Report on HLS Asia Industrial Visit

Bachelor of Technology in Petroleum Engineering

by

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Declaration

We declare that this written submission represents our ideas in our own words, and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea / data / fact / source in our submission. We understand that any violation of the above will be cause for disciplinary action by PANDIT DEENDAYAL ENERGY UNIVERSITY.

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Approval Sheet

This report titled **"Report on HLS Asia Industrial Visit"** is recommended for the credits of Industrial Orientation.

Sign of Examiners:

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Sign of Supervisor:

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Date: __________________________

Place: __________________________

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1 Introduction

1.1 Company Profile: HLS Asia

HLS Asia Limited (HLSA), originally known as HLS India Limited, was established in 1987 as a public limited company in collaboration with Halliburton Energy Services Inc., USA. Created to provide world-class oilfield services in India, HLSA introduced advanced wireline logging and reservoir evaluation technologies to the country's growing petroleum sector. Over the years, it expanded its operational capabilities, adopted international standards, and built a strong technical workforce. The company has consistently supported both national and global E&P operators, earning a reputation for reliability, technological excellence, and professional service delivery across diverse terrains and challenging well environments.

Figure 1.1: HLS Asia Logo

Significance in Petroleum Industry:

- Provides high-quality subsurface data crucial for exploration and drilling decisions
- Enhances reservoir understanding and supports accurate field development planning
- Improves well performance and production optimization for E&P companies
- Maintains international standards in logging, safety, and service quality
- Operates reliably in challenging terrains and high-temperature/high-pressure wells
- Provides advanced Halliburton technologies to Indian operations
- Strengthens India's domestic oilfield capabilities through skilled and internationally trained engineers
- Ensures timely data delivery through advanced computing and satellite transmission
- Maintains strong HSE practices, ensuring safe and environmentally responsible operations

Main Services Offered by HLS Asia:

- Open-hole, cased-hole, and production wireline logging
- Completion and pipe-recovery logging operations
- Wireline and tubing-conveyed perforation
- High-tech logging: Magnetic Resonance Imaging (MRI), Resistivity Imaging, GEM elemental analysis
- Reservoir description and fluid analysis services
- Reservoir monitoring in complex and high-pressure/high-temperature wells
- Tool pusher logging and casing-patch solutions
- Training programs and equipment maintenance support
- Data processing, log interpretation, and real-time satellite data transmission

1.2 Gandhinagar Workshop Overview

1.3 Aim and Scope of Visit

2 Industrial Orientataion

2.1 Introduction to Well Logging Services

Well logging is a critical formation evaluation technique employed to characterize subsurface geological formations and fluid content within a borehole. The process involves deploying sophisticated sensor suites into the well—typically via wireline conveyance or logging-while-drilling (LWD) assemblies—to acquire continuous, depth-correlated measurements of physical rock properties. These acquisitions generate data records, known as logs, which facilitate the detailed analysis of the reservoir without the prohibitive cost and time associated with extensive physical coring. This diagnostic process is versatile, applicable in both "open-hole" environments to assess potential pay zones immediately after drilling, and "cased-hole" environments to evaluate cement integrity and monitor saturation changes during the well's production life.

To construct a comprehensive petrophysical model, a diverse array of logging tools is utilized to quantify specific parameters. Fundamental services include Gamma Ray logs for lithological identification and shale volume estimation, alongside Resistivity logs, which are essential for discriminating between non-conductive hydrocarbons and conductive formation water. To assess reservoir storage capacity, porosity logs—comprising density, neutron, and sonic measurements—are utilized to quantify void space volume.

Complementing these are auxiliary tools such as caliper logs, which map borehole geometry to assess stability, and formation testers that isolate specific zones to capture pressure gradients and in-situ fluid samples, validating the physical state of the reservoir.

The integration of this data is indispensable for accurate reservoir characterization, reserve estimation, and field development planning. By accurately delineating rock types, fluid contacts, and permeability, operators can mitigate drilling risks, determine the commercial viability of a zone, and optimize completion strategies, such as precise perforation placement. Furthermore, cased-hole logs provide essential assurance regarding hydraulic isolation and zonal integrity. Ultimately, well logging serves as the foundation for robust reservoir modeling, enabling data-driven decisions that maximize economic efficiency and hydrocarbon recovery throughout the asset's entire lifecycle.

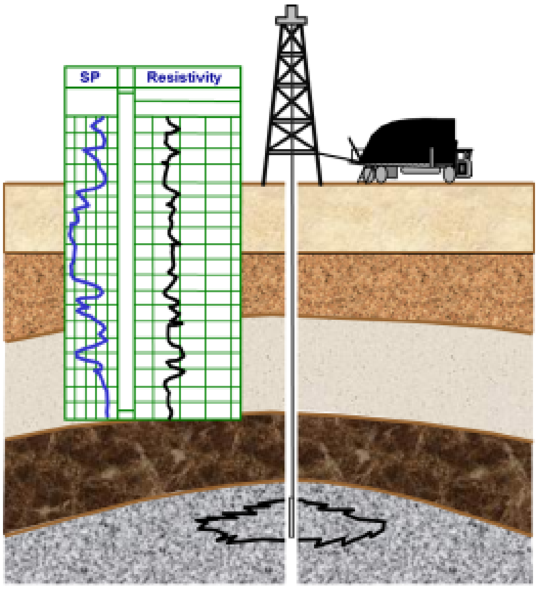

Figure 2.1: Well Logging Process

2.2 Overview of Well Logging Tools

2.2.1 Open Hole Tools

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Spectral Density Tool

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Induction Resistivity Tool

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Calliper Tool

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Neutron Porosity Tool

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Spectral Gamma Tool

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Circumference Acoustic Scanning Tool

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2.2.2 Cased Hole Tools

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Cement Logging Tool

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Perforation Gun

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2.3 Process of Well Logging

2.3.1 Data Acquisition Van (Logging Unit)

The Logging Unit, also referred to as the Data Acquisition Van, is the central control hub for conducting well logging operations. It is a mobile, fully equipped workstation designed to monitor, record, and process all incoming data from downhole tools in real time. The van is fitted with advanced data acquisition systems, high-performance computers, depth-tracking instruments, communication panels, and specialized software used for interpreting logging measurements. The interior environment is climate-controlled to protect sensitive electronics and ensure stable working conditions for logging engineers. During field operations, the engineers seated inside the unit continuously monitor parameters such as gamma ray counts, resistivity curves, neutron-density responses, caliper readings, and tool status indicators. The van also houses power control modules, safety interlocks, and backup systems to prevent data loss in case of power instability. All surface equipment is integrated through cables running to the wellsite winch unit, enabling precise synchronization between downhole tool movement and data acquisition. In essence, the Data Acquisition Van acts as the "brain" of the logging operation, ensuring accurate, real-time interpretation and high-quality dataset generation for reservoir evaluation.

Figure 2.2: Data Acquisition Van

2.3.2 Data Acquisition and On-site Processing

The data acquisition and on-site logging process involves a systematic workflow that begins with rig-up and ends with quality control and data delivery. Once the tools are assembled and tested, they are lowered into the wellbore using the winch system, and the depth encoder ensures accurate measurement of tool position throughout the operation. As the tools descend and later ascend through the formation, sensors measure physical properties such as natural gamma radiation, formation resistivity, porosity, bulk density, borehole geometry, and acoustic travel time. These measurements are transmitted through the logging cable to the Data Acquisition Van, where the logging engineer continuously monitors the logs for abnormalities, depth mismatches, or tool malfunctions. During the process, calibration checks are performed to ensure the accuracy of tool readings, and real-time data is cross-verified with pre-job models and formation expectations. Communication between the engineer, rig crew, and tool technicians remains constant to coordinate tool movement, manage wellsite risks, and respond quickly to operational changes. Once logging is complete, the data undergoes preliminary processing, environmental correction, and quality control. A field print or digital log is then generated and delivered to the operating company for further petrophysical interpretation. This structured workflow ensures that high-quality, reliable subsurface data is obtained during every logging operation.

2.4 Tool Storage, Maintenance and Dispatch

2.4.1 Asset Management and Storage Infrastructure

The Gandhinagar facility utilizes a segregated infrastructure model designed to preserve asset integrity and adhere to strict statutory inventory controls. The workshop is divided into distinct operational zones, separating non-hazardous wireline assets—specifically open-hole and cased-hole logging sondes—from hazardous materials. To mitigate the risks of galvanic corrosion and electronic degradation common in humid environments, all electronic cartridges, telemetry subs, and acoustic devices are housed in climate-controlled, humidity-regulated storage units. Hazardous materials are managed with heightened security protocols compliant with Indian national standards; radioactive sources used for density and neutron logging are secured in subterranean, lead-shielded bunkers approved by the Atomic Energy Regulatory Board (AERB), while explosive materials, including perforating charges, are stored in earth-mounded magazines licensed by the Petroleum and Explosives Safety Organization (PESO). All inventory movement is tracked via the HLS digital asset management system, ensuring real-time visibility of tool location, life-cycle history, and utilization statistics.

2.4.2 Maintenance Lifecycle and Calibration

To ensure "First Run Success" and minimize non-productive time (NPT), the facility executes a rigorous maintenance regimen immediately following every field deployment. The lifecycle begins with thorough decontamination and pressure washing to remove formation fluids and drilling mud, followed by a detailed mechanical inspection of pressure housings, threads, and connectors to identify erosion or physical trauma. Technicians systematically replace all elastomeric sealing elements (O-rings) and backup rings to guarantee pressure isolation up to the tool's rated maximum. Concurrently, electronic diagnostics are performed using the HLS Test Bench to simulate downhole power loads and telemetry speeds, verifying the health of printed circuit boards and sensors. Critical formation evaluation sensors—specifically Gamma Ray, Neutron, and Density tools—undergo Master Calibration using traceable reference standards to correct for detector drift, while induction tools are verified against known resistivity markers. Prior to returning to the ready rack, pressure-critical assets undergo hydrostatic validation in a Pressure Test Vessel (PTV) to certify seal integrity.

2.4.3 Dispatch Operations and Pre-Deployment Verification

The dispatch phase consolidates technical preparation with logistics coordination to ensure operational readiness at the wellsite. This process begins with the assembly of the toolstring according to the specific client well program, followed by a System Integration Test (SIT). During the SIT, the assembled string is powered via a surface logging unit to verify inter-tool communication, telemetry synchronization, and software compatibility. Once validated, equipment is packed into shock-resistant transportation baskets designed to prevent vibration damage during transit. The logistics team coordinates the movement of these assets, paying strict attention to regulatory documentation. This includes the preparation of comprehensive manifest dossiers containing calibration certificates, inventory lists, and—for hazardous cargo—the requisite regulatory transport permits and TREMCARDS (Transport Emergency Cards) as mandated by the Motor Vehicles Act and AERB guidelines for the transport of Dangerous Goods (Class 7 and Class 1).

2.5 Health, Safety and Environmental (HSE) Management

2.5.1 General Site Safety

General site safety protocols at the HLS Asia Gandhinagar Workshop form the foundation of all operational activities, especially because the facility handles high-value logging tools, heavy mechanical equipment, radioactive materials, and explosives. Personnel are required to wear complete personal protective equipment (PPE), including helmets, flame-resistant coveralls, safety shoes, high-visibility vests, goggles, and gloves before entering work areas. The workshop is divided into controlled access zones—Green, Yellow, and Red—each restricting entry based on operational risk, with the Red Zone reserved for hazardous materials and accessible only to authorized staff. Before the start of daily operations, safety induction sessions and toolbox talks are conducted to brief workers about ongoing activities, potential hazards, emergency communication, and preventive measures.

All equipment handling is restricted to certified technicians who inspect hoisting and lifting tools before use. Fire safety measures are robust, with strategically placed fire extinguishers, functional alarms, and clearly marked evacuation routes. The workshop maintains high housekeeping standards by ensuring clean, hazard-free workstations, proper tool arrangement, and systematic waste segregation. Throughout all operations, documentation and compliance with HLS and OISD safety regulations are strictly maintained through logbooks, audits, and scheduled inspections. This strong HSE culture ensures safe operations and minimizes risks during all workshop activities.

2.5.2 Handling of Radioactive(RA) Sources

Radioactive sources used in well logging tools are handled under strict regulatory control following AERB guidelines. These sources are stored inside shielded lead containers placed within a dedicated RA bunker equipped with radiation signage, surveillance, and monitoring systems. Access to this area is highly restricted and permitted only to trained personnel holding valid AERB certifications. All handling of radioactive capsules, including loading and unloading into logging tools, is performed within controlled zones using specialized tools to minimize exposure. Radiation levels are continuously monitored using survey meters, area monitors, and personal dosimeters, and exposure records are updated monthly. Transportation of radioactive sources follows regulated procedures, using certified lead casks with tamper-proof seals, along with transport permits and chain-of-custody documentation.

In case of any radiation abnormality or suspected source breach, emergency protocols require immediate evacuation, activation of alarms, restricted entry, and assessment by the Radiation Safety Officer (RSO). Spent or expired radioactive sources are not stored locally; instead, they are returned to manufacturers or other AERB-approved disposal facilities.

These strict measures ensure safe, compliant, and efficient handling of all radioactive materials in well logging operations.

2.5.3 Handling of Explosives(EXPL)

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2.6 Present Market Status and Future Scope

The global market for wireline services is experiencing consistent growth, with Fortune Business Insights projecting a compound annual growth rate of about 5.18% from 2025 to 2032. Additional estimates from WiseGuy suggest that the wireline logging segment alone may expand from USD 14.1 billion in 2025 to roughly USD 20.8 billion by 2035. Growth is particularly strong in the Asia-Pacific region, with countries such as India emerging as major contributors. Zion Market Research similarly forecasts that the global wireline logging services market could reach approximately USD 15.42 billion by 2034, further reinforcing the sector's upward trajectory.

In India, the oil and gas upstream sector is also set for substantial expansion. Mordor Intelligence reports that the country's exploration and production market may rise from around USD 16.08 billion in 2025 to about USD 20.53 billion by 2030, reflecting a CAGR of nearly 5%. The oilfield services segment is expected to grow even more rapidly. According to TechSci Research, this market could expand at a CAGR of about 12.4% through 2029. OIL India's strategic vision for 2030 also highlights plans for upstream growth, indicating increasing demand for logging, reservoir evaluation, and related technical services.

Technological advancements are further shaping the industry's future. The growing adoption of digital and real-time logging tools, enhanced data analytics, and sophisticated reservoir evaluation techniques is boosting demand for advanced service providers such as HLSA. Additionally, the rising focus on carbon capture and storage (CCS) is creating new applications for wireline services, particularly in the monitoring and assessment of storage reservoirs, according to various market forecasts.

2.7 Competitors and Other Threats

The competitive environment for logging and wireline services is largely shaped by the speed of new technology, increasing digitalisation, and the dominance of international oilfield service companies. Academic research suggests that advanced logging tools which include spectral gamma ray, cement bond logs, and induction/neutron porosity tools are fundamental to subsurface evaluation workflows in the sector.

These tools require a high level of technical capability, on-ongoing technology investments, and specialised skills, making entry for regional service providers such as HLS Asia problematic. Well-logging is a significant reference for reservoir characterisation and formation evaluation (Rider & Kennedy, The Geological Interpretation of Well Logs, Elsevier).

Research on spectral gamma ray (SGR) logging also emphasizes that leading companies have developed multi-detector gamma ray systems which are capable of more advanced lithology analysis and shale discrimination than traditional single detector systems (Klaja & Dudek, 2016). These are simply now the standard operating procedure on multi detector gamma ray systems from companies such as Schlumberger, Halliburton, Baker Hughes and Weatherford.

In a similar vein, cement bond logging work stresses the necessity of obtaining high quality CBL/VDL in order to ensure long-term well integrity (Saini et al., 2021). International contractors are continually upgrading their sonic based cement evaluation tools to enhance accuracy, reliability, and operational efficiency that clients will increasingly expect during tender evaluations.

One competitive threat is digital transformation. State of the art machine learning models can automatically execute functions such as synthetic log creation, lithofacies forecasting, and porosity prediction with high accuracy (Zhang et al., 2025). International service companies investing in modern day AI platforms have a clear competitive advantage compared to moderately sized companies without similar digital assets.

The research literature has also documented operational risks in wireline logging, such as tool failure, borehole washout, cement channeling, and depth mismatches. Bigger companies cope with these risks better because of experience, staff expertise, and redundancy in equipment. These situations, along with digitalisation and expectations from customers, are the most serious risks to HLS Asia in a competitive scenario.

3 Learnings from Industrial Visit

3.1 Key Learnings

The industrial visit to HLS Asia provided a clear understanding of how safety, technology, and operational discipline come together in real-world well logging environments. One of the most significant learnings was the uncompromising emphasis placed on safety, especially while working around high-risk equipment and hazardous materials. The detailed safety briefing highlighted strict procedures for handling radioactive sources and explosives, underscoring the need for certified personnel, secure containment, and continuous monitoring when working with tools that use gamma-ray, neutron, or other radiation-based measurements. This reinforced the idea that risk mitigation and operational planning are foundational to every field activity.

The visit also offered valuable exposure to the variety and complexity of well logging tools used in diagnostics and well-integrity assessments. Tools such as the VDL (Variable Density Log) tool, Spectral Gamma tool, and perforation guns illustrated the multi-physics nature of modern logging operations, where acoustic, radioactive, and mechanical measurements work together to provide comprehensive subsurface insights. Observing these tools up close demonstrated the level of precision, calibration, and miniaturization required for them to function reliably in high-pressure downhole conditions. Their integration within a toolstring further highlighted how advanced diagnostics depend on synchronized data from multiple sensors.

A key takeaway from the visit was the realization that even with sophisticated tools, successful data acquisition still relies heavily on human expertise. Engineers and operators continuously adjust acquisition parameters based on real-time data, ensuring high-quality measurements despite changing well conditions. The explanations provided by the crew highlighted the importance of judgment, environmental corrections, and collaborative interpretation with subsurface teams to derive meaningful conclusions from raw logs.

Finally, the tour of the Data Acquisition Van tied all these elements together. The van served as the operational hub where real-time data visualization, quality control, and digital processing took place. Seeing how numerous channels of data are monitored simultaneously emphasized the role of the digital workflow in modern well logging. Overall, the visit offered a comprehensive and practical understanding of the blend of safety, technology, and human decision-making that enables accurate and reliable well-diagnostics operations.

3.2 Connections to Classroom Learning

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4 References