

INTRODUCTION TO PROCESS TECHNOLOGY OBJECTIVES

Session	Topic	Objective(s)
1	Course Overview	<ol style="list-style-type: none"> 1. Describe successful course performance, including: <ul style="list-style-type: none"> • Attendance • Homework (projects and papers) • Class participation • Evaluation (method and scoring) 2. Describe the following components (aspects) of the PTAC Program: <ul style="list-style-type: none"> • Individual expectations • Program purpose • Program value • Industry involvement
2	History of the Process Industry	<ol style="list-style-type: none"> 1. Explain the growth and development of the Process Industry. 2. Report the impact of the industry on: <ul style="list-style-type: none"> • The community • Other industries • The environment • The economy 3. Identify industry responses to current issues and trends such as: <ul style="list-style-type: none"> • Global competition • Safety and environmental regulations • Technology advancements 4. Explain and describe the responsibility of the following regulatory agencies: <ul style="list-style-type: none"> • EPA • OSHA • DOT • NRC 5. Define and use (application) new terms or phrases presented in this session
3	Your Career as a Process Technician	<ol style="list-style-type: none"> 1. Describe the roles, responsibilities, and expectations of the Process Technician: <ul style="list-style-type: none"> • Work environment (all weather, drug and alcohol free, team-structured, constantly changing and 24 hours per day operations). • Employer expectations. • Equipment and process operations, maintenance and control. • Physical requirements (lifting, pulling, climbing, etc.). 2. Describe the impact of shift work on: <ul style="list-style-type: none"> • Individual (Health and Safety). • Family relationships. 3. Describe changes and future trends in the role of the Process Technician. 4. List the factors responsible for future role changes of the Process Technician. 5. Describe the difference between organized and non-organized (union and non-union) operations.

4	Working on Teams	<ol style="list-style-type: none"> 1. Describe the differences between work groups and teams. 2. Describe the different types of teams encountered in the Process Industry. 3. Identify the characteristics of a "High Performance" or an effective team. 4. Define the terms: <ul style="list-style-type: none"> • Synergy • Team Dynamics 5. Describe the steps or stages through which a team evolves (forming, storming, norming, and performing). 6. Identify factors that contribute to the failure of a team including: <ul style="list-style-type: none"> • Failure to achieve the defined outcome • Failure as a team to work together and achieve full synergy 7. Define workforce diversity and its impact on workplace relations: <ul style="list-style-type: none"> • In a team environment • Work group (coworker)
5	Basic Physics	<ol style="list-style-type: none"> 1. Define the application of physics in the petrochemical Process Industry. 2. Define matter and the states in which it exists. 3. Use physical property characteristics to describe various states of matter (liquid, gas, and solids). 4. Define and provide examples of the following terms: <ul style="list-style-type: none"> • Mass • Density • Elasticity • Viscosity • Buoyancy • Specific Gravity • Flow • Evaporation • Pressure • Velocity • Friction • Temperature • British Thermal Unit 5. Describe the three (3) methods of temperature (BTU) transfer: <ul style="list-style-type: none"> • Convection • Conduction • Radiation 6. Describe how Boyle's Law explains the relationship between pressure and volume of gases. 7. Describe how Charles' Law explains the relationship between temperature and volume of gases. 8. Describe how Dalton's Law explains the relationship between pressure and gas. 9. Describe how the General Gas Law explains the relationship between temperature, pressure, and volume of gas. 10. Describe how Bernoulli's Law explains the flow of liquids and gasses.

6	Basic Chemistry	<ol style="list-style-type: none"> 1. Define the application of chemistry in the petrochemical Process Industry. 2. Describe the relationship between molecules, atoms, protons, neutrons, and electrons. 3. Define the difference between organic and inorganic chemistry. 4. Explain the difference between chemical properties and physical properties. 5. Define and provide examples of the following terms: <ul style="list-style-type: none"> • Hydrocarbon • Boiling Point • Chemical Reaction • Acidic • Alkaline • Exothermic • Endothermic • Compounds • Mixtures • Solutions • Homogenous • Equilibrium • Catalyst 6. Describe the difference between an acid and a base (caustic). 7. Describe the method of measure for acids-bases. (what is pH?)
7	Test Review	Class workday and review. This time can be used to makeup missed material, clarify chemistry and physics issues. Use the objectives from each Session to review and check the students for learning.
8	Test #1	Administer Test: A combination of true and false, fill-in-the-blank, matching, and multiple-choice. Models and/or actual hardware should be used whenever possible to determine if learning has occurred.
9	Safety, Health, and the Environment	<ol style="list-style-type: none"> 1. Discuss the safety, health, and environmental hazards found in the Process Industry. 2. Describe the intent and application of the primary regulations impacting the Process Industry: <ul style="list-style-type: none"> • OSHA 1910.119 – Process Safety Management (PSM) • OSHA 1910.132 – Personal Protective Equipment (PPE) • OSHA 1910.1200 – Hazard Communication (HAZCOM) • OSHA 1910.120 – Hazardous Waste Operations and Emergency Response (HAZWOPER) • DOT CFR 49.173.1 – Hazardous Materials – General Requirements for Shipments and Packaging • EPA CFR 264.16 – Resource Conservation and Recovery Act (RCRA)

		<ol style="list-style-type: none"> 3. Describe the role of the Process Technician in achieving successful compliance with regulations. 4. Describe the personal attitudes and behaviors that can help to prevent workplace accidents and incidents. 5. Describe the components of the fire triangle and the fire and fire tetrahedron. 6. Identify the consequences of non-compliance with regulations: <ul style="list-style-type: none"> • Legal • Moral and Ethical • Safety, Health, and Environmental 7. Explain the managerial and engineering controls used in the industry to minimize hazards and maximize worker and system protection in the workplace. 8. Describe (demonstrate, if possible) the correct use of personal protective equipment (PPE). 9. Describe the intent of the OSHA – Voluntary Protection Program (VPP). 10. Describe the application of the International Organization of Standards (ISO)-14000 as it relates to the petrochemical and petroleum industry.
10	Principles of Quality	<ol style="list-style-type: none"> 1. Identify responses in the Process Industry to quality issues. 2. Describe the role each of the following played in quality implementation: <ul style="list-style-type: none"> • W.E. Deming • Joseph Juran • Philip Crosby 3. Describe the four (4) components of Total Quality Management (TQM) and how it is applied in today's workplace. 4. Describe the application of the International Organization of Standardization, ISO-9000 series, as it relates to the petrochemical and petroleum industry. 5. Describe the use of Statistical Process Control (SPC) in the workplace. 6. Describe the roles and responsibilities of the Process Technician in supporting quality improvement within the workplace.
11	Piping and Valves	<ol style="list-style-type: none"> 1. Describe the purpose or function of piping and valves in the Process Industry. 2. Identify the different materials used to manufacture piping and valve components: <ul style="list-style-type: none"> • Carbon Steel • Stainless Steel • Iron • Plastic • Exotic Metals Identify the different types of piping and valve connecting methods: <ul style="list-style-type: none"> • Screwed • Flanged • Welded • Glued or bonded 3. Identify the different types of pipe fittings used in the industry and their application: <ul style="list-style-type: none"> • Coupling • Elbow

		<ul style="list-style-type: none"> • Tee • Cross • Union • Nipple • Bushing • Plug • Cap <p>4. Identify the different types of valves used in the industry and there application:</p> <ul style="list-style-type: none"> • Ball • Butterfly • Check • Diaphragm • Gate • Globe • Plug • Relief <p>5. Discuss the hazards associated with the improper operation of a valve:</p> <p>6. Individual</p> <p>7. Equipment</p> <p>8. Describe the monitoring and maintenance activities associated with piping and valves:</p> <p>Look</p> <ul style="list-style-type: none"> • Inspect for connection leaks • Inspect for wear from corrosion or erosion • Check for loose valve parts • Identify the symbols used to represent the different types of piping and valve components presented in this session <p>Do</p> <ul style="list-style-type: none"> • Grease and lubricate • Adjust packing • Labeling
12	Tanks, Drums, and Vessels	<p>1. Describe the purpose or function of tanks, drums, and vessels in the Process Industry.</p> <p>2. Explain the relationship of pressure to the vessel shape and wall thickness.</p> <p>3. Describe the purpose of dikes, firewalls and containment walls around tanks, drums, and vessels.</p> <p>4. Define and provide examples of the following terms as they relate to tanks, drums, and vessels:</p> <ul style="list-style-type: none"> • Floating Roof • Sphere • Blanket • Vapor Recovery • Foam Chamber • Vortex Breaker • Sump (Possum Belly) • Baffle • Mixer

		<ul style="list-style-type: none"> • Weir • Gauge Hatch • Boot • Manway <p>5. Describe the monitoring and maintenance activities associated with tank farm operations:</p> <ul style="list-style-type: none"> • (Listen) Inspect for abnormal noise • (Touch) Inspect for abnormal heat on vessels and piping • (Look) Monitor levels • (look) Check firewalls and sumps • (Feel) Check for excessive vibration-pumps/mixers • (Smell) Awareness of abnormal odors-leaks <p>6. Identify the symbols used to represent the different types of tanks, drums, and vessels presented in this session.</p> <p>7. Identify and describe the various types of reactors and their purpose.</p> <p>8. Identify and describe the various types of reactor and their purpose.</p>
13	Pumps	<p>1. Describe the purpose or function of pumps in the Process Industry.</p> <p>2. Explain the difference between the two common types of pumps used in the Process Industry:</p> <ul style="list-style-type: none"> • Centrifugal (horizontal and vertical) • Positive displacement (rotary and reciprocating) <p>3. Identify the primary parts of a typical centrifugal pump:</p> <ul style="list-style-type: none"> • Casing • Shaft • Impeller • Suction eye • Discharge/Volute <p>4. Describe the operations of a centrifugal pump.</p> <p>5. Explain the difference between the rotary and reciprocating type of positive displacement pumps.</p> <p>6. Identify the primary parts of a typical reciprocating type positive displacement pump:</p> <ul style="list-style-type: none"> • Casing • Pistons • Connecting rods • Crank shaft • Valves (inlet and outlet) <p>7. Describe the operations of a positive displacement pump.</p> <p>8. Discuss the hazards associated with the improper operation of both the positive displacement and centrifugal pump:</p> <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment <p>9. Describe the monitoring and maintenance activities associated with pumps:</p> <ul style="list-style-type: none"> • (Listen) Inspect for abnormal noise • (Touch) Inspect for excessive heat • (Look) Check oil levels • (Look) Check for Leaks at seals and flanges

		<ul style="list-style-type: none"> • (Feel) Check for excessive vibration <p>10. Identify the symbols used to represent the different types of pumps presented in this session.</p>
14	Compressors	<ol style="list-style-type: none"> 1. Describe the purpose or function of compressors in the petrochemical Process Industry. 2. Explain the difference between a pump and compressor in terms of what function each performs. 3. Explain the difference between the two (2) more common types of compressors used in the Process Industry: <ul style="list-style-type: none"> • Centrifugal (Dynamic) • Positive Displacement (rotary and reciprocating) 4. Identify the primary parts of a typical centrifugal compressor: <ul style="list-style-type: none"> • Casing • Shaft • Impeller • Suction • Discharge 5. Describe the operations of the centrifugal compressor. 6. Explain the difference between the rotary and reciprocating type of positive displacement compressors. 7. Identify the primary parts of a typical reciprocating type positive displacement compressor. <ul style="list-style-type: none"> • Casing • Pistons • Connecting rods • Crank shaft • Valves (inlet and outlet) 8. Describe the operations of a positive displacement compressor. 9. Discuss the hazards associated with the improper operation of both the positive displacement and centrifugal compressor: <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment 10. Describe the monitoring and maintenance activities associated with compressors: <ul style="list-style-type: none"> • Look: Check oil levels, check for leaks at seals and flanges • Listen: Inspect for abnormal noise • Touch: Inspect for excessive heat and vibration 11. Identify the symbols used to represent the different types of compressors presented in this session.
15	Test Review	Class workday and review. This time can be used to makeup missed material, clarify chemistry and physics issues. Use the objectives from each Session to review and check the students for learning.
16	Test #2	Administer Test: A combination of true and false, fill-in-the-blank, matching, and multiple-choice. Models and/or actual hardware should be used whenever possible to determine if learning has occurred.

17	Steam Turbines	<ol style="list-style-type: none"> 1. Describe the purpose or function of steam turbines in the Process Industry. 2. Identify the primary parts of a typical (non-condensing) steam turbine: <ul style="list-style-type: none"> • Casing • Shaft • Moving and fixed blades • Governor • Nozzle • Inlet • Outlet (Discharge) • Trip and Throttle Valve 3. Describe how a steam turbine operates. 4. Discuss the hazards associated with the improper operation of a steam turbine: <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment 5. Describe the monitoring and maintenance activities associated with a steam turbine: <ul style="list-style-type: none"> • Look <ul style="list-style-type: none"> – Check oil levels-lubrication – Check bearings – Check for leaks at seals and flanges • Listen for abnormal noise • Touch - Check for excessive vibration 6. Identify the symbols used to represent the steam turbine and associated equipment presented in this session.
18	Electricity and Motors	<ol style="list-style-type: none"> 1. Explain the difference between AC and DC current. 2. Identify what current (AC or DC) is most commonly used in the Processing Industry. 3. Describe the purpose or function of the electric motor in the Process Industry. 4. Identify the primary parts of a typical electric motor: <ul style="list-style-type: none"> • Frame • Shroud • Stator • Rotor • Fan • Bearings • Lubrication System 5. Discuss the hazards associated with the improper inspection and operation of an AC motor: <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment 6. Describe the monitoring and maintenance activities associated with an electric motor: Look

		<ul style="list-style-type: none"> • Check grease fitting-lubrication • Check for loose covers and shrouds <p>Listen for abnormal noise</p> <p>Feel</p> <ul style="list-style-type: none"> • Check for excessive heat • Check for excessive vibration <p>7. Identify the symbols used to represent electric motors and associated equipment presented in this session.</p>
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19	Heat Exchangers (Part 1)	<ol style="list-style-type: none"> 1. Describe the purpose or function of heat exchangers in the Process Industry. 2. Recall the three (3) methods of temperature (BTU) transfer: <ul style="list-style-type: none"> • Convection • Conduction • Radiation 3. Identify the primary parts of a typical tube and shell exchanger: <ul style="list-style-type: none"> • Tube inlet and outlet • Shell inlet and outlet • Tube sheet • Baffle • Exchanger head (channel type) • Tube bundle 4. Describe the operations of a typical tube and shell exchanger. 5. Describe the different applications of a typical tube and shell exchanger: <ul style="list-style-type: none"> • Reboiler (forced feed and thermosiphon) • Heater/preheater • Aftercooler • Condenser • Chiller • Interchanger 6. Discuss the hazards associated with the improper operation of a heat exchanger: <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment 7. Describe the monitoring and maintenance activities associated with a heat exchanger: <p>Look</p> <ul style="list-style-type: none"> • Check for external leaks – head, flanges, and bleeders • Check for internal tube leaks – sample results • Check for abnormal pressure drop • Check for temperature drop – fouling <p>Listen – Inspect for abnormal noise</p> <p>Touch – Check for excessive vibration</p> 8. Identify the symbols used to represent the heat exchanger and associated equipment presented in this session.
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20	Heat Exchangers (Part 2) Cooling Towers and Fin Fans	<ol style="list-style-type: none"> 1. Describe the purpose or function of a cooling tower in the Process Industry. 2. Describe the relationship between a fin fan exchanger and a cooling tower. 3. Identify the primary parts and support systems of a typical cooling tower: <ul style="list-style-type: none"> • Basin • Suction screens • Makeup (water) • Blowdown • Water distribution (header and cells) • Fill • Drift eliminators • Fan with chimney or stack • Chemical treatment 4. Describe the operation of a cooling tower. 5. Describe the different applications or use of water from a cooling tower: <ul style="list-style-type: none"> • Process condensers • Lubricating system coolers (Rotating Equipment) 6. Describe the similarity of a typical fin fan exchanger to a cooling tower. 7. Discuss the hazards associated with the improper operation of a cooling tower: <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment 8. Describe the monitoring and maintenance activities associated with a cooling tower: <p>Look</p> <ul style="list-style-type: none"> • Balanced water distribution • Screen plugging • Chemical balance (pH and hardness) • Check temperature differential <p>Listen – Inspect for abnormal noise (fans and pumps)</p> <p>Feel – Check for excessive vibration (fans and pumps)</p> 9. Identify the symbols used to represent cooling towers and fin fans, and associated equipment presented in this session.
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21	Furnaces	<ol style="list-style-type: none">1. Describe the purpose or function of a furnace in the Process Industry:<ul style="list-style-type: none">• Crude oil distillation• Catalytic cracking• Catalytic reforming• Superheating steam• Reactors• Olefins• Hydrocracking2. Describe the operation of a furnace:<ul style="list-style-type: none">• How a furnace works3. Describe the types of fuel used in a furnace:<ul style="list-style-type: none">• Natural gas• Fuel oil• Process oil• Process gas• Fuel gas4. Identify the primary parts of a typical furnace:<ul style="list-style-type: none">• Radiant tubes• Stack• Damper• Air register• Burner (gas or oil)• Pilot• Convection section• Economizer section• Draft gauges• Furnace purge (snuffing steam or nitrogen)5. Describe the different types of furnaces by draft:<ul style="list-style-type: none">• Natural draft• Forced draft• Induced draft• Balanced draft6. Describe the different furnace designs:<ul style="list-style-type: none">• Cylindrical• Cabin• A-Frame7. Describe the monitoring and maintenance activities associated with a furnace.8. Discuss the hazards associated with the improper operation of a furnace:<ul style="list-style-type: none">• Individual• Equipment• Protection• Environment
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22**Boilers**

1. Describe the fundamental principles of boiler operation.
2. Describe the operation of boilers in the Process Industry:
 - Drivers
 - Distillation columns
 - Heat exchangers
 - Reactors
 - Extruders
3. Identify the primary parts and support systems of a typical fuel-fired boiler:
 - Firebox
 - Stack
 - Damper
 - Air register
 - Burner (gas or oil)
 - Raw gas burners
 - Pre-mix burners
 - Combination burners
 - Pilot
 - Downcomer
4. Identify the primary parts and support systems of a typical fuel-fired boiler (continued):
 - Fuel gas valve
 - Riser
 - Radiant tubes (water tubes)
 - Superheated steam
 - Draft gauges
 - Boiler purge (air)
 - Describe the types of fuel used in a boiler:
 - Natural gas
 - Fuel oil
 - Fuel gas
 - Process oil
 - Process gas
5. Describe the different types of boilers by draft:
 - Natural draft
 - Forced draft
 - Induced draft
 - Balanced draft
6. Describe the difference in fire tube and water tube boilers.
7. Describe the monitoring and maintenance activities associated with operating boilers:
 - Look
 - Listen
 - Feel
8. Discuss the hazards associated with the improper operation of a boiler:
 - Individual
 - Equipment
 - Production
 - Environment

23	Test Review	Class workday and review. This time can be used to makeup missed material, clarify chemistry and physics issues. Use the objectives from each Session to review and check the students for learning.
24	Test #3	Administer Test: A combination of true and false, fill-in-the-blank, matching, and multiple-choice. Models and/or actual hardware should be used whenever possible to determine if learning has occurred.
25	Distillation	<ol style="list-style-type: none"> 1. Describe the purpose or function of a distillation column or tower in the Process Industry. 2. Describe the importance of knowing the properties of a chemical when performing distillation. 3. Identify the primary parts and support systems of a typical tray-type distillation column: <ul style="list-style-type: none"> • Tower • Trays (Downcomers, Weirs, and Risers) • Feed Tray • Condenser (Overhead) • Reflux • Stripping Section (Refinery) • Reboiler • Rectifying or Fractionating section (Refining) • Tower Bottoms and Overhead 4. Describe the distillation process. 5. Describe the use of packing as it pertains to distillation. 6. Discuss the hazards associated with the improper operation of a distillation column: <ul style="list-style-type: none"> • Individual • Equipment • Production • Environment 7. Describe the monitoring and maintenance activities associated with distillation column operations: <ul style="list-style-type: none"> • (Listen) Inspect for abnormal noise (pumps and reboilers) • (Look) Check for leaks • (Look) Check samples for separation • (Look) Check temperature and pressure differentials 8. Identify the symbols used with distillation columns and associated equipment presented in this session.

26	Process Control Instrumentation	<ol style="list-style-type: none"> 1. Describe the purpose or function of process control instrumentation in the Process Industry. 2. Describe the major types of process control instrumentation: <ul style="list-style-type: none"> • Electronic • Pneumatic • Digital • Analog 3. Define a generic control loop and provide an example. 4. Identify four key variables which are controlled by process control instrumentation: <ul style="list-style-type: none"> • Temperature • Pressure • Level • Flow 5. Identify typical process control instruments, their applications and functions: <ul style="list-style-type: none"> • Transmitter • Recorder • Controller • Transducer • Control valve • Thermocouples • Alarms • Actuators • Sensor • Positioner • Signal control element 6. Describe distributive control systems and how they are applied in the Process Industry. 7. Discuss the hazards associated with process control instruments. 8. Describe the monitoring and maintenance activities associated with process control instrumentation. 9. Identify symbols used to represent process control instruments.
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27	Process Utilities	<ol style="list-style-type: none"> 1. Discuss the different types of process utilities and their applications: <ul style="list-style-type: none"> • Boiler feed water • Drinking water • Cooling water • Fire water • Service water • Treated water • Potable water • Waste water <ul style="list-style-type: none"> – Sewer water – Storm water – Oily water • Condensate • Plant and instrument air
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		<ul style="list-style-type: none"> • Nitrogen • Process water • Sour water <p>2. Describe the different types of equipment associated with each of the utility systems found in the Process Industry:</p> <ul style="list-style-type: none"> • Pumps • Tanks • Distribution <p>3. Discuss the different types of waste water systems and their applications in process:</p> <ul style="list-style-type: none"> • Sewer water • Storm water • Process waste water
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28	Process Auxiliaries	<p>1. Describe the purpose or function of the different process auxiliary systems and their applications:</p> <ul style="list-style-type: none"> • Flare systems • Refrigeration systems • Lubrication systems • Hot oil systems • Steam <p>2. Discuss the equipment associated with flare systems found in the Process Industry:</p> <p>3. Discuss the parts associated with refrigeration systems found in the Process Industry:</p> <ul style="list-style-type: none"> • Refrigerant • Condenser • Compressor • Evaporator • Expansion <p>4. Discuss the parts associated with lubrication systems found in the Process Industry:</p> <ul style="list-style-type: none"> • Lube oil reservoir tanks • Coolers • Filters <p>5. Discuss the parts associated with hot oil systems found in the Process Industry:</p> <ul style="list-style-type: none"> • Storage tanks • Pumps • Furnaces • Exchangers • Reboilers
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29	Process Print Reading	<ol style="list-style-type: none"> 1. Describe the purpose or function of process systems drawings. 2. Identify the common components and information within process systems drawings. 3. Identify the different drawing types and their uses: <ul style="list-style-type: none"> • Block Flow Drawings • Process Flow Drawings (PFD) • Piping and Instrument Drawings (P&ID) • Utility Flow Drawings (UFD) • Electrical Drawings <ul style="list-style-type: none"> – Wiring Diagrams – Schematics • Isometrics 4. Identify the different components and their symbols in each type of drawing: <ul style="list-style-type: none"> • Block Flow Drawings • Process Flow Drawings (PFD) • Piping and Instrument Drawings (P&ID) • Utility Flow Drawings (UFD) • Electrical Drawings • Isometrics
30	Process Facility Tour	<p>This session has been allocated for a plant tour. This activity will require planning and scheduling. If a facility is not available for entry the instructor should take the students to a public area with a clear view of a facility. This activity is intended to establish relationship between content in the course and actual equipment and processes. Consider the following:</p> <ol style="list-style-type: none"> 1. Transportation 2. Permits for access to the facility 3. Tour Guide 4. Proper clothing <p>Behavior guidelines such as: Not touching equipment, controls and materials. Stay as a group. Etc.</p>
31	Test Review	<p>Class workday and review. This time can be used to makeup missed material, clarify chemistry and physics issues. Use the objectives from each Session to review and check the students for learning.</p>
32	Test #4	<p>Administer Test: A combination of true and false, fill-in-the-blank, matching, and multiple-choice. Models and/or actual hardware should be used whenever possible to determine if learning has occurred.</p>