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ISO 9001:2008 Certified

Symbols, Schematics & Troubleshooting

Five-Day Course Outline
(WEST DEC Facility, Brookshire, Texas)

Note: a job safety analysis (JSA) will be presented before each lab exercise.

Section I - Introduction

A. Shop safety
   1. Fire awareness
   2. Toolbox meetings (JSAs)
   3. Awareness of potentially hazardous activities of other groups
   4. Personal protective equipment
   5. Trapped pressure
   6. Compressed air
   7. Security of equipment being worked on or mounted on work benches
   8. Working under suspended loads
   9. Load rating of lifting equipment
   10. Rotating machinery
   11. Hand tools and electric power tools
   12. Chemical storage and identification
   13. Tool care and maintenance
   14. Housekeeping

B. Safety equipment required in the shop
   1. Steel-toed work boots
   2. Safety glasses with side shields
   3. Work gloves
   4. Coveralls

Section II - SMARTDRAW CAD System

Students will be given introductory level instruction on the use of a CAD system known as SMARTDRAW. Each student will use the SMARTDRAW software to develop schematics diagrams during the course of the week's instruction.

Section III - Fluid Control System Symbols

A. A discussion of the process used to develop pneumatic or hydraulic control systems from the block diagram phase through simple schematics to engineering flow diagrams, piping and instrumentation drawings (P&ID), and fabrication and construction drawings. Symbols used in fluid control schematics and P&ID drawings will be explained in detail.

B. **Lab**

1. From a written description, develop a block diagram of a simple fluid process.
2. From a block diagram, develop a fluid control schematic of a simple fluid control process.

Section IV - Fluid Power System Symbols

A. Detailed instruction will be given on the symbols used in fluid power control process schematics. Differences between fluid power and fluid control processes will be discussed. The types of fluid power cylinders will be described along with the calculations used to compute the forces that each type of cylinder can develop. Fluid power valve schematics will be explained, and each type of valve configuration and control function will be reviewed.

B. **Lab**
   1. Calculate the net force output available during the extend and retract cycle of single-acting and double-acting cylinders.
   2. Using actual manipulator and selector valve hardware, develop schematic representations of actual hardware.
   3. Using block diagrams develop simple schematic drawings of a fluid power control circuit.

Section V - Fluid Power System Schematics

A. Using their knowledge of fluid power system symbols, students will be introduced to the various fluid power control subsystems used in a subsea BOP control system. Each subsystem will be explained in detailed and actual simulated functional schematics will be used to show the functional inter-relationships between each control in a subsystem circuit. Subsystem troubleshooting techniques using subsystem schematics will be discussed.

B. **Lab**
   1. Using system schematics, trace each subsystem control circuit from the driller's panel to the subsea pod.
   2. Trace a BOP "open" and a "close" command through a system schematic.

Section VI - Electrical Control Circuits

The typical electrical symbols used in the BOP control system will be described. Typical electrical components, used in BOP piloted control systems will be discussed. The inter-relationships between the electrical commands and signals and the BOP hydraulic control system functions will be described. The complete BOP control system electrical schematic, including the driller's panel and the hydraulic pressurization unit (HPU), will be evaluated to discuss the troubleshooting and problem assessment process.

Section VII - BOP Control System Schematics

Both the BOP control system hydraulic and electrical schematics will be discussed in detail. Troubleshooting and problem analysis techniques for end-to-end problem analysis of the control system will be discussed in detail.

Section VIII - Troubleshooting Techniques and Report Development

Instructor Conley Perry points out control panel components

A. Basic troubleshooting techniques will be evaluated. The “fishbone” method of troubleshooting will be reviewed in detail. Problem report writing techniques will be reviewed.

B. **Lab**

1. Each student group will be given a system problem using the combined driller’s panel, HPU, hose, and control pod system. They will demonstrate the proper technique to systematically troubleshoot a simulated failed component that will be placed in the system.
2. Each student group will photo document the troubleshooting techniques used, document the problem assessment process used, and develop a problem analysis report to document the result of the system analysis.