





Scientech Stresswave SRV Leak Detection

Scientech Symposium 2015







- SRV = Safety Relief Valve
- "A pressure relief vessel which automatically releases a substance from a boiler, pressure vessel or other system, when the pressure exceeds preset limits."



Agenda

- Stresswave Technology Overview
- Valve Leakage Detection Project
- Valve Testing Data
- SRV Maintenance Examples Using Stresswave
- Questions/Comments



What Are Stresswaves?

Stresswaves are ultrasonic acoustic energy impulses (~40kHz) that radiate through solid, liquid and gas in all directions.





Causes of Stresswave Energy

- FRICTION
 - Contact Pressure
 - Contact Surface Area
 - Roughness Smoothness
 - Relative Surface Speeds
 - Lubricant Condition
 - Operating Load
 - Operating Speed

- SHOCK & IMPULSE
 - Impact Velocity
 - Damage/Imperfection
 Size
 - Depth
 - Area
- Gas or Fluid FLOW
 - Leakage
 - Turbulence
 - Cavitation

Stresswave Basics

- Stresswave principle: "<u>Resonance is good!</u>"
- Natural frequency of valve metal structures ~ 40kHz
- Structure-borne Ultrasonic Frequencies
 - Low amplitude
 - Easily reflected
 - Quickly damped

Stresswave Basics



- SWE = Stress Wave Energy
- A unit of measure based on the energy contained within the raw sensor signal
- Increases in orders of magnitude as stress and friction increase.



- Piezoelectric accelerometer
- Designed specifically to utilize the natural resonant frequency of the piezoelectric crystal element
- The sensor incorporates an internal filter to reduce low frequency noise
- INTRINSIC SAFETY:
 - Class I, Division 1, Groups A, B, C & D
- Process Temperature -50°C to 120°C
- Radiation hardening: manufacturer is recommending 100 Mrad test



Valve Leak Detection Project

- Exelon was experiencing leakage with their Target Rock
 SRVs causing unscheduled outages
- Exelon partnered with Scientech in 2008 to use Stresswave technology to detect valve leakage
- Testing of the technology was performed at the NWS valve testing facility in Spartanburg, SC
- A permanent Stresswave system was installed in 2009 and all Exelon valves that are refurbished at NWS go through the Stresswave test



NWS Testing Summary – Exelon Valves





NWS Testing Summary – Exelon Valves Using Scientech





NWS Testing Summary – Exelon Valves Using Scientech





Valve Leak Detection Project

- In 2013 Exelon and Scientech were awarded a NEI TIP (Top Industry Practice) Award for Stresswave testing of Limerick and Peach Bottom GS MSRVs
- "The TIP Awards highlight the nuclear industry's most innovative techniques and ideas"





Exelon Benefits

- Save \$7M/yr. in SRV unscheduled outages
- Save \$750K/yr. 50% reduced SRV scheduled maintenance at LGS
- Reduced SRV SWE average by 200% with improved SRV repair methods





























Valve Leak Detection – Web Server





Valve Leak Detection – SwanviewLX

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Valve Leak Detection – SwanviewLX

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NWS Valve Testing Data

Exelon Generation	Company LLC		Lift	NWS	SWS							
NWS Technologies			4	13:56	17:56							
Hot Shop 2			5	14:06	18:06							
			6	14:16	18:16							
Sen 1A Pilot				Sen 4A Main			Sen 2A 2nd Stage			Sen 1B Exhaust		
DATE	SWE VALUE	LIFT #		DATE	SWE VALUE	LIFT #	DATE	SWE VALUE	LIFT #	DATE	SWE VALUE	LIFT #
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5/23/2013 18:05	36	4		5/23/2013 18:05	26	4	5/23/2013 18:05	46	4	5/23/2013 18:05	23	4



NWS Valve Testing Data

- Is the valve leaking: YES or NO?
- YES: How much is the valve leaking?
 - The Stresswave Energy (SWE) metric is able to quantify valve leakage
 - Leakage can be recorded, tracked and analyzed
- <u>NO</u>: How tight is the seal?
 - Improve maintenance techniques



NWS Valve Testing Data

- SWE = Stresswave Energy
 - Total stress energy contained within sensor signal
- Sigma = Standard Deviation
 - Amount of variation from the average
- UCL = Upper Control Limit
 - Statistical distribution limit of the SWE level of the tested valve

Scientech Report





NWS Valve Testing Data Comparison – Reheater Valve





NWS Valve Testing Data Comparison – Reheater Valve





NWS Valve Maintenance – TR SRV

First Two Lifts were OK, and Lift #3 Failed Cold Bar Testing





NWS Valve Test after Maintenance – TR SRV Failed Scientech

- Two automatic lifts were performed and leakage was detected at ~750psig
- The valve was fully disassembled for repair
- The main piston rings were found to have scoring marks and were replaced
- The main seat and disk were lapped again and the SRV was placed on the steam test cell for As-Left Certification



NWS Valve Test after Maintenance – TR SRV Passed Scientech

AFTER

12000 - Li	ft #5 Li	ft #6	Lift #7
10000 -			
8000 -		After SRV maintenance to replace the Main seat rings and some lapping, the SRV Passes three final As Loft Cortification	
4000 -		Lifts & Cold Bar Testing during Lifts #5, #6, & #7.	
2000 -			
0 01/21/2013 07:15 DM		A A A A A A A A A A A A A A A A A A A	01/21/2012 02:07 DM



NWS Valve Testing and Maintenance – SRV

- Scientech Stresswave technology can "hear" valve leakage.
- Exelon developed software calculations with Scientech that can:
 - Reliably identify quality valve performance
 - Quantitatively measure valve leak magnitude
 - Predict valve integrity and future performance
- Exelon checks that the UCL values for the seats are within the normal range
- The ASME Cold Bar is still the final acceptance criteria



Conclusion

Questions/Comments





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