

# ADVANCED PRODUCTION LOGGING

## Advanced Production and Through Casing Logging For Reservoir Monitoring

18 - 22 July 2011, Kuala Lumpur, Malaysia – **REVISED CONTENT!**



### Your Expert Trainer: Dr James Smolen

Internationally recognized expert in cased hole logging with more than 30 years of oil industry experience in well logging, related research, and training with 10 years in design, development, and testing of new cased hole equipment at Schlumberger. Clients include *Amoco, BP, Chevron, Conoco Phillips, Mobil, AGIP/ENI, Anadarko, Oxy, ONGC, ESSO Australia, Schlumberger, Baker Hughes (Atlas), Halliburton, Weatherford, and many others.*



James is the author of **Cased Hole and Production Log Evaluation by Penn Well Publications**. He also authored more than a dozen technical publications on these subjects and in 1988 he was a Distinguished Lecturer for SPE and SPWLA.



## 5 Day Course Outline

### Advanced Production and Through Casing Logging For Reservoir Monitoring

The following agenda is based on three morning and three afternoon sessions daily, each session approximately one to 1-1/4 hours in length. These sessions are labeled **M1**, **M2**, **M3**, and **A1**, **A2**, and **A3** respectively. Note that class problems (**PROBLEMS**) and movies (**MOVIES**) have been highlighted. Numerous log examples for class discussion are also presented throughout the course.

#### DAY 1

- M1**
- Introduction to advanced production evaluation logging
    - Formation evaluation through casing
    - Flow zonal contributions to production with a PLT
  - Integration of formation evaluation, cement and casing inspection, and the production for enhanced reservoir management.
    - A look at the downhole environment (**MOVIE**)
- M2**
- Gamma Ray (GR) Logging
    - Open hole/cased hole correlation
    - Shale response and shale volume determination (**PROBLEM**)
    - Other applications
- M3**
- Pulsed Neutron Capture (PNC) Logs
    - Principles of neutron energy, gamma ray emissions, and capture
    - Basic formation model—Classic Model
    - Ideal Sigma log response (**PROBLEM**)
- A1**
- Pulsed Neutron Capture Logs (**Continued**)
    - Porosity and salinity limitations for sigma (**PROBLEM**)
  - Determination of bulk formation capture cross section by logging tools
    - Exponential decay of neutron population
    - Measurement of decay rate and sigma
- A2**
- Development of the capture technique and log presentation
    - Major service company equipment development
    - Primary and secondary log measurements
    - Discrimination of borehole from formation environment
    - Effects of different BH fluids
    - Fluid for best formation measurements
- A3**
- Computation of saturations--clean and shaley zones (**PROBLEM**)
    - Dual water model overview
    - Miscellaneous applications of PNC tools
    - Residual Oil Saturation, ROS, by log-inject-log technique

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### DAY 2

- M1**
- Using X-Plots for determining water saturation from sigma (**PROBLEM**)
    - Matrix-water-hydrocarbon X-Plots
    - Compensation for Shaley zones
- M2**
- Detection of Water Flow by Oxygen Activation using PNC tools
    - Waer movement from stabilized background count rate
    - Water Movement Specific tools/measurements
    - Atlas Hydrolog and Halliburton TMD-L
    - Schlumberger Water Flow Log, WFL (**PROBLEM**)
- M3**
- Carbon-Oxygen Measurements
    - Used when salinities are low or unknown
    - Sources of carbon and oxygen counts downhole
    - Inelastic and capture data and log runs
    - Windows vs. Elemental Yields Techniques
- A1**
- Carbon-Oxygen Measurements (**continued**)
    - Log presentations (BV, ratios, Ca/Si-C/O overlay, C/O envelope)
    - Setting up C/O envelope from Open Hole information
      - Clean zones (**PROBLEM**)
      - Shaley zones (**PROBLEM**)
- A2**
- New tools (RST, RPM, RMT)
    - Determination of saturation and holdup for the RST (**PROBLEM**)
  - Specialized PNC/PNS applications
    - WOC location through a sand screen or gravel pack
    - Problems with Sigma evaluation through tubing and casing
    - Effects of Shut-in on invasion and saturation evaluation
    - Detection of acid placement
    - Baker Atlas "Gas View", an enhanced technique for gas detection
- A3**
- PNC/PNS job planning program and preparation
    - Downhole temperature, pressure
    - Conveyance and logging speed
    - Borehole fluid
    - Borehole configuration, size, caliper (open hole)/depth of investigation
    - Shut-in or Flowing
    - Porosity, Shaleyiness

### DAY 3

- M1**
- Through-Casing Resistivity
    - Tool Theory
    - Stationary measurements
    - Effects of anomalies, normalization, and cement
  - Formation Testing Through Casing
    - Testing using perforations
    - Plugging holes after testing (CHDT)
- M2**
- Continuously Run Spinner Flowmeters in Vertical Wells
    - Types of Spinners
    - Log data required to be recorded
  - Spinner response under ideal conditions
    - Effects of viscosity and mechanical threshold
    - Detection of bulk fluid movement using spinners

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- M3
  - Interpretation of Spinner Logs for Bulk Production Profile
    - Multipass plot technique (**PROBLEM**)
    - Interpretation when only down runs are available
  
- A1
  - Two pass overlay technique (**PROBLEM**)
    - Flow profile correction factor
    - Compute bulk production profile (**PROBLEM**)
  
- A2
  - Fluid Identification Devices for Multiphase Flow
    - Holdup vs. cut
    - Bulk fluid density
      - Pressure differential tools (Gradiomanometer)
      - Nuclear fluid density, focused and unfocused
      - Capacitance devices
    - Bubble probes (DEFT/Flowview, GHOST, CAT, RAT)
    - Gas Holdup Tool --GHT
    - Other (PNC borehole sigma, borehole C/O, etc.)
      - Slip velocity between the flowing phases

- A3
  - Computation of Two Phase Flow in a Well (**PROBLEM**)

#### DAY 4

- M1
  - Productivity Index, Inflow Performance, Zonal Production
    - Radial flow into a wellbore
      - Effects of pressure drawdown
      - Productivity Index, PI
    - Inflow Performance Relationship (**IPR**)
    - Linear IPR
    - Vogel relationship
  
- M2
  - Determining zonal IPRs using flowmeter and pressure data (**PROBLEM**)
    - Predicting zonal performance at different well flow rates
  
- M3
  - Requirements to solve for three phase flow
  - Multiphase flow in deviated wells
    - Marathon study (Liquid-Liquid) (**MOVIE**)
    - Atlas Flow Loop (Gas- Liquid) (**MOVIE**)
  - Tools to deal with the deviated multiphase flow environment
  - The problem of large diameter casing with low multiphase flow
  
- A1
  - High Deviation Angle and Horizontal Multiphase Flow
  - Visualization of horizontal flow
    - Schlumberger Cambridge Research Center Video (**MOVIE**)
    - Schlumberger Flagship Tool String
      - Dual DEFT (Flowview Plus)/GHOST-Gas Holdup
      - Non-radioactive gadolinium based tracers for stratified flow
    - Baker Atlas POLARIS Tool String and Atlas Flow Loop (**MOVIE**)
      - Pulsed Neutron Holdup Indicator (PNHI/RPM)
      - MultiCapacitance FlowMeter (MCFM)
  
- A2
  - Schlumberger Flow Scan Imager—(FSI) (**PROBLEM**)
    - Sondex/Halliburton horizontal flow tools (MAPS)
      - Spinner Array Tool (SAT)
      - Capacitance Array Tool (CAT), Resistance Array Tool (RAT)

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- A3
- Conveying tools in the horizontal/highly deviated environment
    - Pump down
    - Coiled Tubing
    - Tractors
- DAY 5
- M1
- Temperature Logging
    - Causes of temperature anomalies
  - Temperature logs in producing wells
    - Liquid entries
    - Gas entries
    - Detection of channels
  - Quantitative temperature log evaluation (**PROBLEM**)
  - Temperature logs in injection wells
    - Special applications--measure induced fracture height and acid placement
- M2
- Noise Logs
  - Stationary noise measurements of noise and frequency
    - Log presentation
    - Determination of single or two phase flow
    - Location of gas-liquid interfaced in the wellbore
    - Detection of moving fluid in channels
    - Review combination noise-temperature surveys
  - Radioactive Tracer Logging
    - Tool configuration for injection well profiling
    - Radioactive materials available
    - Basic technique for location of injection zones and channels
  - Quantitative Injection Profiling
  - Area technique (**PROBLEM**)
    - Area under GR curve indicates fraction of initial flow remaining
  - Velocity Shot Technique (**PROBLEM**)
    - Selection of positions for velocity shot tests
    - Computation of volumetric flow rate
- M3
- Distributed Temperature Sensing (DTS) and Smart Well Logs
    - What DTS is and how it works--non-intrusive temperature logs
    - A few basic DTS computations (**PROBLEM**)
    - How the fiber optic line is set up in a well
    - Quality/resolution issues
- A1
- Other sensors for intelligent completions
    - Applications and examples of DTS
  - Distributed Acoustic Sensors--DAS

### Who Should Attend?

Senior and experienced reservoir and production engineers and geologists, petrophysicists, log analysts and others involved in well surveillance, maximizing recovery, identifying production problems, or planning workover operations. Participants are required to have undergone prior basic training on this subject or have had extensive work experience in related topics discussed above.

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### About Your Expert Trainer: Dr James Smolen

Internationally recognized "Guru" in cased hole logging with more than 30 years of oil industry experience in well logging, related research, and training with 10 years in design, development, and testing of new cased hole equipment at Schlumberger. Clients include Amoco, BP, Chevron, Conoco Phillips, Mobil, AGIP/ENI, Anadarko, Oxy, ONGC, ESSO Australia, Schlumberger, Baker Hughes (Atlas), Halliburton, Weatherford, and many others.

#### Education:

- B.S., Mechanical Engineering, Northwestern University, Evanston, Illinois, 1965
- M.S., Mechanical Engineering, University of California, Berkeley, 1966
- Ph.D., Mechanical Engineering, University of California, Berkeley, 1970

#### Professional Membership and Career:

- Member Society of Professional Well Log Analysts,
- SPWLA, 1972-present
- Member Society of Petroleum Engineers, SPE, 1972-present
- Professional Engineer, Texas, 1974-2005
- Distinguished Lectures for the SPWLA, 1988
- Distinguished Lecturer for the SPE, 1988

#### He also authored more than a dozen technical publications on these subjects

1. Smolen, James J. and van der Spek, Alex, "Distributed Temperature Sensing—A DTS Primer for Oil & Gas Production" Unclassified, Shell International Exploration And Production B. V., The Hague, The Netherlands, 2003.
2. Smolen, James J., and Gysen, Michel, "PLATO User Manual" Shell International Exploration and Production B.V., The Hague, The Netherlands, and Interpretive Software Products, Inc., Houston, Texas, 2000.
3. Whittaker, J.L., Golich, G.M., and Smolen, J.J., "Diagnosing Horizontal Well Production in the Belridge Field with Downhole Video and Production Logs" SPE Paper 38295, 1997 SPE Western Regional Meeting, Long Beach, June 1997.

#### Here are some current testimonials from previous delegates attending Dr. Smolen's courses:

*James's explanation is easy to understand, Provides cased hole & prod log from A to Z, Excellent and highly recommended cased hole logging course, Good course, esp trainer, Great videos!*

PETRONAS Carigali, Murphy Sarawak Oil, BG Exploration & Production, Kondur Petroleum SA and many others.

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# REGISTRATION FORM: Advanced Production Logging

<b>Advanced Production Logging - Kuala Lumpur, Malaysia</b>	<b>Early Bird Price</b>	✓	<b>Normal Price</b>	✓	<b>TEAM DISCOUNTS</b>
<b>5 days Training Course</b>	<b>SG\$ 4,699</b>		<b>SG\$ 4,899</b>		<p>PetroEdge recognises the value of learning in teams. Group bookings at the same time from the same company receive the following:</p> <p>3 or more at 5% off 5 or more at 7% off 8 or more at 10%</p> <p><b>Team discounts are exclusive of Early Bird discounts or other promotions.</b></p>

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Mr  Mrs  Ms  Dr

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Job Title: \_\_\_\_\_

Department: \_\_\_\_\_

**Delegate 2:** \_\_\_\_\_  
Mr  Mrs  Ms  Dr  Other

Telephone: \_\_\_\_\_ Email: \_\_\_\_\_

Job Title: \_\_\_\_\_

Department: \_\_\_\_\_

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