

Implications	Included: Designing tools and materials, sizing tools, transformers, resistors, PCBs, capacitors, diodes, SCRs, inverters, batteries, cables, computers and internet.
3. Methods of Assessment	Competency may be assessed through: 3.1 Oral questioning 3.2 Written tests 3.3 Practical Tests
4. Context of Assessment	Competency may be assessed 4.1 On job 4.2 Off job 4.3 During Industrial Attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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## **INSTALL ELECTRICAL MACHINE CONTROL SYSTEMS**

**UNIT CODE:** ENG/OS/ET/CR/03/6/A

### **UNIT DESCRIPTION**

This unit covers competencies required to install electrical machine control system. Competencies includes; conducting site survey, designing machine control system, assembling tools, equipment and materials, mounting electrical and electronic components, performing wiring of electrical and electronic components, terminating wiring on electrical and electronic components, configuring and testing the installed electrical machine control system, commissioning and documenting installation report.

### **ELEMENTS AND PERFORMANCE CRITERIA**

<p><b>ELEMENT</b></p> <p>These describe the key outcomes which make up workplace function.</p>	<p><b>PERFORMANCE CRITERIA</b></p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
<p>1. Conduct site survey</p>	<p>1.1.Site is surveyed basing on the suitability of installation to be performed</p> <p>1.2.Conditions of the site are evaluated according to the established procedures</p> <p>1.3.Installation layout is developed as per the standard operating procedure</p> <p>1.4.Measurements are taken in line with expected installation</p> <p>1.5.Survey report is generated and shared with relevant parties in accordance of the contract</p>
<p>2. Design machine control system</p>	<p>2.1. Machine control system is designed as per the scope of the control system</p> <p>2.2. Machine control system is designed in line with the system functionality</p> <p>2.3. Machine <b>control system design</b> is established basing on the system configuration</p> <p>2.4. Machine <b>control design methodology</b> is established in line with standard operating procedure (control signal-decision-action)</p> <p>2.5. Designing is performed in consideration of machine’s manufacturer’s manuals</p>
<p>3. Assemble tools, equipment and materials</p>	<p>3.1.Tools, equipment and materials are identified as per the tasks to be carried out.</p> <p>3.2.Tools, equipment and materials are assembled basing on their functionality</p> <p>3.3.Tools, equipment and materials are configured in consideration of system’s installation requirements</p> <p>3.4.Tools, equipment and materials are assembled in consideration of <b>system parameters</b></p>
<p>4. Mount electrical and electronic components</p>	<p>4.1.<b>System components</b> are labelled in line with their functions</p> <p>4.2.System components are mounted as per the system design</p> <p>4.3. System components are mounted basing on standard operating procedures</p> <p>4.4.Control panels <b>enclosures</b> and locations are determined as per established standards</p>

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<p>5. Perform wiring of electrical and electronic components</p>	<p>5.1. Wiring of system components is performed in adherence to IEE regulations</p> <p>5.2. Wiring of components is performed in line with standard operating procedure.</p> <p>5.3. Wiring of electronic components is performed as per the system design</p> <p>5.4. Cable types and rating are selected in accordance with system components' power rating and functionality (power cables and signal cables)</p>
<p>6. Terminate system wiring</p>	<p>5.1 <b>Termination methods</b> are identified basing on load sizes</p> <p>5.2 Wiring is terminated in adherence to IEE regulations</p> <p>5.3 Wiring termination is performed in consideration of OSHA regulation</p> <p>5.4 Wiring labelling is performed in accordance with standard operating procedures</p>
<p>7. Configure and test the installed control system</p>	<p>7.1. Control system is configured basing on the expected system functionality</p> <p>7.2. System components are tested in line with their power ratings</p> <p>7.3. System components are tested based on their functionality</p> <p>7.4. System components are tested in line with manufacturer's manuals</p> <p>7.5. Testing the system is performed as per system functionality</p>
<p>8. Commission the system and document installation report.</p>	<p>8.1. Installation report is prepared in line with standard operating procedures</p> <p>8.2. Installation report is documented and shared with relevant parties based on the contract</p> <p>8.3. User training is performed in accordance with system functionality</p> <p>8.4. Commissioning of the installed system is performed as per standard operating procedure</p> <p>8.5. Commissioning of the installed system is performed in consideration of safety standards</p>

## RANGE

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

Variable	Range
1. Control system design may include but not limited to:	<ul style="list-style-type: none"><li>• PI</li><li>• PID</li><li>• PLC</li><li>• SCADA</li></ul>
2. Control system methodology may include but not limited to:	<ul style="list-style-type: none"><li>• Communication protocols (Ethernet, Modbus, Profibus)</li></ul>
3. IEE regulations on cable jointing may include but not limited to:	<ul style="list-style-type: none"><li>• Electrical wiring and testing</li><li>• Cable sizes</li><li>• Cable termination</li></ul>
4. Guidelines in the manufacturer's manuals may include but not limited to:	<ul style="list-style-type: none"><li>• Well Ventilated room</li><li>• Raised surface</li><li>• Near the charge controllers</li></ul>
5. System parameters may include but not limited to:	<ul style="list-style-type: none"><li>• Voltages and current</li><li>• Frequency</li><li>• Speed</li><li>• Temperature</li><li>• Vibration</li></ul>
6. System components may include but not limited to:	<ul style="list-style-type: none"><li>• Power supply</li><li>• CPU</li><li>• Input-output modules</li><li>• Rails</li><li>• Connectors</li><li>• Cables</li><li>• Ferrule</li><li>• Lugs</li><li>• Relay</li></ul>
7. Enclosure may include but not limited to:	<ul style="list-style-type: none"><li>• Panels and distribution boards</li><li>• IP classes</li></ul>
8. IEE regulations on cable laying and termination may include but not limited to:	<ul style="list-style-type: none"><li>• Firmness</li><li>• Insulation</li></ul>

<b>Variable</b>	<b>Range</b>
9. Expected interference may include but not limited to:	<ul style="list-style-type: none"> <li>• Electromagnetic field</li> </ul>
10. IEC standards may include but not limited to:	<ul style="list-style-type: none"> <li>• BS 7691</li> <li>• IEC 364</li> <li>• IEC 391</li> <li>• IEC 445</li> <li>• IEC 446</li> <li>• IEC 62257</li> </ul>
11. Network protocols may include but not limited to:	<ul style="list-style-type: none"> <li>• TCPIP</li> <li>• UDP</li> <li>• HTT</li> </ul>
12. Protection devices may include but not limited to:	<ul style="list-style-type: none"> <li>• RCDs</li> <li>• Lightning arresters</li> <li>• Earth rods</li> <li>• SPDs</li> <li>• Fuses (AC &amp; DC)</li> <li>• Relays</li> <li>• Isolators</li> </ul>

## **REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

- Control system components
- Electrical wiring
- Electrical design software
- MS Word & Excel
- Network Components and devices
- Color coding
- Use of electrical & mechanical tools
- Troubleshooting
- Electrical power distribution
- Power protection
- Testing techniques
- Measurement
- Electrical standards

## **FOUNDATION SKILLS**

The individual needs to demonstrate the following foundation skills:

- Electrical principles
- Electrical codes

- Life cycle costing for energy systems
- OSHA, WSHA, and industry safety procedures and regulations
- Operate test equipment and interpret results
- Metering and interconnection industry
- Environmental regulations
- Read and understand plans and symbols
- Draw plans
- Use of CAD
- Parameters for normal/abnormal operation of equipment for climate zones
- Knowledge of principles of machine control system
- Research effectively on the internet (including old equipment)
- Computer skills
- Problem solving & decision making
- Analytical
- Troubleshooting
- Work Ethics
- Project management
- Teamwork

## EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Conducted site survey basing on the suitability of the system to be installed</p> <p>1.2 Designed machine control system in regard to expected system functionality</p> <p>1.3 Designed machine control system in line with expected methodology</p> <p>1.4 Designed machine control system based on the scope of the system</p> <p>1.5 Assembled tools, equipment and materials basing on their functionality</p> <p>1.6 Mounted electrical and electronic components in accordance to standard operating procedures</p> <p>1.7 Performed wiring of electrical components as per IEE regulations</p> <p>1.8 Terminated electrical wiring in regard to IEE regulations</p> <p>1.9 Configured and tested the system as per system functionality</p> <p>1.10 Prepared and documented the installation report in line</p>
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	<p>with standard operating procedures</p> <p>1.11 Performed user training and commissioned the control system installation as per the contract</p>
2. Resource Implications	<p>The following resources must be provided:</p> <p>Resources same as that of workplace are advised to be applied Including; PLCs, SCADA, sensors, amplifiers, motors, relays, contactors, controllers, cables, switches, VSDs protection devices etc.</p>
3. Methods of Assessment	<p>Competency may be assessed through:</p> <p>3.1 Observation</p> <p>3.2 Oral questioning</p> <p>3.3 Practical Tests</p> <p>3.4 Written Tests</p>
4. Context of Assessment	<p>Competency may be assessed</p> <p>4.1 On job</p> <p>4.2 Off job</p> <p>4.3 During industrial attachment</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

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