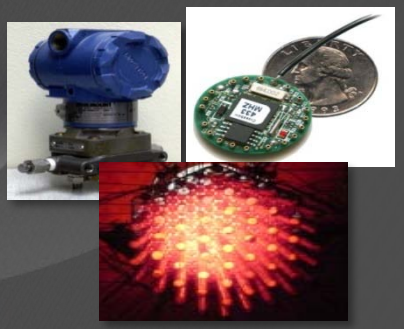
Advanced I&C

On-line Monitoring and Calibration Techniques in Nuclear Power Plants



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Presented at:

International Conference on Opportunities and Challenges for Water Cooled Reactors in 21st Century

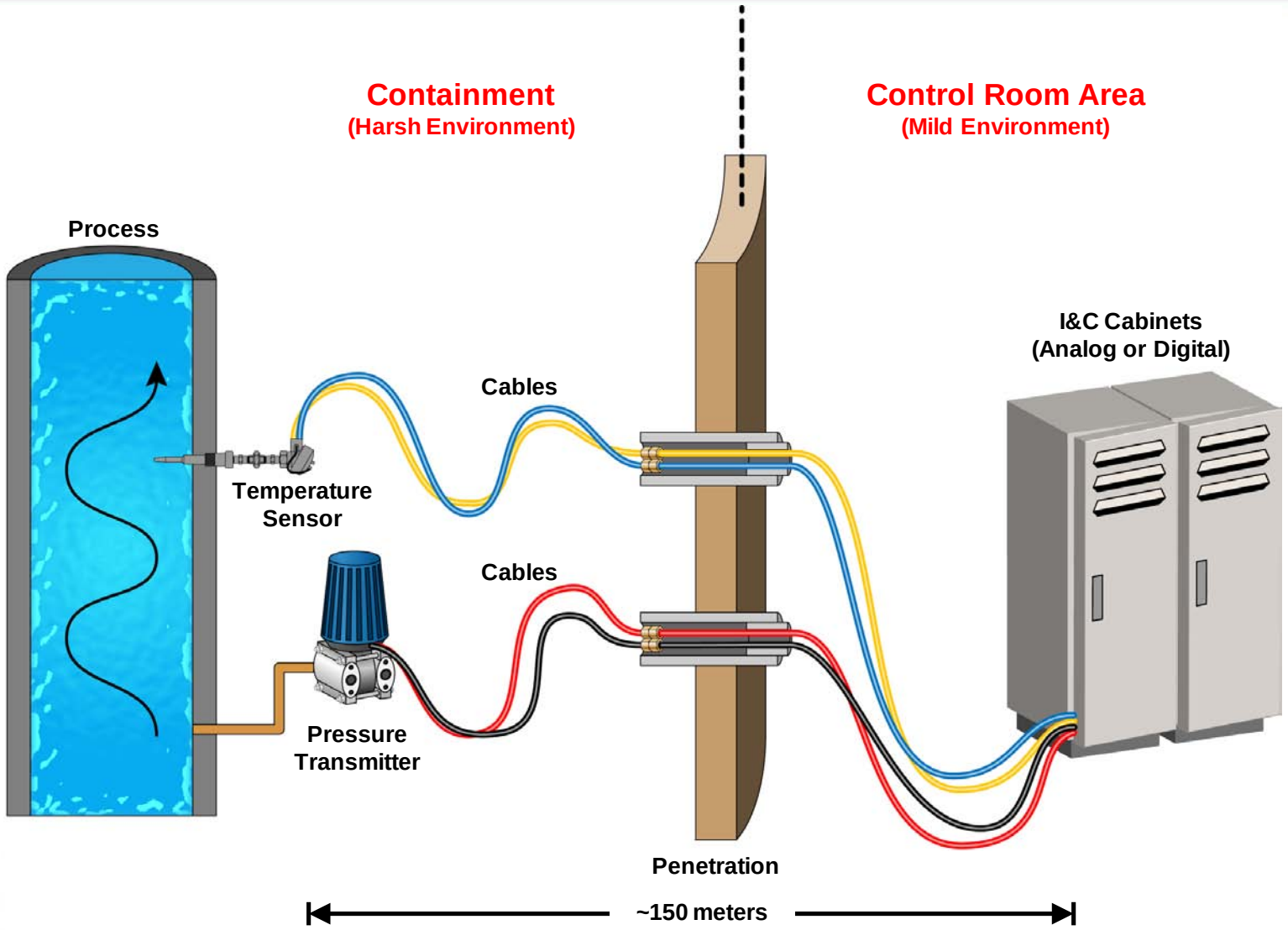
Vienna International Centre

International Atomic Energy Agency

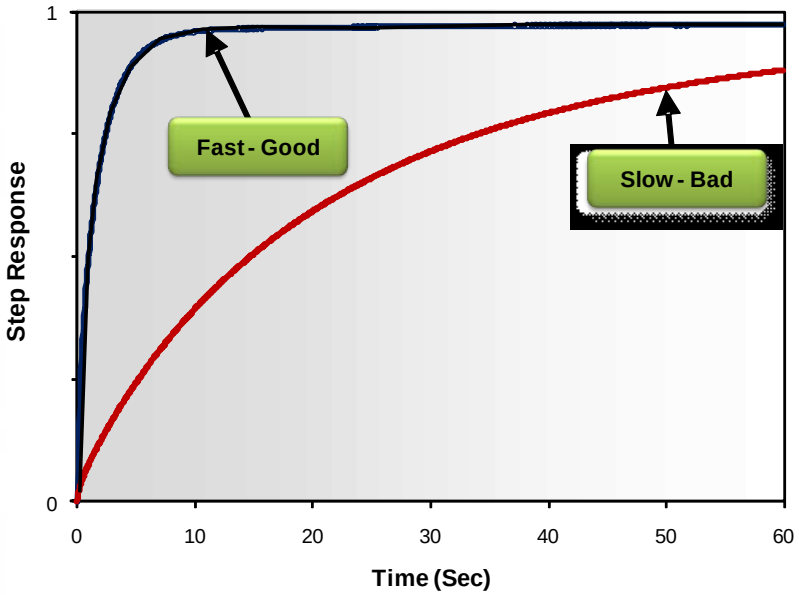
Vienna, Austria

27-30 October 2009

Do Not Forget Sensors and Cables

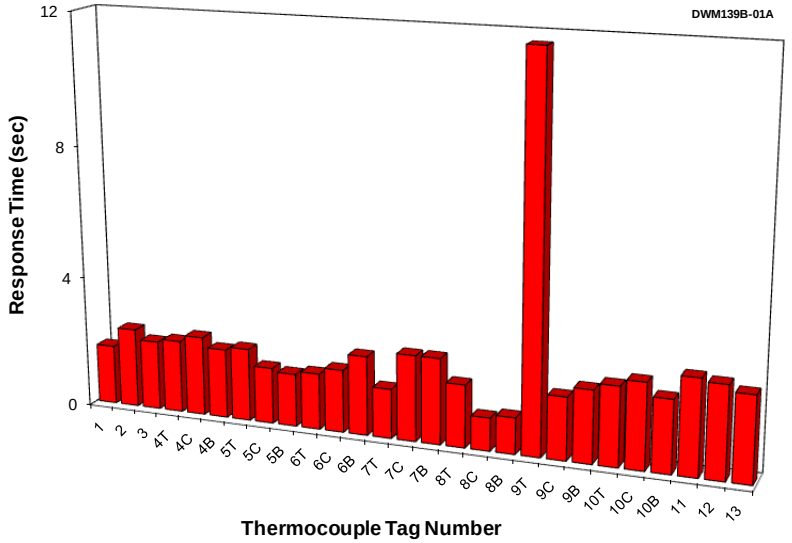


Proper Installation is Critical to Temperature Sensor Performance

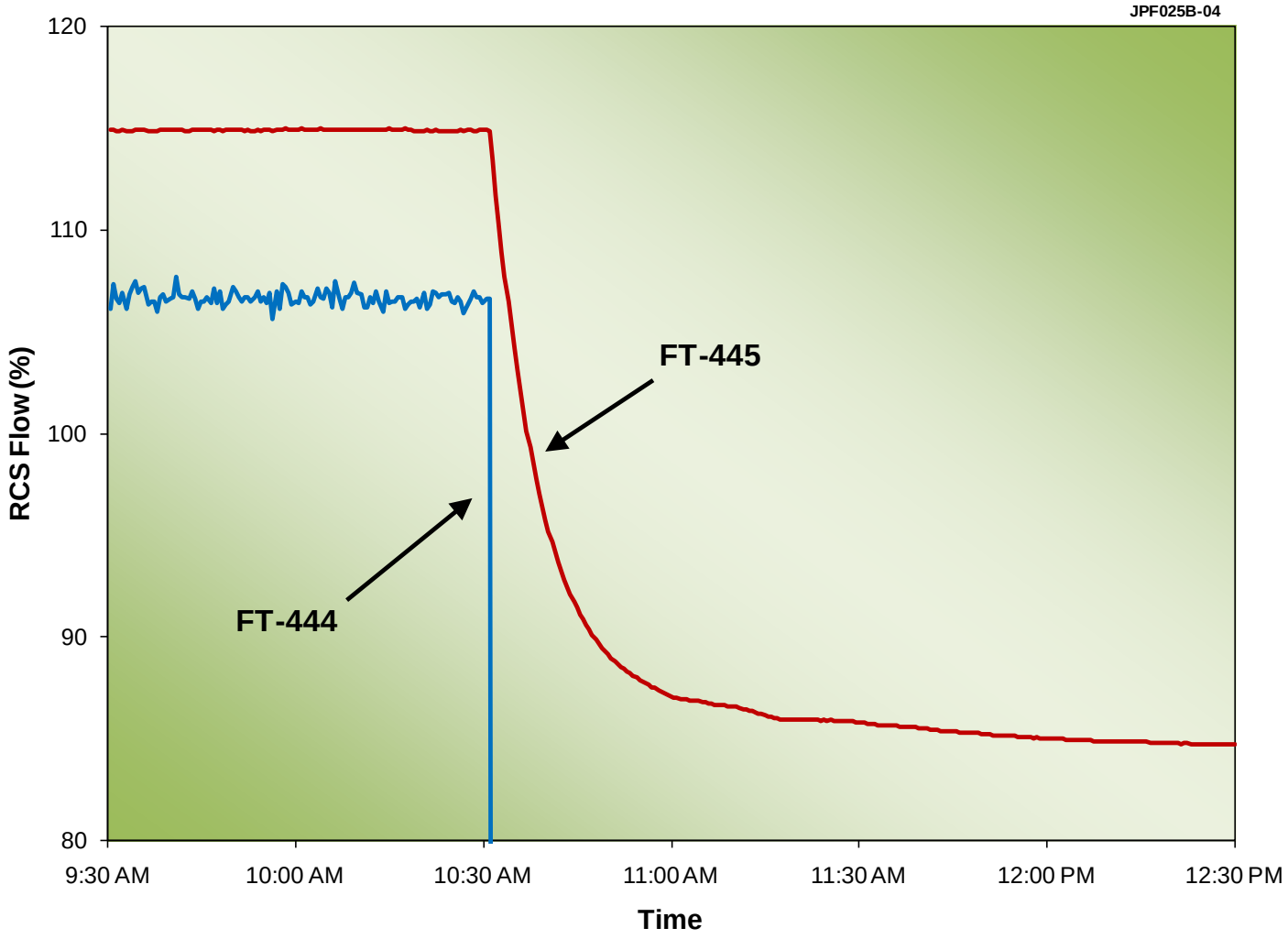


RTD

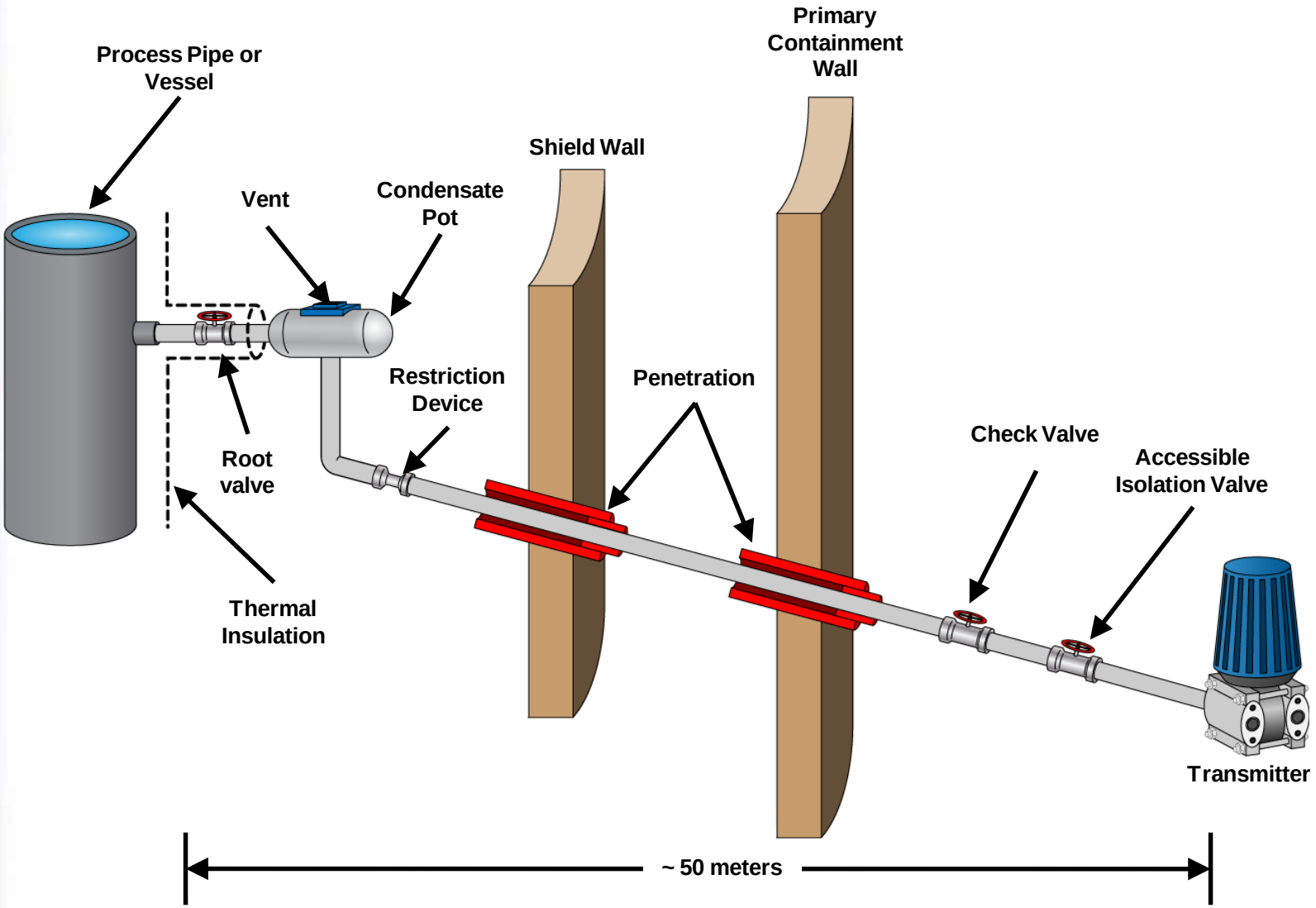
Thermocouple



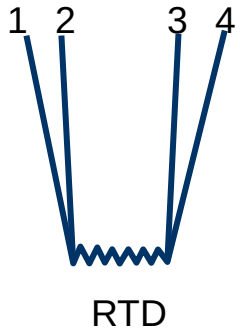
Nuclear Power Plant Pressure Transmitter Failure Mode Detected by Pure Luck

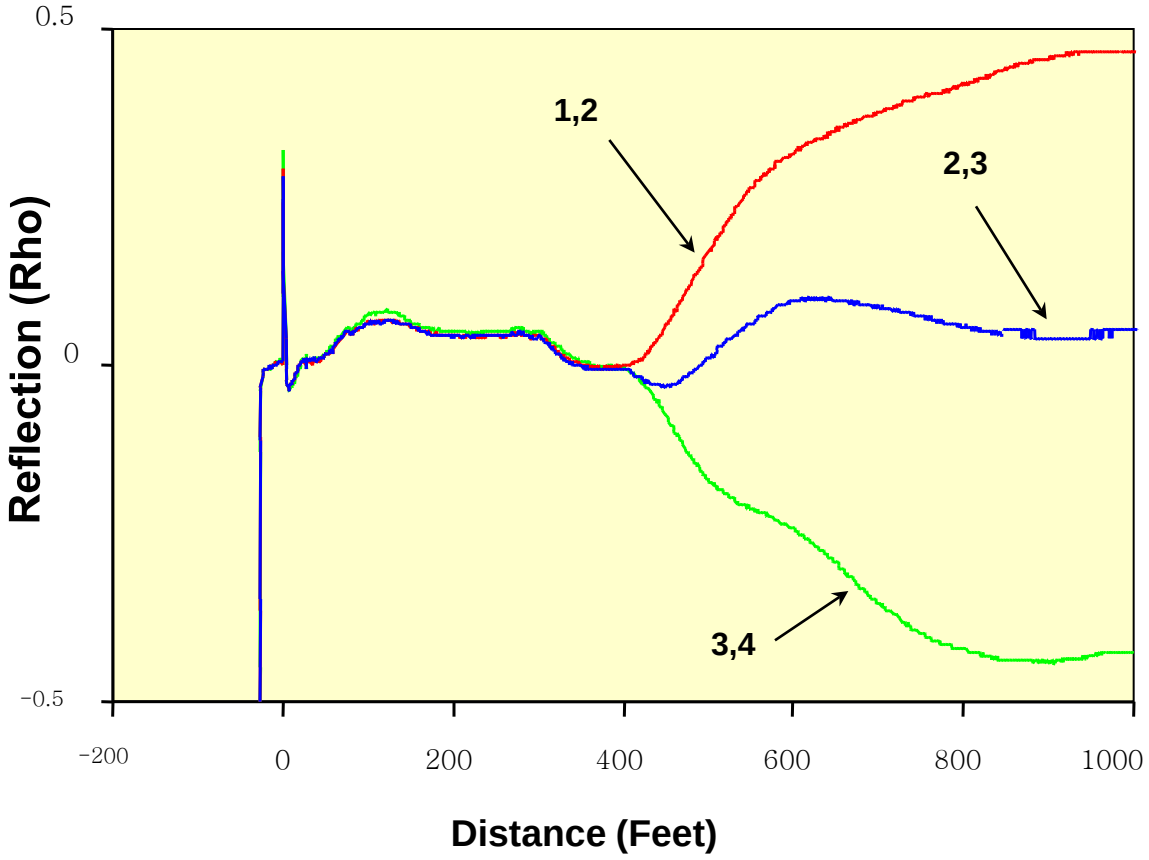


Sensing Lines are Critical to the Performance of Pressure Transmitters

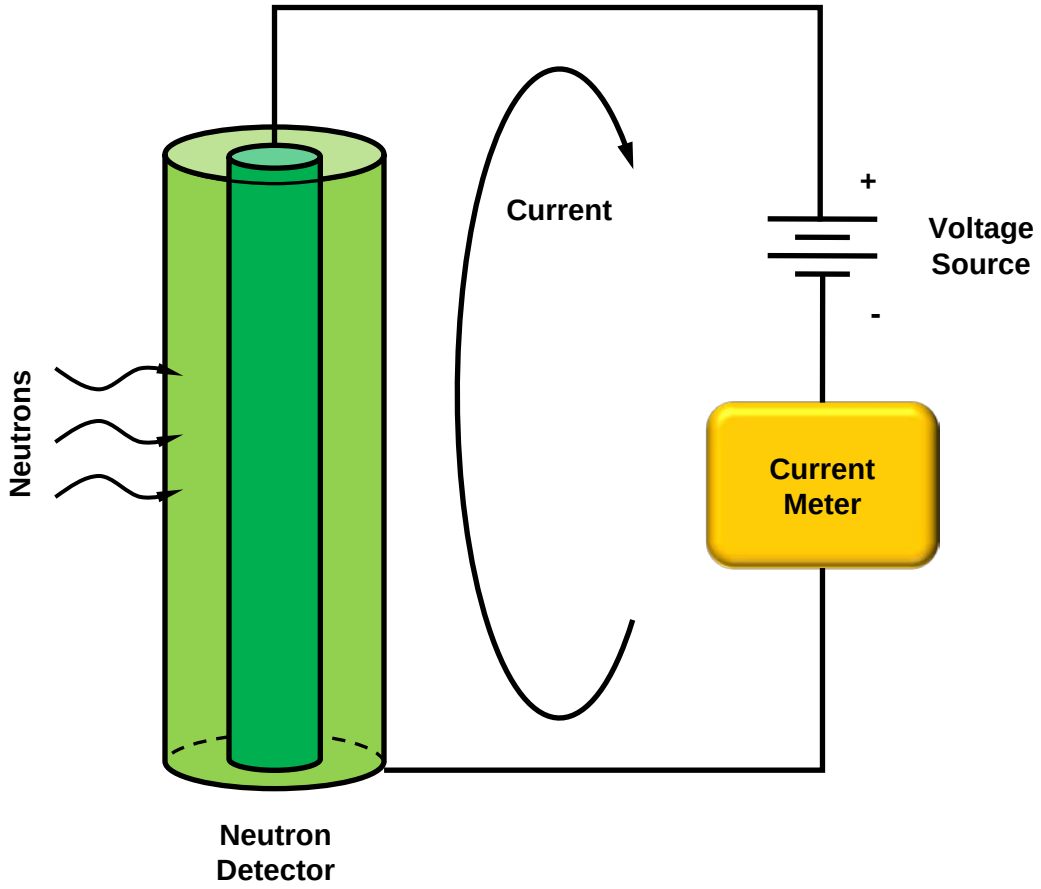


Cable Diagnostics



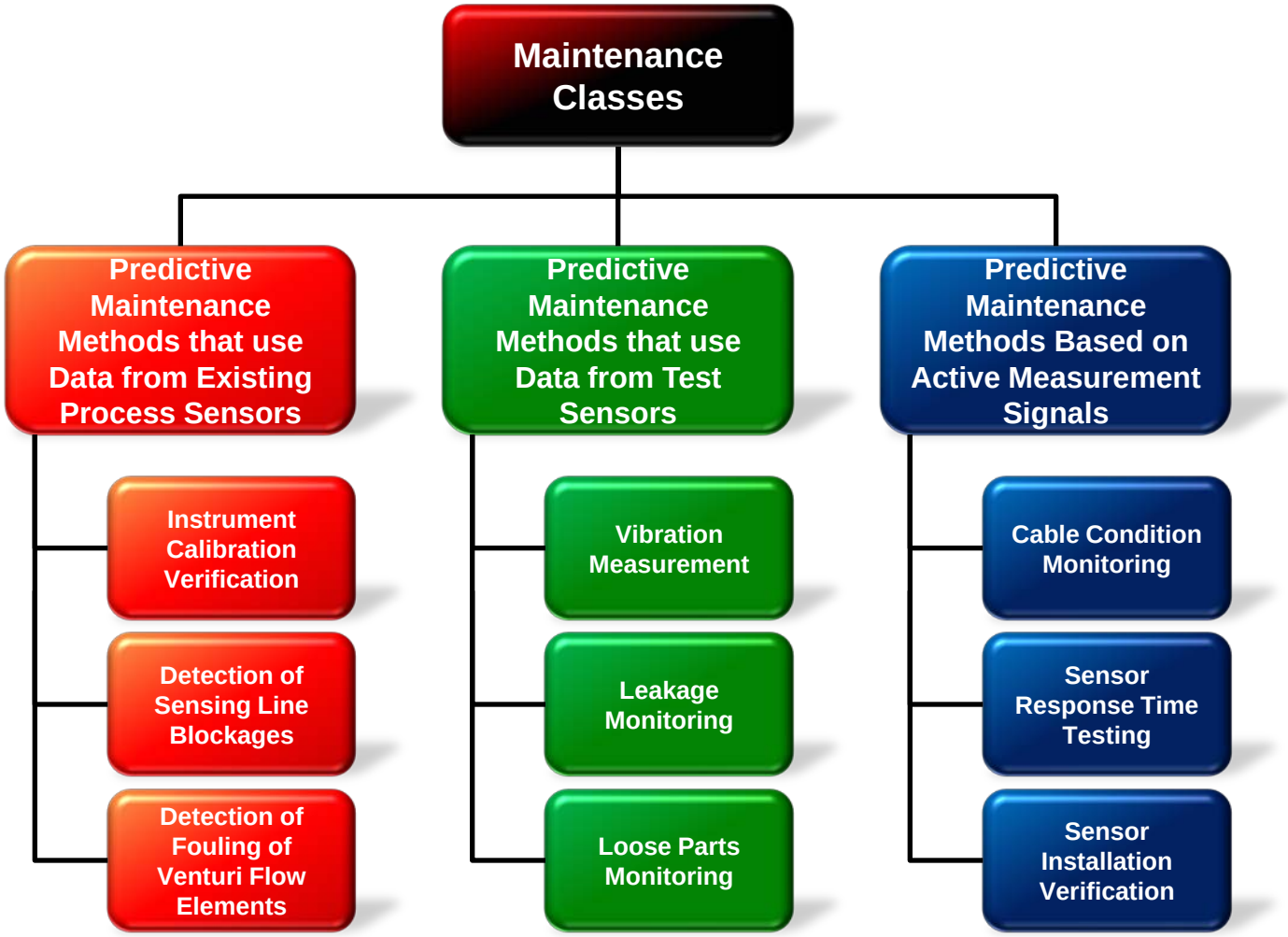


Signal Problems are Not Always in Cables



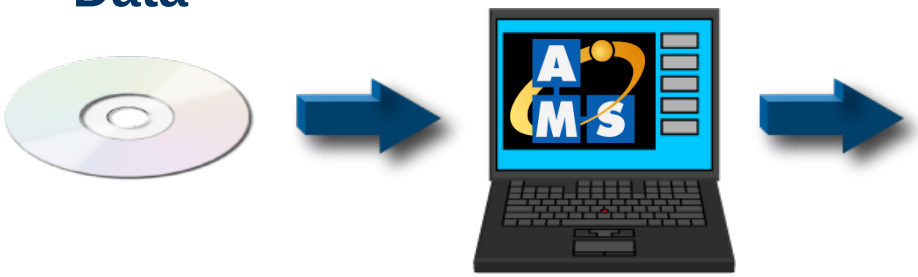
I – V Test

Conventional and Advanced Predictive Maintenance Technologies



Plant Implementation of On-Line Calibration Monitoring

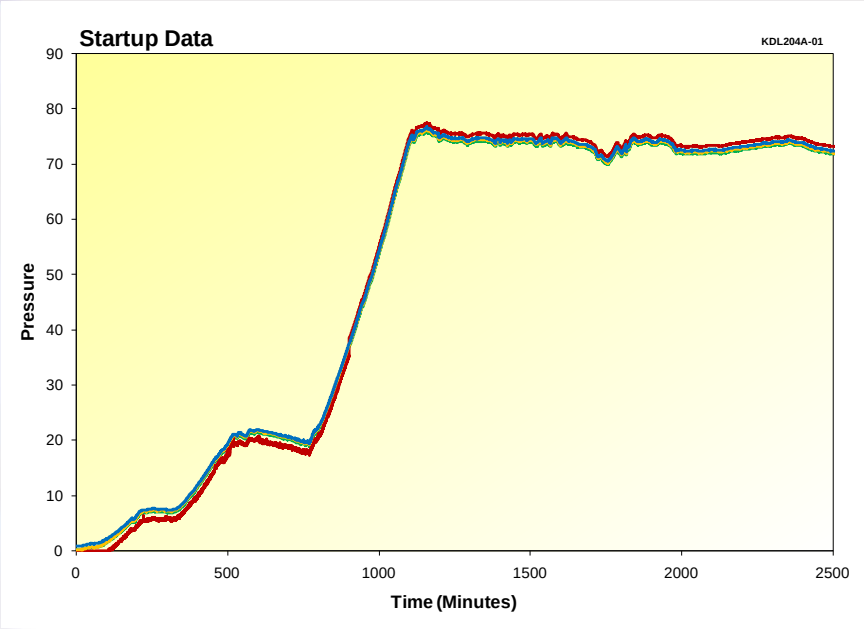
Plant Computer Data

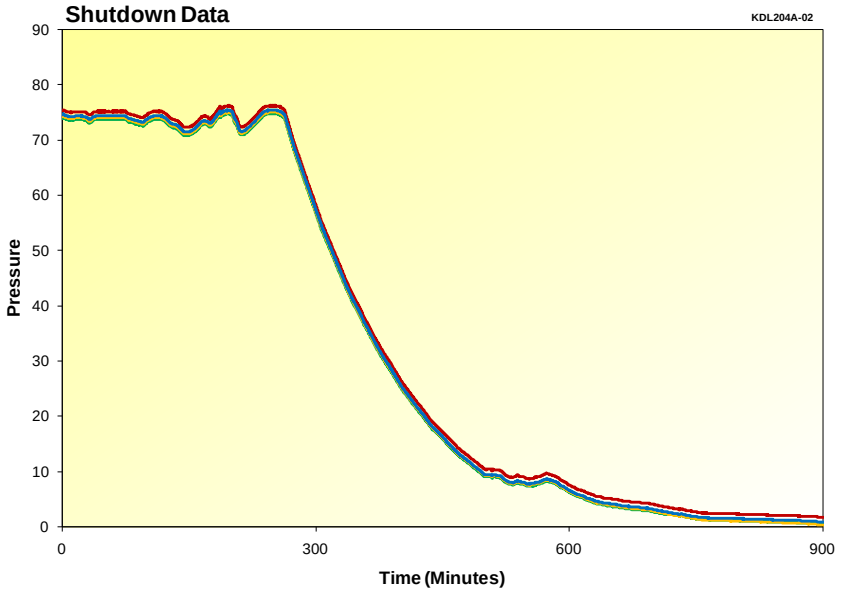


Status of Plant Instrumentation

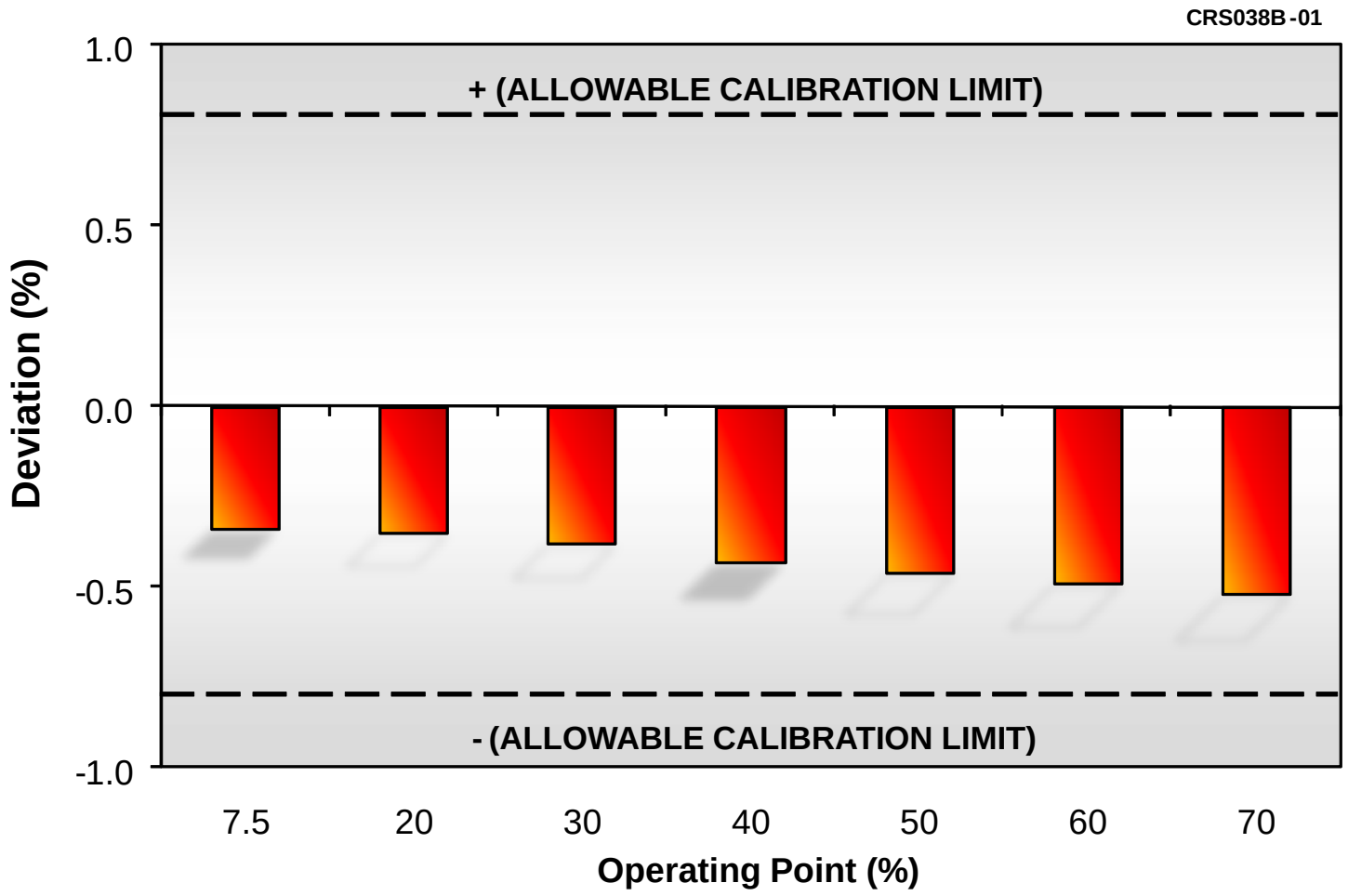
Item #	Tag	Group	Online Monitoring Result
1	1AB-P-0513-W	MAIN STEAM PRESSURE LOOP 1	Good
2	1AB-P-0525-W	MAIN STEAM PRESSURE LOOP 2	Good
3	1AB-P-0536-W	MAIN STEAM PRESSURE LOOP 3	Good
4	1AB-P-0544-W	MAIN STEAM PRESSURE LOOP 4	Good
5	1AE-L-0501-W	STEAM GENERATOR A LEVEL WR	Good
6	1AE-L-0505-W	STEAM GENERATOR A LEVEL WR	Good
7	1AE-L-0502-W	STEAM GENERATOR B LEVEL WR	Good
8	1AE-L-0506-W	STEAM GENERATOR B LEVEL WR	Good
9	1AE-L-0503-W	STEAM GENERATOR C LEVEL WR	Good
10	1AE-L-0507-W	STEAM GENERATOR C LEVEL WR	Good
11	1AE-L-0504-W	STEAM GENERATOR D LEVEL WR	Good
12	1AE-L-0508-W	STEAM GENERATOR D LEVEL WR	Good
13	1BB-L-0465-W	PRESSURISER LEVEL	Bad
14	1BB-L-0466-W	PRESSURISER LEVEL	Good
15	1BB-L-0467-W	PRESSURISER LEVEL	Good
16	1BB-L-0468-W	PRESSURISER LEVEL	Good
17	1BB-P-0401-W	RCS PRESSURE WR PPS	Good
18	1BB-P-0402-W	RCS PRESSURE WR PPS	Good
19	1BB-P-0403-W	RCS PRESSURE WR PPS	Good
20	1BB-P-0404-W	RCS PRESSURE WR PPS	Bad
21	1BB-P-0455-W	PRESSURISER PRESSURE	Good
22	1BB-P-0456-W	PRESSURISER PRESSURE	Bad
23	1BB-P-0457-W	PRESSURISER PRESSURE	Good
24	1BB-P-0458-W	PRESSURISER PRESSURE	Bad
25	1AE-L-0547-W	STEAM GENERATOR D LEVEL NR	Good
26	1AE-L-0548-W	STEAM GENERATOR D LEVEL NR	Good
27	1AE-L-0549-W	STEAM GENERATOR D LEVEL NR	Good
28	1AE-L-0554-W	STEAM GENERATOR D LEVEL NR	Good

Plant Startup and Shutdown Data





On-Line Calibration Monitoring Results Covering the Full Operating Range of a Transmitter



Conclusions and Recommendations

- Do not forget the sensors, process-to-sensors interfaces, cables, connectors, and penetration
- The validity, accuracy, and fidelity of process signals depends on proper installation of sensors and flawless cables and connectors
- On-line monitoring techniques and in-situ test methods are now mature enough for ready use in nuclear power plants
- Regulators have approved the OLM concept to verify the calibration of nuclear plant pressure, level, and flow transmitters
- U.S. plants are applying for generic NRC licensing to implement OLM for online calibration monitoring of pressure, level, and for transmitters
- Research is needed to establish the uncertainty of modeling techniques for on-line calibration monitoring applications

Thank You