PROCESS TROUBLESHOOTING

TOPIC	OBJECTIVES
Overview	1. Discuss why we need to troubleshoot. • Murphy's Law 2. Brainstorm and identify things that could go wrong within a process. 3. Define proactive and reactive and give examples of each. 4. Discuss the consequences of proactive and reactive. • Safety and health • Process upset • Equipment damage • Environmental compliance issues • Downtime • Loss of production • Financial impact
Monitoring Instruments and Equipment	1. Discuss the importance of monitoring instruments and equipment as it relates to troubleshooting 2. Discuss ways monitoring instruments and equipment will aid in troubleshooting a process 3. Discuss instrument indicators when a process is operating abnormally • Process variables • Alarms • Controller output • Trends 4. Discuss equipment indicators when a process is operating abnormally • Pressures (pump suction/discharge) • Differential pressure (across filters) • Leaks • Abnormal sounds • Abnormal temperatures • Abnormal vibrations • Abnormal smells • Cavitation of a pump • Surging on a compressor, etc.
Relationships between Equipment and Instruments	1. Discuss the basic parts of a control loop and how they relay information 2. Discuss how failure of one instrument in a control loop would affect another 3. Discuss how a control loop will respond to change in set point 4. Discuss how a control loop will respond to an upset such as: • Loss of pump • Loss of instrument air • Plugged filter • Steam trap failure

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	• Fouled exchanger • Power failure 5. Discuss how instrument or equipment failure may affect systems. a. Loss of a reflux pump on a distillation column b. Level indicator on a condensate pot c. Control valve failure on a feed line to a reactor d. Loss of temperature indication on a reactor
Relationships between Systems	1. Discuss the domino effect among interrelated systems (i.e., how one system affects another) a. Product of one system is feed stock for the next b. Thermal interconnectivity (i.e., hot fluid from one system used to preheat feed to another) 2. Given a scenario, explain how a problem in one system can affect other systems: • Reformer in a refinery provides hydrogen for other processes • Reactors producing a mixture of products that need to be separated by distillation (feed composition change) • Heat from reactor product stream used in a waste heat boiler to generate steam
Troubleshooting Tools	1. Given a process scenario, use tools provided to explain how each would be used in troubleshooting a problem • Process Flow diagrams • Process & Instrument Diagrams • Material balance • Statistical Process Control charts • Historical trends • Energy balance • Lab analysis / on-stream analyzers • How instruments, equipment and systems inter-relate • Field verification • Hand-held devices such as temperature sensors, vibration monitors, etc. • Baseline information • Operating procedures/training manuals • Engineering and equipment specifications • Cause and Effect diagram a. What is it supposed to do b. What is it doing c. What would cause it to do what it is doing
Troubleshooting Steps	1. Identify and document the symptoms of a problem: • Recognize normal conditions • Recognize abnormal conditions • Collect and document applicable data • Identify potential problems and the magnitude and urgency of the problem based on the data collected

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	2. Communicate the problem • Determine what communication is needed • Discuss with team members to help troubleshoot the problem and identify the possible causes 3. Identify the most likely cause: • Eliminate causes that do not fit the data • Evaluate and prioritize remaining possible causes • Determine the most likely causes(s) 4. Collect additional data to confirm most likely cause 5. Develop a plan to take corrective action(s) based on priorities • Short-term solution (compensating action to keep plant/unit running) • Intermediate term solution (temporary action to prevent extended downtime) • Long-term solution (action to eliminate problem(s)) 6. Document incident • Upset • Troubleshooting steps • Corrective action(s) • Cause
Troubleshooting Exercises or Scenarios (Guidelines)	1. Apply troubleshooting steps to an everyday problem (for example, car engine failure, washing machine runs over, car brake failure, remote for VCR fails, etc.) 2. Given a scenario, preferably that reflects an industry within your area, use troubleshooting steps to identify symptom(s), identify cause(s) and develop corrective action(s) for a process upset. Note to Instructor: The following list suggests potential problems. a) Equipment problems • Pump cavitation • Filter plugging • Loss of heat transfer • Tube failure • Agitator failure • Power failure to equipment • Coupling failure • Loss of cooling • Etc. b) Instrument problems • Loss of instrument air • Plugged air filter

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	• Wet instrument air supply • Computer failure • Loss of power to transmitter • Calibration problems with transmitter • Break in thermocouple • Short in thermocouple • Incorrect valve position • I/P calibration and/or failure • Blocked in transmitter • Etc. c) Process problems • Composition change • Contamination • Inhibitor present or absent • Change in feed ratio • Bad or spent catalyst • Loss of feed • Weather-related changes • Incorrect valve alignment • Etc.