SaskPower	Install and Operate Mobile Transformers	Standard Operating Procedure

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1.0 Persons Affected

This Standard Operating Procedure (SOP) affects:

- All SaskPower personnel and contractors working under the direction or coordination with Transmission Operations and Maintenance and Distribution Operations involved with:
    - Inspection of mobile transformers.
    - Transport of mobile transformers.
    - Installation of mobile transformers.
    - Operation of mobile transformers.

2.0 Purpose

This SOP provides:

- The standard for job preparation and on-site steps for transporting, installing, energizing, placing in service, and operating a distribution mobile transformer. This standard also covers how to de-energize, remove, and transport the mobile transformer back to its storage location when it is no longer in service.

3.0 Rationale

This SOP ensures the following:

- Major safety steps are highlighted that are required, must be performed or considered during mobile transformer installations.
- Critical information that will assist end users in transporting, installing, energizing, placing in service, and operating mobile transformers.
- Address the de-energizing, removing, and transporting of the mobile transformer back to its storage location.

4.0 Scope

In-the-Scope of the Procedure

- The procedure includes the following:
    - The coordinated procedure between personnel for the transport, inspection, installation, and operation of mobile transformers.
    - De-energization, removal, and transport of a mobile transformer to a storage location.
    - The roles and responsibilities of everyone involved in the process.

Out-of-the-Scope of the Procedure

- The procedure does not include the following:

- Specific requirements for routine and preventative maintenance of mobile transformers.
- SaskPower personnel or contractors negating from their responsibility to perform a Hazard and Risk Assessment or identify safety steps that are not covered in this SOP.
- Replacing training, work procedures or specific permits that are required when installing a mobile transformer or removing a mobile transformer from service.

5.0 Policies and Regulatory Requirements

This SOP is a result of the following regulations, policies, industry standards, and corporate directives and standards:

Regulatory Requirement(s)

- Saskatchewan Occupational Health & Safety Regulations (Section 451 - 452)

Policies

- Job Hazard Assessment Policy
- Personal Protective Equipment Policy

Standards

- Hazard & Risk Assessment Standard
- SaskPower Standards and Processes in support of Corporate Safety Policies

Other

- SaskPower Standard Protection Code
- SaskPower Safety Rulebook

6.0 Roles, Responsibilities and Prerequisites

In-the-Scope of the Procedure Role(s)	Quantity Required	Responsibilities	Prerequisites
TOM Out-of-Scope Manager	1	1. Ensure all SaskPower personnel & contractors are aware of the proper methods to work with mobile transformers. 2. Ensure all SaskPower personnel & contractors have the proper equipment to fulfill the tasks. 3. Provide assistance for any related questions or concerns.	

		4. Coordinate the activities of the SaskPower personnel & contractors. 5. Ensure the SaskPower personnel & contractors are able to and understand their roles and responsibilities as outlines in this SOP.	
TOM In-Scope Supervisor	1	1. Ensure all personnel are performing the tasks outline in this SOP.	
TOM personnel & contractors	1 or more	1. Understand and follow the procedures as outlines in this SOP. 2. Coordinate transport. 3. Set-up, test, and maintain mobile transformer. 4. Test and troubleshoot. 5. Apply relay settings on mobile transformer for mobile and substation protection.	1. Qualified Electrical Worker 2. Standard Protection Code Training
Power Line Technicians	1 or more	1. Obtain permits	1. Standard Protection Code Distribution Course
Issuing Authority	1	1. Follow Standard Protection Code permit requirements.	1. Successful completion of Standard Protection Code training.

7.0 Tools and Equipment

Minimum Tools and Equipment Required:

- Approved potential test indicator
- Phasing and voltage meter
- Spill Kit
- Mobile Transformer
- Standard Protection Code Cards as required
- Transformer Ratio Test Set
- Grounding Equipment as required
- Insulated Hot Sticks

8.0 Planning and Preparation Checklist

Things to Check before Starting the Procedure:

☐ Complete Hazard and Risk Assessment

☐ Applicable Personal Protective Equipment (PPE) is available and in good condition

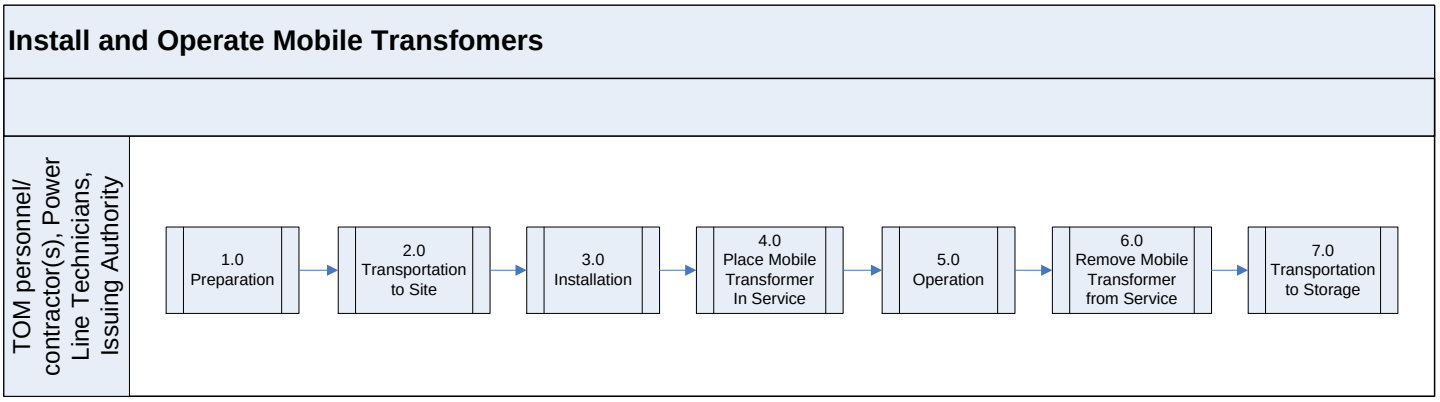
☐ Reviewed SaskPower Standard Protection Code and related permits

☐ Reviewed limits of approach, testing for absence of potential procedure, and proper grounding Procedures

- ☐ Ground conditions for mobile transformer placement
- ☐ Site access conditions
- ☐ Ensure test dates on tools and equipment are current
- ☐ Reviewed and understand how to enter all incidents or near misses

9.0 Procedure

High Level Flowchart



The Procedure

Note: Routine and preventative maintenance of the mobile transformers is the responsibility of Transmission Operations and Maintenance and is outside the scope of this procedure.

In the case of an oil spill, refer to the "Identify Oil-Filled Equipment Containing PCB's Standard Operating Procedure" and follow the oil spill reporting and procedures in the "T&D Environmental Procedures & Spill Reporting" lotus notes database.

1.0 Preparation

1.1 Obtain Relay Settings

1.1.1 Apparatus Maintenance personnel/contractor(s) shall obtain the mobile transformer's relay settings from Protection Engineering.

- *The site specific relay settings should be reviewed and provided by Protection Engineering for each site the mobile transformer will be installed in.*
- *Mobile transformer relay settings, substation low voltage relay settings, and Mobile transformer RVE settings should be obtained prior to installation of the mobile transformer.*

1.2 Inspect Mobile Transformer

1.2.1 Apparatus Maintenance personnel or contractor(s) shall inspect the mobile transformer and prepare it for transport ensuring;

- *Circuit Switcher is closed.*

- *Rapid ground is closed.*
- *DC Power is turned off.*
- *120 Vac power is disconnected.*
- *All breather valves are closed.*
- *All bushing and arrester cover-ups are installed.*
- *All parts of the mobile transformer are folded in and ready for transport.*

2.0 Transportation to Site

2.1 Coordinate the Transport of the Mobile Transformer

2.1.1 Apparatus Maintenance personnel/contractor(s) shall coordinate the transport of the mobile transformer to site.

- *Ensure the driver hired to transport the mobile is a qualified truck driver and has an understanding of the load he/she will be transporting. (i.e. oil-filled equipment, max travel speed, height, weight, etc.)*

2.2 Transport the Mobile Transformer

2.2.1 The Truck Driver Shall:

- *Consider the time of day, weather, and road conditions before attempting to transport the mobile transformer to the location where it is needed.*
- *Participate in a site orientation with SaskPower personnel upon arrival at a SaskPower station.*

2.2.2 SaskPower personnel shall meet the truck driver on site.

- *Perform a site orientation with the truck driver.*
- *Assist the truck driver in placing the mobile transformer on the correct location on site.*
- *Place the mobile transformer ensuring the H11 bushing is under the Red Phase line.*

3.0 Installation

3.1 Set up the Mobile Transformer

3.1.1 Apparatus Maintenance personnel/contractor(s) shall unfold the mobile transformer on site.

- *Ensure the trailer supports are solid and the mobile transformer is level.*
- *Mobile Installation Video #1: mobile install 1.m4v*
- *Mobile Installation video #2: mobile install 2.m4v*

3.1.2 Apparatus Maintenance personnel/contractor(s) shall install temporary fence around the mobile transformer.

- *Position the two gated sections of the fence on opposite sides of the transformer to allow the shortest distances to an exit.*

- *Ensure the temporary fence is electrically separate (minimum 10 feet of separation) from the station fence and from the transformer ground.*
- *Bond each section of the fence to the next with a bonding strap.*
- *Check your vertical clearance when installing the rods between fence sections. Always maintain your limits of approach to overhead conductors.*
- *Fully install the rods that connect each section of fence as these also serve as grounding rods.*

3.1.3 Apparatus Maintenance personnel/contractor(s) shall set up the equipment on the mobile transformer.

- *Ensure protection settings are applied.*
- *Select the proper voltage tap for the high voltage side. (i.e. 72 kV or 138 kV)*
- *Perform a ratio test to confirm the correct ratio is selected..*
- *Select the appropriate high voltage lightning arrestor tap position according to the selected high side voltage (i.e. 72 kV or 138 kV)*
- *Open, lock and tag the high voltage circuit switcher and remove its DC power to prevent unwanted operation. Attach an Abnormal Card. Cards can be removed once the risers are connected.*
- *Open, lock and tag the low voltage RVE/Circuit Breaker and remove its DC power to prevent unwanted operation. Attach an Abnormal Card. Cards can be removed one the riser are connected.*

3.2 Perform Switching

3.2.1 District Operating personnel, under the authority of the District Operating Authority, shall open the necessary switches to accommodate the installation of the high and low voltage risers of the mobile transformer in the isolated state.

3.3 Set LTCs on Transformers

3.3.1 Apparatus Maintenance personnel/contractor(s) shall place the transformer LTCs in manual operation.

- *Place the Mobile Transformer LTC on Manual Operation.*
- *Place the Main Station Transformer LTC on Manual Operation.*

4.0 Place Mobile Transformer In Service

4.1 Provide Training

4.1.1 Apparatus Maintenance personnel shall provide training as required on the operation of the Mobile Transformer being installed prior to energization.

- *Provide training/orientation to designated Switching Station Maintenance personnel.*
- *Provide training/orientation to designated District Operating personnel.*

4.2 Make Riser Connections

4.2.1 Apparatus Maintenance personnel/contractor(s) shall advise the District Operating Authority or designate:

- *When the Mobile Transformer preparation is complete and the HV and LV risers may be connected.*
- *Mobile HV and LV isolating devices are open, locked and tagged abnormal and DC power has been removed.*

4.2.2 District Operating and/or Transmission Line personnel shall obtain necessary permits.

4.2.3 District Operating, designated DEL Crew, or Transmission Line Crew shall connect the HV and LV risers or cables.

4.3 Energize Mobile Transformer

4.3.1 Apparatus Maintenance personnel/contractor(s) shall energize the Mobile Transformer from the high voltage side and ensure proper operation of the Mobile Transformer components.

- *Check the operation of the pumps, tap changer, and any other devices.*
- *Ensure the rapid ground is open before attempting to energize mobile transoformer.*

4.4 Place Mobile Transformer in Parallel

4.4.1 Apparatus Maintenance personnel/contractor(s) shall adjust the Mobile Transformer secondary voltage to match the distribution system 25 kV voltage.

- *The Mobile Transformer should be set 1 or 2 volts secondary higher than the existing bus voltage.*
- *The Mobile Transformer voltage will drop to the system voltage once load is applied.*

4.4.2 District Operating personnel shall:

- *Check the phasing and voltages of the LV side prior to paralleling the mobile transformer.*
- *Close the LV switch or RVE/circuit breaker on the mobile to place the mobile transformer in parallel with the main station transformer.*

4.5 Remove Main Station Transformer from Service

4.5.1 Under the authority of the District Operating Authority, District Operating personnel shall;

- *Complete the necessary switching to separate, isolate, and de-energize the distribution station transformer being taken out of service for maintenance.*

4.6 Place Mobile Transformer in Auto

4.6.1 Apparatus Maintenance personnel/contractor(s) shall place the mobile transformer LTC in automatic operation.

- *Receive the necessary permits issued by the District Operating Authority.*

5.0 Operation

5.1 Normal Operation

5.1.1 District Operating Authority will designate staff to be responsible for the operation of the mobile transformer while it is in service.

- *Respond to and investigate problems with the mobile transformer while it is connected to the distribution system.*

5.2 Respond to LV Trip

5.2.1 District Operating personnel shall respond to the mobile transformer in the case of a LV side trip.

- *If only the RVE/LV circuit breaker has tripped, the district operating personnel may re-energize by closing the mobile RVE/LV Circuit Breaker without consulting with Transmission Operation and Maintenance personnel.*
- *Record all relay targets and report them to Apparatus Crew personnel and manager within 48 hours of the event.*

5.3 Respond to HV Trip

5.3.1 District Operating personnel shall respond to the mobile transformer in the case of a HV side trip.

- *If the cause of the mobile transformer HV circuit switcher trip is due to a loss of potential on the line that is feeding the HV side of the mobile transformer, the mobile transformer may be re-energized without consulting Transmission Operations and Maintenance personnel.*
- *If the HV side of the mobile transformer trips for any reason other than loss of potential on the line feeding the HV side of the mobile transformer, District Operating personnel shall contact the Area Electrical Technician responsible for the area in which the mobile is operating to investigate the cause and troubleshoot.*

Note: If the Area Electrical Technician cannot be reached the Transmission Operations and Maintenance Management on-call person shall be contacted. The management on-call person is always available from GCC.

5.3.2 Transmission Operations and Maintenance personnel/contractor(s), in co-operation with the District Operating Authority, shall determine how to proceed in the event the mobile transformer trips and needs to be returned to service.

- *Take into account the nature of the problem, availability of staff, availability of materials, and customer impact when determining how to proceed.*

- *Switching Station Maintenance, Apparatus Maintenance Crews, and/or System Test personnel may be sent to investigate and assist with restoration.*

5.4 Main Station Transformer Ready for In-Service

5.4.1 District Operating personnel shall continue procedure steps 5.1, 5.2, and 5.3 to maintain operation of the Mobile Transformer until the Main Station Transformer is ready to return to service.

6.0 Remove Mobile Transformer from Service

6.1 Place Main Station Transformer in Parallel

6.1.1 Personnel designated by the District Operating Authority shall ensure all grounds have been removed from the Main Station Transformer when it is ready to be returned to service.

6.1.2 Apparatus Maintenance personnel/contractor(s) shall place both transformers LTCs in manual operation.

- *Place the Main Station Transformer LTC in manual operation.*
- *Place the Mobile Transformer LTC in manual operation.*

6.1.3 District Operating personnel shall;

- *Obtain the necessary permits.*
- *Install AVR fuses on the Main Station Transformer.*
- *Close the Main Station Transformer HV circuit switcher (or equivalent) to energize the Main Station Transformer.*

6.1.4 Apparatus Maintenance personnel/contractor(s) shall adjust the Main Station Transformer secondary voltage to match the 25 kV bus voltage.

- *The Main Station Transformer should come within 1 or 2 volts secondary higher than the bus voltage.*

6.1.5 District Operating personnel shall close the 25 kV bay switch (or equivalent) to place the Main Station Transformer in parallel with the Mobile Transformer.

6.2 Isolate Mobile Transformer

6.2.1 District Operating personnel shall;

- *Perform switching to isolate the mobile transformer.*

6.2.2 Apparatus Maintenance personnel/contractor(s) shall;

- *Open the Mobile RVE/Circuit Breaker and remove the DC Power.*
- *Open the Mobile HV Circuit Switcher and remove the DC power.*
- *Whenever possible, only open the HV and LV switches on the mobile transformer when it is isolated from the system.*

6.2.3 District Operating and/or Transmission Line personnel shall remove the HV and LV risers or cables after.

- *Obtain the necessary permits from the District Operating Authority.*

7.0 Transportation to Storage

7.1 Prepare Mobile Transformer for Transport

7.1.1 Apparatus Maintenance personnel/contractor(s) shall prepare the mobile transformer for transport.

- *Fold the Mobile Transformer components into the trailer.*
- *Close Circuit Switcher.*
- *Close Rapid Ground switch.*
- *Turn off DC Power.*
- *Close all breather valves.*
- *Install all bushing and arrester cover-ups.*
- *Raise Leveling supports.*

7.2 Transport Mobile Transformer to Storage Location

7.2.1 Apparatus Maintenance personnel/contractor(s) shall ensure the driver hired to transport eh mobile is a qualified truck driver and has an understanding of the load he/she will be transporting. (i.e. Oil-filled equipment, max travel speed, height, weight, etc.)

7.2.2 SaskPower personnel/contractor(s) shall meet the Truck Driver at the station and perform a site orientation.

7.2.3 The Truck Driver shall;

- *Consider the time of day, weather, and road conditions before attempting to transport the mobile.*
- *Participate in a site orientation with SaskPower personnel upon arrival at a SaskPower station.*
- *Park the mobile transformer in a designated spot at the SaskPower storage location with the assistance of SaskPower personnel.*

7.2.4 Apparatus Maintenance personnel/contractor(s) shall assist the truck driver in backing up the mobile to the designated position at the storage location.

7.3 Ready Mobile Transformer for Storage

7.3.1 Apparatus Maintenance personnel/contractor(s) shall set up the mobile transformer for storage.

- *Open all breather valves.*
- *Plug the mobile transformer power system into a 120 V power supply.*
- *Turn on DC Power.*

10.0 Acronyms, Definitions and Symbols

Acronyms and Abbreviations

AC - Alternating Current

AVR - Automatic Voltage Regulator

DC - Direct Current

GCC - Grid Control Centre

HV - High Voltage

LTC - Load Tap Changer

LV - Low Voltage

PPE - Personal Protective Equipment

RVE - Type of Recloser

TOM - Transmission Operations & Maintenance

Vac - AC Voltage

Definitions

Abnormal Card

A green card with black letters which is placed on a device to prohibit operation of the device due to an abnormal condition. The name of the person placing the card, apparatus description, date, and reason for the abnormal condition are recorded on the card.

Arrester

A device used to protect electrical equipment from over-voltage transients.

District Operating Authority

A person deemed qualified and competent, who is responsible for the operation of specified apparatus.

HV & LV Risers

The high voltage and low voltage risers on the mobile transformer where connections to the station are made.

Isolated State

The state that exists when apparatus is disconnected or interrupted from all sources of dynamic energy and controls have been put in place to prevent the change of position of the separating device(s).

Qualified

Means possessing a recognized degree, a recognized certificate, or a recognized professional standing and demonstrating, by knowledge, training and experience, the ability to deal with problems related to the subject-matter, the work, or the project.

Ratio Test

A test that identifies the turns ratio of a transformer.

Voltage Tap

The location the tap changer on a transformer is set.

11.0 Components

The following is a list of components for this SOP which can be accessed through the SOP System:

Component Name	Component Type	Component Description	Location of Component
Install and Operate Mobile Transformers Flowchart	Flowchart	High level and mid-level flowchart for the procedure.	SOP Online - SOP Bundle - Install and Operate Mobile Transformers
Mobile Installation Video #1: mobile install 1.m4v	Video	Used in conjunction with the SOP procedure.	SOP Online - SOP Bundle - Install and Operate Mobile Transformers
Mobile Installation Video #2: mobile install 2.m4v	Video	Used in conjunction with the SOP procedure	SOP Online - SOP Bundle - Install and Operate Mobile Transformers

12.0 Owner

Owner
Director, Transmission Services

13.0 References

none