Fundamentals of Liquids Curriculum
(2.5 Days)

I. The Purpose of Measurement
   A. Inventory Control / Loss Management
   B. Historical Perspective

II. Physical Properties and Quality
   A. Physical Properties
      1. Molecular Structure
         a) Saturated and Unsaturated Hydrocarbons
         b) Cracked Hydrocarbons
      2. Undesirables
   B. Analytical Tests
      1. Boiling Point
      2. Freezing Point
      3. RVP
      4. Equilibrium Vapor Pressure
      5. Density
      6. Viscosity
         a) Newtonian Fluids and Non-Newtonian Fluids
         b) Resistance to Deformation and Angular Shear
      7. Other
   C. Component Distribution (Mole%, Volume%, Weight%)
      1. Example Calculations
      2. Shrinkage and the impact on Volumetric Accuracy
   D. Chromatography
      1. Basic Structure
      2. Types of Detection
III. Dynamic Measurement
   A. General
      1. Volume / Mass
      2. Inferential / Direct
   B. Meters
      1. Direct Measurement
         a) Mass (Coriolis)
         b) Positive Displacement
      2. Inferential Measurement
         a) Orifice
         b) Turbine
         c) Ultrasonic
      3. Flow Conditioning
      4. General Installation Guidelines
         a) Inference Meters
         b) PD Meters
         c) Mass Meters (Coriolis)

IV. Performance Verification
   A. Density Prover Certification
      1. Water Fill Method
      2. Calculations
      3. Demonstration of Calibration
      4. Recalibration Frequency
   B. Meter Prover Certification
      1. Water Draw Method
      2. Water Fill Method
      3. Calculations
      4. Field Exercise?
      5. Recalibration Frequency
V. Operations
   A. Density
      1. Densitometer Types
      2. Field Calculations
   B. Meter Provers
      1. Types
         a) Volumetric
         b) Gravimetric
         c) Pipe Provers
            (1) Bidirectional
            (2) Unidirectional
            (3) Small Volume utilizing Pulse Interpolation
      2. Master Meters
   C. Volume and Mass Proving Operations
      1. Calculations
      2. Safety

VI. Measurement Systems Design Overview
   A. Component Layout
      1. Meters
      2. Densitometers
      3. Provers
      4. Samplers
      5. Valves
      6. Strainers
      7. Gas Chromatographs
VII. Static Measurement
A. General
   1. Volume / Mass
   2. Inferred / Direct
B. Inferred
   1. Properties to be determined
      a) Level
      b) Temperature
      c) Pressure
      d) Density
   2. Level (of Tanks)
      a) Upright Cylinder
      b) Spheres
      c) Bullets
      d) Rail
      e) Ship/Barge
      f) Truck
   3. Calculations