbers of tubes where increased production rates can help to minimize inspection schedule.

When a US utility required a replacement manipulator system due to obsolescence, system requirements were detailed, and a purchase specification was generated. The major requirements for this system included:
1. A minimum 24” working envelope
2. Ability to deliver the inspection probe.
3. Control system compatible with Windows
4. Encoded positioning (Row and Tube information) that interfaces with the eddy current data acquisition software.

With general needs identified, additional design parameters were considered. Other design features incorporated were:
1. Quick and easy to install
2. Reliable and robust hardware
3. Current actuator technology
4. Adjustable length of manipulator
5. Various mounting options
6. Hardware and Software designed with future applications considered (tube plugging, tube cleaning, dual probing, automated acquisition.

With input from Anatec-LMT, the engineering team at Corestar International developed the IM-2 manipulator system to meet all of the design parameters specified. The system was delivered to the utility, and has been utilized on clean as well as radiologically contaminated components.

The IM-2 manipulator has been deployed for inspection work at the following sites:
1. Oconee – Turbine Lube Oil Cooler and LPI Heat Exchanger Inspection
2. Prairie Island – Residual Heat Removal Heat Exchanger Inspections
3. Susquehanna – Spent Fuel Pool Cooler eddy current and tube cleaning
4. Perry - Residual Heat Removal Heat Exchanger Inspection

Conclusion
The design and deployment of a remotely operated manipulator system allows inspection of many heat exchangers that must be inspected for license renewal and are often vital to safe plant operation and shutdown. Improved accuracy and productivity gains over current processes have been demonstrated, and further improvements to the manipulator systems are on-going.
Use of VPN Technology for Eddy Current Inspection Data Transmission

Summary
Currently in the United States, point-to-point T1 data connections are used widely for transmission of steam generator eddy current inspection data offsite for remote analysis. Remote analysis of the data is performed to minimize the number of personnel on-site. This results in cost savings for the utility clients by minimizing the costs for travel, office space, and site badging. Due to the rising costs and decreased reliability of point-to-point T1 technology a replacement technology was needed. Virtual Private Networking (VPN) technology, which is a mature technology and provides for excellent data security, increased bandwidth, and reduced cost has been successfully utilized for inspections in the US and abroad.

Discussion
Remote data analysis for PWR Steam Generator inspections is common practice in the US and abroad. The main technology used for data transfer for the past twenty to twenty-five years has been point-to-point T1 connections. At one time, this technology provided an excellent value for bandwidth. Over the last several years, however, the cost of point-to-point T1 connections has risen dramatically. This is primarily due to the fact that point-to-point T1 technology has reached the useful life in the eyes of the providers.

Point-to-point T1 is a private data connection securely connecting two or more locations with T1 data speeds (1.554Mbps). A T1 point to point circuit is a closed network data transport service and is considered to be inherently secure with no data encryption needed. Point to Point T1 services are available in higher bandwidth speeds by combining multiple T1’s and multiplexing them, by using point-to-point Ethernet, or by using point-to-point DS3.

A replacement for point-to-point T1 connections was needed. Virtual Private Network (VPN) technology is a suitable replacement that provides for reliable security, increased bandwidth, and decreased cost. The primary requirement for utilizing VPN technology is a high speed (3-5 megabit minimum) internet connection at both work locations. While this type of connection was unheard of twenty years ago, it is commonplace today. This can also allow for these connections to remain active if remote access is required between outages.

A Virtual Private Network (VPN) is a private, secured tunnel through the public internet backbone joining one location with another. The size of the VPN tunnel, and therefore how much data can be sent at once, is dependent upon the bandwidth available from either point. For example if one side of the VPN tunnel has a 1.4 megabit (upload and download) connection and the other side has a 10 megabit (upload and download) connection then the data transfer would be limited by the lesser of the two bandwidths at 1.4 megabits.

Conclusion
Functionally, the point-to-point T-1 network and the VPN network are identical. VPN has the advantages of lower cost and scalable bandwidth. VPN technology provides a lower cost, secure solution for transmission of eddy current inspection data for the purpose of remote data analysis.