

**TRANSFORMER  
COMMISSIONING  
EXHIBIT**

## **1 Scope**

This document provides an overview of requirements to complete the final transformer, oil-filled reactor or three-phase regulator field pre-commissioning deliverables by the Equipment Manufacturer.

## **2 Testing and commissioning responsibilities**

Unless otherwise specified by PacifiCorp (Owner). Equipment Manufacturer shall be responsible for all aspects of transformer pre-commissioning requirements as defined in this document and PacifiCorp's procedure SP-TRF-INST.

In general, equipment and all other equipment devices shall be tested and verified to meet Equipment Manufacturer and industry standards and to be fully functional. If there is a conflict between the Equipment Manufacturer testing requirements and PacifiCorp installation and/or testing procedures, PacifiCorp's procedures shall prevail, unless specifically otherwise agreed to in writing by PacifiCorp.

In broad terms the Equipment Manufacturer is responsible for the transportation, off-loading, positioning, assemble, oil processing and testing of transformer.

## **3 Definitions**

**3.1** In this document, Equipment Manufacturer will be defined as Supplier.

**3.2** PacifiCorp will be defined as Owner.

**3.3** Oil-filled reactor, phase-shifting transformer and three-phase regulator will have the same meaning as transformer.

**3.4** Pre-commissioning is intended to have the following meanings:

**3.4.1** Installation/assembly of the transformer

To place, position, or fit into a position or location and then to assemble sub-components, other accessories and fittings to the transformer as required to make it ready to be operational.

**3.4.2** Acceptance testing

To perform appropriate and defined electrical, mechanical, thermal, pressure, operational and functional testing of transformer and transformer sub-components.

## **4 Documentation**

**4.1** General expectations

**4.1.1** No installation or testing forms with failed test results should be submitted to Owner. The technician shall contact Supplier and Owner to determine an appropriate course of action when acceptable test results, assembly or equipment issue cannot be achieved.

## **4.2 Pre-commissioning schedule and test plan**

**4.2.1** Supplier shall provide a written pre-commissioning schedule and test plan for all pre-commissioning activities to be completed for this project no later than thirty (30) calendar days prior to the start of those activities, unless specific exceptions have been granted by Owner in writing. This plan and schedule shall include a complete list of test equipment to be used and a list of test forms. The test plan shall include a detailed description of the test procedures that will be followed and the sequence in which they will be followed. The test plan shall include the overall sequence and time frame that equipment will be installed and tested. Owner shall approve this plan in writing before any test or pre-commissioning work may commence.

**4.2.2** Pre-commissioning schedule and test plan will be submitted to Owner e-mail [mjrequiptrchnng@PacifiCorp.com](mailto:mjrequiptrchnng@PacifiCorp.com) for approval by Owner's substation technical services group.

**4.2.3** Supplier shall factor into test plan the required coordination with Owner or Owner's Contractor the logistics required to complete the pre-commissioning activities of the equipment.

## **4.3 Installation and testing documentation required – final field copies**

**4.3.1** Supplier shall supply Owner with the preliminary field completed test data and reports within two (2) days after completion of the tests. These test results shall be dated and signed by the lead on-site test technician. Supplier will submit preliminary field completed test data and reports to Owner e-mail [mjrequiptrchnng@PacifiCorp.com](mailto:mjrequiptrchnng@PacifiCorp.com).

**4.3.2** Final field test data and reports shall be submitted within ten (10) days after completion of the tests and no later than five (5) days prior to energization of the transformer. Supplier will submitted final field test data and reports to Owner e-mail [commissioning@pacificorp.com](mailto:commissioning@pacificorp.com) according to section 4.4.

## **4.4 Use of Owner-provided installation procedures and forms**

**4.4.1** Equipment-specific procedures and forms are provided by Owner as an exhibit to the Contract, Release or Purchase Order.

**4.4.2** These equipment-specific procedures and forms shall be utilized during the installation and testing of equipment. Each required installation and testing form must be completed in full before it is submitted.

**4.4.3** All Supplier procedures and forms that are to be used shall be included with the pre-commissioning test plan for Owner review and approval before they can be used.

## **4.5 Owner-specific transformer procedures and forms – description and documentation**

**4.5.1** The installation and testing of transformer shall be performed in accordance with Owner procedure SP-TRF-INST, and all sub-procedures referenced therein.

- 4.5.2 Follow and complete Owner form SF-TRF-INST beginning at receipt of transformer from the shipper. Complete and submit as defined in this document all required forms listed in Owner procedure SP-TRF-INST.
    - 4.5.3 If transformer is to be oil-filled on site, the dry-out and oil filling process described in Owner procedure SPC-TRF-OILPROC shall be followed. Complete the vacuum processing logs on Owner form SFC-TRF-OILPROC.
  - 4.6 Transformer travel impact recorder data
    - 4.6.1 The dated and signed impact recorder scroll or an electronic impact recorder report that defines the recorder start and finish dates with all recorded data during the unit transport will be completed and submitted as part of the field testing data. The electronic impact report must define or explain what has taken place during the transport. An electronic spread sheet print out will not be accepted. The electronic final report must be an Adobe Acrobat format report that identifies the transformer the report data is for.
  - 4.7 Transformer nameplate
    - 4.7.1 The nameplate attached to the transformer must be compared with the Supplier nameplate drawing. This is to ensure all data on the transformer nameplate and drawing match. A readable photo of the attached transformer nameplate will be submitted with the field testing data.
  - 4.8 Electronic test set-generated data
    - 4.8.1 Test set-generated electronic data results shall be submitted in two (2) formats. This will typically apply for power factor, transformer turns ratio (TTR), and sweep frequency response analysis (SFRA) test results:
    - 4.8.2 Adobe Acrobat copies or print-outs of all test set generated reports; and
    - 4.8.3 Test set-generated data files shall be submitted as separate attachments in the OEM test equipment software format.
  - 4.9 Installation reports and file naming convention
    - 4.9.1 Complete all required test reports, installation forms, electronic forms and marked up drawings. Submit field copies to [commissioning@pacificorp.com](mailto:commissioning@pacificorp.com) and with a cc to [mjrequiptrchng@PacifiCorp.com](mailto:mjrequiptrchng@PacifiCorp.com) using the following naming convention:  
*[SubstationName]\_[EquipmentPositionNumber]\_[PacifiCorpSAPNumber]\_[Form Name **OR** TestReportType]\_[Date]*
    - 4.9.2 Test data and forms pertaining to any one piece of equipment shall be submitted together in one e-mail. If the e-mail message size will exceed ten (10) megabytes, the data shall be divided into separate e-mails and clearly labeled with subpart numbers, for example: Part 1 of 3; Part 2 of 3; etc.
    - 4.9.3 E-mail subject line: *[Substation]\_[TaskID]\_[WorkOrderNumber]*, where:
      - 4.9.3.1 Substation is defined as the installed location of equipment;

**4.9.3.2** Task ID is defined as work done (e.g. transformer installation); and

**4.9.3.3** Work order number is the Owner work order number assigned to project.

**4.9.4** When several different forms are submitted for a particular piece of equipment, these forms may not be combined or scanned into one electronic Adobe Acrobat file. Each form or data set shall be included as a separate attachment contained in the one (1) e-mail submittal. The body of the e-mail shall list all the attachments contained in the e-mail by form or document name.

**4.9.5** All test forms shall be delivered to Owner electronically in the original Adobe Acrobat format as provided and using marked up design or installation drawings, when required. Testing and verification data not specifically addressed in this specification shall be formally documented and submitted in Adobe Acrobat format, unless otherwise agreed to by Owner.

**4.9.6** All information fields on all Owner-provided forms shall be completed in full by Supplier. Where more than one of Supplier's subcontractor performs parts of the work for the equipment pre-commissioning, their respective work shall be combined on one (1) form for Owner review. Partially-completed forms from each subcontractor are unacceptable.

**4.9.7** Equipment control wiring verifications, alarm verifications and all other required testing that does not have a specific associated check sheet or computer generated test results shall be highlighted (yellow for wire verification and pink for devices), initialed by the tester, and dated on the appropriate clean equipment drawing or print. The highlight will confirm that all verification and testing has been completed by Supplier.

**4.9.8** Additions or changes of equipment, wiring, or any other modifications to the drawings shall be fully and professionally documented. Removals or changes of equipment devices or wiring shall be drawn in green. All equipment or wiring changes shall be reviewed and approved by Supplier's design engineer and Owner. All changes shall be documented with new drawings approved by Supplier and submitted to Owner for approval.

#### **4.10** Review and acceptance of test results

**4.10.1** All test results, forms and data shall be approved and accepted by Owner. This data acceptance is required to complete the final terms of the contract for the pre-commissioning of equipment as defined in this document.

## **5 Personnel qualifications**

### **5.1** General

All technicians shall be pre-qualified by Owner for each project prior to any installation or testing work commencing. All technicians shall be experienced in installation and testing of this equipment with similar voltage class and type as this project entails. All installation and testing of this equipment must be carried out by qualified technicians.

## **5.2 Lead testing technician**

The lead testing technician shall have a minimum of ten (10) years of relevant experience in transformer testing, including being in charge of testing programs for other transformers of a similar size and nature to this project. The lead testing technician shall be present on-site during all testing activities. All testing of equipment shall be performed under the direct on-site supervision of the lead testing technician.

## **5.3 Installation technician**

The installation technician shall have a minimum of five (5) years of relevant experience in transformer installation, assembly and oil processing.

## **5.4 Proof of experience**

Each technician shall submit detailed written documentation that describes the relevant equipment previously installed and tested to support the technician's claims of relevant experience. The evidentiary documentation shall explain the specific responsibility and role that the person provided. Documentation shall include the company name for each project where work was performed. The purpose of this process is to corroborate the technician's claims of specific and relevant experience. A general purpose resume-style document is unacceptable.

All technicians may be interviewed by Owner representatives to determine if the technician is approved for installation and/or testing activities. All documentation for the technician shall be submitted one month before any installation or testing is to commence. Approvals may be limited to certain equipment types or by voltage class. Approvals will apply to all Rocky Mountain Power and Pacific Power equipment.

# **6 Required test equipment**

Supplier shall furnish all required test equipment. All test equipment shall have been tested, calibrated and certified to be in fully functional condition by the test equipment manufacturer (or other certified facility) in accordance with the test equipment manufacturer's recommended calibration intervals, prior to performing any testing. Copies of all certificates shall be provided to Owner prior to testing. Owner will field verify that only pre-qualified test equipment is used during actual testing. Test technicians must be familiar with the use of this test equipment and have a thorough understanding of the devices that are being tested.

The following is a list of approved test equipment. Deviations from this list shall require Owner approval. Complete details of test equipment that deviates from the approved list of test equipment, as well as any other test equipment that will be used and is not listed here, shall be submitted with the pre-commissioning and test plan prior to the start of the work as described in Section 4.2.

## **6.1 Voltmeter and ammeter**

Multi-meters may be used during the calibration of meters, transducers and relays. Any meter used must be high-accuracy digital and meet the following specifications:

**6.1.1** 4.5 digit or better resolution;

**6.1.2** True RMS AC measurement;

**6.1.3** Basic DC accuracy: 0.05 percent of scale used; and

**6.1.4** Basic AC accuracy: 0.2 percent of scaled used.

**6.2** Power factor/exciting current test set (e.g. Doble M4000)

**6.3** Sweep frequency response analyzer (e.g. Doble M5000 series)

**6.4** Current transformer test set

A device specifically designed to test current transformers shall be used. Approved devices include:

**6.4.1** Model CTER-91 Vanguard EZ Current Transformer Test Set (preferred);

**6.4.2** AVO Current Transformer Excitation Test Set; or

**6.4.3** Appropriate Vanguard current transformer excitation test set device.

**6.5** Computer and printer

A computer and associated communications cables for communicating with the various types of test equipment is required and shall include special software to communicate with test equipment, substation integration devices, and/or intelligent test equipment devices (i.e., relays, panel meters, transformer tap controllers, etc.). Supplier is responsible for providing the computer, printer, cables and any other associated hardware and software that may be needed.

<b>Revision Log</b>		
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