

Electrical Submersible Pumps (ESP) Design and Operation Training Course

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Overview

The Electrical Submersible Pumps ESP Design and Operation Training Course is a one-week course for production engineers, artificial lift specialists, and field operations technicians who leave with an operational ESP design dossier and lifecycle troubleshooting guide to optimize artificial lift systems. Operating companies encounter frequent electrical failures, pump gas locking, severe sand erosion, and unplanned workovers that reduce production efficiency. This course addresses these operational bottlenecks through systematic equipment selection, nodal analysis modeling, surface electrical integration, and failure teardown evaluations. Agile Leaders Training Center delivers the Electrical Submersible Pumps ESP Design and Operation Training Course.

Who Should Attend

- Production engineers responsible for artificial lift system performance, well monitoring, and artificial lift run-life optimization.
- Reservoir and petroleum engineers modeling inflow performance relationships, multiphase fluid flow, and total dynamic head requirements.
- Field operations specialists overseeing ESP downhole equipment installation, commissioning, and surface electrical operations.
- Electrical and facilities engineers managing variable speed drives, dedicated step-down transformers, and wellsite power quality.
- Well intervention technicians reviewing downhole pull records, component dismantle inspections, and failure forensic logs.

The course assumes participants actively evaluate well production telemetry and artificial lift performance at work, and it leaves out introductory wellhead mechanics and basic electrical circuit calculations.

Departments and Industries

The course draws operational cases from upstream production assets and continuous industrial processing plants.

- Upstream petroleum exploration and production departments
- Subsurface engineering and artificial lift asset management teams
- Field operations and well intervention service companies
- Geothermal power generation and resource extraction facilities
- Industrial deep groundwater pumping and regional water utility networks
- Offshore crude production platforms and processing facilities

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Learning Objectives

By the end of this course, participants will be able to:

- Apply nodal analysis methods to size downhole pump stages and match reservoir inflow performance curves.
- Analyze fluid properties and gas-liquid ratios using multiphase flow correlations to prevent pump cavitation.
- Diagnose surface power discrepancies and electrical harmonics using variable speed drive telemetry and IEEE standards.
- Evaluate downhole equipment wear by applying API RP 11S1 teardown procedures to identify root failure causes.
- Prioritize pump operating envelopes and protector configurations to prevent motor fluid contamination in sour service.
- Build an integrated ESP design and operational monitoring dossier adhering to API RP 11S installation standards.

Course Agenda

Day 1: Reservoir Fluid Mechanics and ESP System Architecture

- Inflow performance relationship modeling and multiphase flow calculations for ESP sizing
- Centrifugal pump stage geometry, head capacity curves, and API RP 11S2 performance testing criteria
- Two-pole induction motor mechanics, winding insulation classes, and heat dissipation dynamics
- Seal chamber protector configurations, thrust bearing load limits, and API RP 11S7 testing requirements
- Intake configurations, downhole rotary gas separators, and multiphase charge handling systems

Day 2: Electrical Infrastructure, Surface Systems, and Sour Service Metallurgy

- Variable speed drive modulation, harmonics mitigation, and surface controller operating boundaries
- Dedicated step-down transformer integration and power balance under nominal 60-Hz operations
- Power cable specification, flat versus round profiles, and API RP 11S5 conductor selection rules
- Motor lead extension integrity, pothead barrier sealing, and API RP 11S6 field cable testing protocols
- Sour service metallurgy selection and environmental cracking limits aligned with NACE MR0175

Day 3: Wellbore Integration, Nodal Design, and Rigless Deployment

- Nodal analysis system modeling and total dynamic head calculation using industry design software
- Motor-pump operating point matching, fluid velocity limits, and motor cooling jacket design
- API RP 11S3 handling practices, spooling unit procedures, and downhole cable protector spacing
- Wellhead penetrator assemblies, pack-off sealing mechanics, and surface blowout preventer integration
- Rigless coiled tubing-deployed ESP systems and downhole deployment methods for intervention minimization

Day 4: Operational Monitoring, Troubleshooting, and Failure Analysis

- Real-time downhole sensor telemetry, motor temperature trends, and intake pressure interpretation
- Variable speed drive electrical signature diagnosis, underload setpoints, and overload trip remediation
- API RP 11S8 downhole vibration baseline thresholds and mechanical instability troubleshooting
- Motor insulation resistance evaluation and high-potential cable testing applying IEEE Std 1017 methods
- API RP 11S1 standardized teardown reporting workflows and component wear forensic categorization

Day 5: Field Troubleshooting Practice and Capstone Sizing Project

- Suggested activity: Diagnose electrical short circuits and mechanical scale lockup from field operational logs
- Suggested activity: Calculate pump stage recalculations for fluctuating gas-to-oil ratios and water cuts
- Suggested activity: Perform a forensic teardown assessment using API RP 11S1 failure report templates
- Suggested activity: Evaluate variable speed drive harmonics mitigation for an onshore wellsite transformer network
- Capstone exercise: Assemble an operational ESP design dossier and lifecycle troubleshooting guide for a high-rate sour oil well

Practical Exercises

The course uses field wellbore data sets, equipment specification sheets, and pump operational logs.

- Suggested activity: Calculate pump stages and select motor ratings from reservoir inflow data and casing profiles.
- Suggested activity: Diagnose downhole electrical ground faults using ammeter recordings and insulation resistance traces.
- Suggested activity: Complete a standardized equipment dismantle analysis following API RP 11S1 teardown criteria.
- Suggested activity: Build an operational protection schedule detailing drive trip limits and vibration warning thresholds.

FAQs

Who suits the Electrical Submersible Pumps ESP Design and Operation Training Course?

The Electrical Submersible Pumps ESP Design and Operation Training Course suits production engineers, petroleum specialists, and artificial lift supervisors. The course assumes participants manage artificial lift well telemetry at work, leaving out elementary pipeline hydraulics and introductory electrical fundamentals.

How does this course differ from general artificial lift courses?

General artificial lift courses survey rod pumps, gas lift, and progressing cavity systems at a conceptual level. The Electrical Submersible Pumps ESP Design and Operation Training Course focuses specifically on multi-stage centrifugal pump sizing, downhole electrical testing, variable speed drive integration, and forensic teardown analysis.

What industry testing practices govern electric submersible pump systems?

Electric submersible pump systems are tested using API RP 11S2 for pump performance and gas handlers, API RP 11S6 for power cable acceptance, API RP 11S7 for seal chamber sections, and IEEE Std 1017 for motor insulation resistance verification.

How do variable speed drives enhance ESP performance?

Variable speed drives regulate motor frequency to shift pump head-capacity performance across reservoir pressure declines. They prevent frequent well cycling, provide soft-start acceleration to reduce mechanical stress, and supply operational telemetry for predictive failure mitigation.

Conclusion

The operational ESP design dossier and lifecycle troubleshooting guide delivers an authoritative framework for managing artificial lift assets. Engineering teams use this technical documentation to eliminate sizing inaccuracies, prevent downhole electrical burnouts, and standardize pull-and-teardown inspections. Applying these structured design methods ensures maximized pump run life and stable hydrocarbon production across demanding field conditions.

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