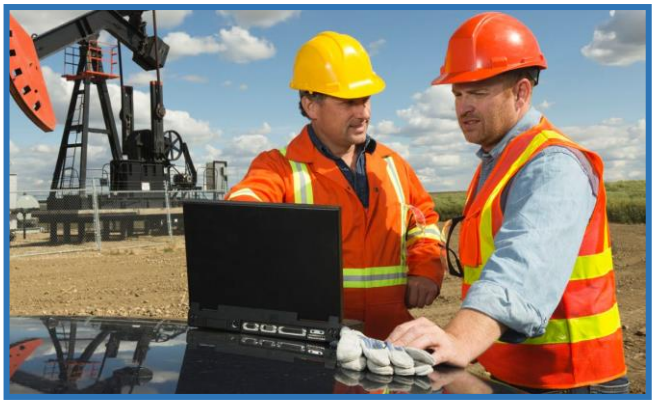
COURSE OVERVIEW DE0898
Vertical Seismic Profiles
(E-Learning Module)



Course Title
Vertical Seismic Profiles
(E-Learning Module)

Course Reference
DE0898

Course Format & Compatibility
SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration
30 online contact hours
(3.0 CEUs/30 PDHs)

Course Description

This E-Learning course is designed to provide participants with a detailed and up-to-date overview of vertical seismic profiles. It covers the seismic exploration categories and seismic signals in the borehole; the zero offset VSP basics, borehole multiples and VSP data processing flow; the different types of VSPs and Horizontal VSPs; the tube wave energy; the comparison of surface seismic, borehole environment, resonance types and its effects; the resonance attenuation and shaker response; the borehole survey types, borehole seismic history, geometry of surveys and checkshot surveys; and the vertical incident VSP, offset VSP, imaging walkaway, AVO walkaway, salt proximity survey and 3D VSP.

During this course, participants will learn the borehole seismic on wireline, pipe conveyed acquisition, through drill seismic (TDS), logging while drilling and through tubing seismic; the simultaneous acquisition and borehole seismic application; the VSP concept and acquisition practices; the VSP survey fundamentals, VSP measurement procedure and the common applications of VSP data in exploration and development; the recording of VSP data, VSP survey recording geometries, offset, walkaway, and zero-offset geometries; and the inverse VSP, drill-bit source inverse VSP, VSP receiver, geophones, transducer geometry and accelerometers.

Course Objectives

Upon the successful completion of this course, participants will be able to:-

- Apply and gain an in-depth knowledge on vertical seismic profiles
- Recognize the seismic exploration categories and seismic signals in the borehole
- Discuss zero offset VSP basics including borehole multiples and VSP data processing flow
- Identify the different types of VSPs and Horizontal VSPs as well as tube wave energy and tube waves
- Compare surface seismic, borehole environment, resonance types and its effects
- Explain resonance attenuation, shaker response, borehole survey types, borehole seismic history, geometry of surveys and checkshot surveys
- Describe the vertical incident VSP, offset VSP, imaging walkaway, AVO walkaway, salt proximity survey and 3D VSP
- Determine borehole seismic on wireline and acquire pipe conveyed as well as through drill seismic (TDS), logging while drilling and through tubing seismic
- Explain simultaneous acquisition, borehole seismic application, the VSP concept and acquisition practices
- Identify the VSP survey fundamentals, VSP measurement procedure and the common applications of VSP data in exploration and development
- Record VSP data, review VSP survey recording geometries, offset, walkaway, and zero-offset geometries
- Recognize inverse VSP, drill-bit source inverse VSP, the VSP receiver, geophones, transducer geometry and accelerometers
- Describe desirable amplitude/phase behavior, distortion-free triaxial seismic data and CSI sensor module
- Identify the general requirements of VSP receivers, locking force, depth correlator and geophone-to-formation coupling measurement
- Illustrate three-point support, downhole digitizer and telemetry system, gimbal-mounted geophones, temperature and tilt angle calibration of geophones and multi-level receiver arrays

Who Should Attend

This course provides an overview of all significant aspects and considerations of vertical seismic profile (VSP) for applied geoscientists, operations geologists and geophysicists who need an understanding of the data acquisition, principles, multiple uses and applications of borehole seismic data, including microseismic and the new fiber optics distributed seismic acquisition systems. The course is also beneficial for team leaders, supervisors, managers and those who are responsible for leading a team and interested in establishing and/or being a part of a highly productive team.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- USA International Association for Continuing Education and Training (IACET)

  Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Fee

As per proposal

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Contents

- VSPs - Vertical Seismic Profiles
- SEISMIC Exploration Categories
- Overview
- What is a VSP?
- Seismic Signals in the borehole
- Zero Offset VSP - The Basics
- Vertical Seismic Profile
- One-Way Time vs. Two Way Time
- Borehole Multiples
- VSP Data - Processing Flow
- Different Types of VSPs
- Horizontal VSPs
- Tube Wave Energy
- Tube Waves
- Surface Seismic Comparison
- Borehole Environment
- Resonance Types & Effects
- Resonance Attenuation
- Shaker Response
- Borehole Survey Types

- Borehole Seismic History
- Geometry of surveys
- Checkshot Surveys
- Zero Offset VSP
- Vertical Incident VSP
- Offset VSP
- Imaging Walkaway
- AVO Walkaway
- Salt Proximity Survey
- 3D VSP
- Borehole Seismic Deployment
- Borehole Seismic on Wireline
- Pipe Conveyed Acquisition
- Through Drill Seismic TDS
- Logging While Drilling
- Through Tubing Seismic
- Simultaneous Acquisition
- Borehole Seismic Application - VSP
- Introduction
- What is a VSP?
- The VSP Concept
- Acquisition Practices
- Why go to such trouble? What benefits can the Explorationists Achieve by Using this Technique?
- There are Several Specific Exploration Objectives for Running a VSP
- VSP Survey Fundamentals
- The VSP Measurement Procedure
- When VSP Should Be Considered
- The Following are Specific Examples of Ways We can Use VSP Data to Calibrate Seismic Data
- Common Applications of VSP Data in Exploration and Development
- We should Record VSP Data
- VSP Survey Recording Geometries
- Offset, Walkaway, And Zero-Offset Geometries
- Offset and Walkaway Geometries

- Inverse VSP
- Drill-bit Source Inverse VSP
- THE VSP Receiver
- Introduction
- Geophones
- Transducer Geometry
- Accelerometers
- Desirable Amplitude/Phase Behavior
- Distortion-Free Triaxial Seismic Data
- CSI Sensor Module
- General Requirements of VSP Receivers
- Locking Force
- Depth Correlator
- Geophone-to-Formation Coupling Measurement
- Three-Point Support
- Downhole Digitizer and Telemetry System
- Gimbal-mounted Geophones
- Temperature and Tilt Angle Calibration of Geophones
- Multi-Level Receiver Arrays
- THE VSP Source
- General Requirements of VSP Sources
- Reliability
- Repeatability
- Monitor Geophones
- Penetration
- Portability
- Bandwidth
- Cycle Time
- Noise Generation
- Environmental Considerations
- Radiation Pattern
- Safety
- Land-Based VSP Source Mechanisms
- Vibrators

- Listening Time
- Bolt Land Airgun and Weight Droppers
- Onshore Airguns
- Shear-Wave Sources
- Explosive S-wave Sources
- Mechanical S-wave Sources
- Offshore Energy Sources
- Deployment of Remote Marine Arrays
- Performance of Airgun Arrays
- VSP Recording System
- Overview
- Gain Requirements
- Analog-to-Digital Converter
- Central Processor Unit
- Source Controller
- Operating with Remote Sources
- Integration of Remote Source and Downhole Data
- PRE - Survey Modeling
- The Importance of Pre-Survey Modeling
- Dipping Reflector Models
- VSP Acquisition Practices and Concerns
- Instrument Tests
- Geophone Tap Tests
- Digital Sampling Requirements
- Recording While Going Downhole
- Acquisition Concerns Unique to VSP
- Differential Pressure Sticking
- Tube Waves
- Combating Tube Waves
- Borehole Conditions
- Resonance in Multiple Casing Strings
- Geophone Positioning by Drillpipe and Coiled Tubing
- VSP Processing Fundamentals
- Basic Principles of VSP Processing

- Wavefield Separation Techniques
- F-k Velocity Filtering
- Median Filtering
- Removal of Down going Wave Modes by Estimation and Subtraction
- Deconvolution of VSP Data
- There are Two Main Approaches to Deconvolving VSP Data
- There are Two Main Ways of Applying the Deconvolution, One-step and Two-step
- Processing Three-Component VSP Data
- Wave-Field Separation Methods for Three-Component Data
- Geometric Separation
- Parametric Inversion
- Other Types of Wave-field Separation Approaches
- Shear Wave Data Processing
- VSP Imaging
- VSPCDP Mapping
- Migration
- Summary of Imaging Approaches for VSP Data
- Comparison Between Forward and Inverse VSP Images
- VSP Applications
- VSPs - Vertical Seismic Profiles Applications
- VSPs Opportunities
- Zero Offset VSP - The Basics
- VSP Data - Processing Flow
- VSP vs Synthetic vs Section
- Different Types of VSPs
- 3D VSP - Shooting Around Platforms
- Horizontal VSPs
- Identification of Subtle Faults
- AVO VSP
- Ekofisk Gas Chimney
- VSPs while Drilling
- Cross Well Seismic/Tomography Applications
- Crosswell VSP

- Resolution Increases to a Few Feet
- Tomography
- Problems - Accuracy Expectations
- Tomographic - Model Results Not Unique
- Effect of Advancing Steam Front
- Effect of Advancing Steam Front Integrated with Stratigraphy
- Carbonate Example - better porosity is found between wells than at wells
- Interwell Reservoir Description
- Borehole Seismic Application - VSP
- Data Acquisition
- Hardware
- Water Guns
- The Downhole Sensor
- Handware for Offset Shooting
- Data Quality
- Well Site Capabilities
- Data Acquisition
- Log Phase
- Playback Phase (Seismic Quicklook)
- Vertical Seismic Profile (VSP)
- Multiple Identification and Prediction
- Primary identification and Prediction
- Optimum Seismic Mapping Frequency
- Determination of Seismic Time Delay
- Predictions Ahead of the Bit
- Estimation of Formation Dip
- Offset Surveys
- Modelling Offset Shooting