

# Refurbishment of Switchgear and Switchgear Devices

## Low and Medium Voltage Products

### Introduction

There are many suppliers who suggest to users that switchgear assemblies, circuit breakers, and associated devices are 100% refurbishable, and that they possess the abilities to perform such activities. The capabilities are often overstated due to the refurbisher's limited access to proper materials, documentation, and design intent. Siemens position is that refurbishment of Siemens switchgear and switchgear devices is possible if and only if:

1. Refurbishing is conducted and validated in accordance with the original manufacturer's specific instructions for replacement, installation, and maintenance, and in strict accordance with the original manufacturer's drawings and other documentation.
2. The refurbisher utilizes only components from the original manufacturer, or in strict accordance to the original manufacturer's drawings and other documentation.

When refurbishment is being considered due to fire or water damage, additional guidelines can be found in the following reference documents:

NEMA: "Guidelines For Handling Water-Damaged Electrical Equipment"

NEMA: "Evaluating Fire- and Heat-Damaged Electrical Equipment"

Refurbishing should not be confused with "conversion," where the firm performing the conversion utilizes parts and

procedures not specifically from the original manufacturer. In these cases, the conversion must be implemented and validated in accordance with ANSI/IEEE Std C37.59.

### Product Certifications and Listing Marks

Many Siemens products contain a third party certification and associated Listing Marks, such as those authorized by UL and CSA. Additionally, many Siemens products are manufactured with self-certification attestations such as the CE Mark.

These product markings confirm that the assembly has been designed, tested, and assembled in compliance with strict industry standards and practices which were in effect at the time product was manufactured.

If the equipment (or components thereof) is being either refurbished or converted, the firms executing the refurbishment or conversion are obligated to remove or otherwise purge the original manufacturer's and/or third-party certifier's (i.e. UL, CSA, etc.) certification mark. These original product markings are no longer applicable, and must be removed.

### Considerations When Refurbishing Switchgear and Switchgear Devices

There are many types of risks and issues which must be carefully considered and addressed when undertaking a refurbishment activity. The following review is not meant to be an all-inclusive list of the potential issues, but to highlight some of the risks.

### Medium-Voltage Power Circuit Breakers

Reconditioning by a non-factory-authorized firm is a high risk activity, and should be done with extreme caution, and only when supported by the original manufacturer's parts, and in strict compliance with the circuit breaker manufacturer's instructions.

Refurbishment outside of the original manufacturer's components and instructions should be considered impermissible. Outside of this scope, the personnel performing the reconditioning activity must have an extremely high level of access to design documentation and to specialized calibration and test equipment.

While the form, fit, and function of the circuit breaker typically does not change over time, internal components and assemblies may. Without detailed knowledge of the relationship between these internal components, the overall performance of the circuit breaker may be compromised. Design documentation is considered intellectual property of the original manufacturer and is therefore not available to refurbishers via legitimate means.

Original manufacturers' components must be utilized as replacement parts. Typically the components that make up the circuit breaker unit are custom manufactured and not commercially available to a third party except from the original manufacturer. These components are designed for use in specific applications, and their key performance characteristics and requirements are unknown to refurbishers.

Substituting components which appear to be similar may result in dynamic performance shifts of the assembly.

For example:

Insulating materials are selected, and specifically oriented, to create and maintain specific performance and electrical clearances that are critical to the dielectric performance of the circuit breaker and should only be purchased from the original manufacturer of the circuit breaker.

Any alterations to the original circuit breaker design, or use of components not purchased from the original circuit breaker manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

Circuit breakers are tested and calibrated by the original manufacturer on equipment specifically designed to perform this function. These specialized systems not only check functionality but also make measurements of key performance indicators, the parameters of which are unknown to refurbishers. Without this functional step, there is no guarantee that the circuit breaker will perform as intended.

For example:

Circuit breaker operating speed and contact pressure are critical to rated operating performance.

Circuit breakers are critical components of a larger power distribution system. Any repair or customization of such a component – outside of the control of the original circuit breaker manufacturer in possession of the necessary intellectual property and components – is an extremely risky activity, and should only be undertaken by those with the most precise history and understanding of the internal workings of the device: the original manufacturer. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

### Low-Voltage Power Circuit Breakers

Reconditioning by a non-factory-authorized firm is a high risk activity, and should be done with extreme caution, and only when supported by the original circuit breaker manufacturer's parts, and procedurally conducted in accordance with the circuit breaker manufacturer's instructions.

Refurbishment outside of the original manufacturer's components and instructions should be considered impermissible. Outside of this scope, the personnel performing the reconditioning activity must have an extremely high level of access to design documentation and to specialized calibration and test equipment.

While the form, fit, and function of the circuit breaker typically does not change over time, internal components and assemblies may. Without detailed knowledge of the relationship between these internal components, the overall performance of the circuit breaker may be compromised. The design documentation is considered the intellectual property of the original manufacturer and is therefore not available to refurbishers via legitimate means.

Original manufacturers' components must be utilized as replacement parts. Typically the components that make up the circuit breaker unit are custom manufactured and not commercially available to a third party except via the original manufacturer. These components are designed for use in specific applications, and their key performance characteristics are unknown to refurbishers. Substituting components which appear to be similar may result in dynamic performance shifts of the assembly.

For example:

Separable contacts are made from formulations unique to each circuit breaker which are proprietary and commercially unavailable.

Spring materials specified by the original manufacturer are designed to withstand high temperature and other special operating stresses, with those design considerations and material specifications unavailable to refurbishers.

Insulating materials used for arc chutes and baffles have outgassing characteristics that are critical to the performance of the circuit breaker and should only be purchased from the original manufacturer.

Any alterations to the original circuit breaker design, or use of components not purchased from the original circuit breaker manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

Circuit breakers are tested and calibrated by the original manufacturer on equipment specifically designed to perform this function. These specialized systems not only check functionality but also make measurements of key performance indicators, the parameters of which are unknown to refurbishers. Without this functional step, there is no guarantee that the circuit breaker will perform as intended.

For example:

Circuit breaker operating speed and contact pressure are critical to rated operating performance.

Circuit breakers are critical components of a larger power distribution system. Any repair or customization of such a component – outside of the control of the original circuit breaker manufacturer in possession of the necessary intellectual property and components – is an extremely risky activity, and should only be undertaken by those with the most precise history and understanding of the internal workings of the device: the original manufacturer. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

#### **Electronic Trip Units of Low-Voltage Power Circuit Breakers**

Whereas it is possible for an original manufacturer to perform some level of reconditioning of an electronic trip unit manufactured under their control, reconditioning by a non-factory-authorized firm is a high risk activity, and should be impermissible. The personnel performing the reconditioning activity must have an extremely high level of access to design documentation, original parts and to specialized calibration and test equipment.

The design documentation, including controlled firmware versions, is closely held intellectual property of the original manufacturer and is therefore not available to refurbishers via legitimate means.

Original manufacturer components must be utilized as replacement parts. Many components that make up the circuitry of a trip unit are custom manufactured and not commercially available to a third party. These components are designed for use in specific applications, and their key performance characteristics are unknown to refurbishers. Substituting components which have similar, or seemingly identical, ratings may result in dynamic performance shifts of the assembly which would only become apparent at extremes of the performance envelope. Any alterations to the original trip unit design, or use of components not purchased from the original manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

The firmware is typically specifically coded to work with specific configurations of the hardware. Mismatches in the versions can produce incompatibilities which could be catastrophic.

The electronic trip units are tested and calibrated by the original manufacturer on equipment specifically designed to perform this function. These specialized systems not only check external function but also make measurements of key internal quantities, the parameters of which are unknown to refurbishers. Without this functional step, there is no guarantee that the electronic trip unit will perform as intended under all foreseeable circumstances.

Electronic trip units are a component of an overall "tripping system." This is recognized by relevant industry standards, such as IEEE Std C37.17, which describes trip system functionality, including verification and validation requirements. The entire trip system (including the electronic trip unit, associated wiring, additional functional modules, and current sensors) must be considered to determine the acceptability of the system. Only the original manufacturer has enough knowledge to make such an assessment. Although there are some field test guidelines published by manufacturers and third parties to give end users some rough approximation to the general health of the trip system, these are by no means detailed enough, nor entail sufficient process control checks to validate that the performance is as the manufacturer originally intended.

Electronic trip units are a critical component of a larger trip system. Any repair or customization of such a component – outside of the control of the original circuit breaker manufacturer in possession of the necessary intellectual property and components – is an extremely risky activity, and should only be undertaken by those with the most precise history and understanding of the internal workings of the device: the original manufacturer. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

#### **Instrument Transformers**

Instrument transformers (current transformers and voltage transformers) are not refurbishable.

Sealed units have no maintainable parts within, and generally require destruction of insulation structures to obtain access to internal components.

Wrapped (taped) and open transformers utilize specific and proprietary materials, and are generally not suitable to be re-wound or maintained.

Improperly applied varnishes and other insulating and environmental protectants may lead to fracturing of primary or secondary wiring, rendering the device inoperable (usually after some amount of thermal cycling – which makes the potential problem difficult to detect during pre-operation testing).

### Protective Relays and Meters (Electromechanical)

Whereas it is possible for an original manufacturer to perform some level of reconditioning of an electromechanical protective relay that they have manufactured, reconditioning by a non-factory-authorized firm is a high risk activity, and should be impermissible. The personnel performing the reconditioning activity must have an extremely high level of access to design documentation, original parts and to specialized calibration and test equipment.

Original components must be utilized as replacement parts. Essentially all components that make up the circuitry of an electro-mechanical device are custom manufactured and not commercially available to a third party. These components are designed for use in specific applications, and their key performance characteristics are unknown to refurbishers. Substituting components which have similar appearance may result in dynamic performance shifts of the assembly which would only become apparent at extremes of the performance envelope.

Any alterations to the original design, or use of components not purchased from the original manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

While the form, fit, and function of the electro-mechanical device typically does not change over time, internal components and assemblies may. Without detailed knowledge of the relationship between these internal components, the overall performance of the circuit breaker or device may be compromised. The design documentation is closely held intellectual property of the original manufacturer and is therefore not available to refurbishers via legitimate means.

The electro-mechanical devices are tested and calibrated by the original manufacturer on equipment specifically designed to perform this function. These specialized systems not only check external function but also make measurements of key internal quantities, the parameters of which are unknown to refurbishers. Without this functional step, there is no guarantee that the electro-mechanical device will perform as intended under all foreseeable circumstances.

Electro-mechanical protective relays are a critical components of a larger protective system. Any repair or customization of such a component – outside of the control of the original manufacturer in possession of the necessary intellectual property and components – is an extremely risky activity, and should only be undertaken by those with the most precise history and understanding of the internal workings of the device: the original manufacturer. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

### Protective Relays and Meters (Solid-State)

Whereas it is possible for an original manufacturer to perform some level of reconditioning of a meters and protective relays they have manufactured, reconditioning by a non-factory-authorized firm is a high risk activity, and should be impermissible. The personnel performing the reconditioning activity must have an extremely high level of access to design documentation, original parts and to specialized calibration and test equipment.

The design documentation, including controlled firmware versions, is closely held intellectual property of the original manufacturer and is therefore not available to refurbishers via legitimate means.

Original manufacturers' components must be utilized as replacement parts. Many components that make up the circuitry of a meter or protective relay are custom manufactured and not commercially available to a third party. These components are designed for use in specific applications, and their key performance characteristics are unknown to refurbishers. Substituting components which have similar, or even identical, ratings may result in dynamic performance shifts of the assembly which would only become apparent at extremes of the performance envelope.

Any alterations to the original design, or use of components not purchased from the original manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

The firmware is typically specifically coded to work with specific configurations of the hardware. Mismatches in the versions can produce incompatibilities which could be catastrophic.

The meters and protective relays are tested and calibrated by the original manufacturer on equipment specifically designed to perform this function. These specialized systems not only check external function but also make measurements of key internal quantities, the parameters of which are unknown to refurbishers. Without this functional step, there is no guarantee that the meter or protective relay will perform as intended under all foreseeable circumstances.

Meters and protective relays are critical components of a larger protective system. Any repair or customization of such a component – outside of the control of the original manufacturer in possession of the necessary intellectual property and components – is an extremely risky activity, and should only be undertaken by those with the most precise history and understanding of the internal workings of the device: the original manufacturer. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

### Medium-Voltage Metal-Clad Switchgear

Whereas it is possible for a refurbisher to conduct some level of reconditioning of switchgear assemblies, careful consideration should be undertaken before commencing such activity.

For the switchgear enclosure ("the sheet metal box" portion) of the equipment (not including mechanisms, bus structures and ventilation features), a fair amount of refurbishment by someone other than the original manufacturer is possible. This is because there are few highly technical items related to this portion of the enclosure. All that the personnel performing the reconditioning activity need to do is maintain the structural integrity (basic strength) and environmental compatibility (finishes) of the enclosure. Outside of this scope, the personnel performing the reconditioning activity must have an extremely high level of access to design documentation.

Otherwise, refurbishment of other components by use of assemblies not of the original manufacturer's components and instructions should be considered impermissible.

Assemblies such as racking, interlocking, MOC/TOC mechanisms, shutters, etc. should not be refurbished by anyone other than the original manufacturer. The personnel performing the reconditioning activity must have an extremely high level of access to design documentation, original parts and to specialized calibration & test equipment. Material specifications, tolerances and production/inspection processes can be critical to ensuring proper performance but may not be as evident to a refurbisher at first glance.

For example:

A part may have slotted holes where it mounts into the enclosure to allow for adjustment. Someone that does not have access to the production inspection/test plan may think the slots are for ease of assembly and the proper adjustment could be ignored when refurbishing the enclosure.

Finishes, spring materials and the application of lubricants can also have a significant impact on the performance of these mechanisms.

The use of the original manufacturer's materials intended for isolation and support of conductors is critical to the physical integrity and the dielectric strength of the switchgear. Many of these components are specially designed molded structures. The personnel performing the reconditioning activity must have an extremely high level of access to design documentation, original parts and to specialized calibration and test equipment. If replacement insulators and supports are not from the original manufacturer then there is no guarantee that the switchgear would survive its rated short circuit current during a fault, or that the insulation level of the gear would be sufficient.

Additionally, the dielectric and heat generation properties of the equipment are not only dependent upon the clearances

provided but also the insulation used. Without the original manufacturer's involvement (providing material properties and clearance guidelines which are often proprietary), requiring the refurbisher to perform some level of conformance testing is highly recommended but eliminating the possibility of refurbishment is not necessary.

Any alterations to the original design, or use of components not purchased from the original manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

Lastly, when it comes to arc-resistant switchgear, refurbishment by someone other than the original manufacturer should never be permitted. Only the original manufacturer has the most precise history and understanding of the internal workings of the system and the risks associated with the equipment. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

### Low-Voltage Metal-Enclosed Switchgear

Reconditioning by a non-factory-authorized firm is a high risk activity, and should be done with extreme caution, and only when supported by the original circuit breaker manufacturer's parts, and procedurally conducted in accordance with the circuit breaker manufacturer's instructions.

Refurbishment outside of the original manufacturer's components and instructions should be considered impermissible. Outside of this scope, the personnel performing the reconditioning activity must have an extremely high level of access to design documentation and to specialized calibration and test equipment.

While the form, fit, and function of the circuit breaker typically does not change over time, internal components and assemblies may. Without detailed knowledge of the relationship between these internal components, the overall performance of the circuit breaker may be compromised. The design documentation is considered the intellectual property of the original manufacturer and is therefore not available to refurbishers via legitimate means.

Original manufacturers' components must be utilized as replacement parts. Typically the components that make up the circuit breaker unit are custom manufactured and not commercially available to a third party except via the original manufacturer. These components are designed for use in specific applications, and their key performance characteristics are unknown to refurbishers. Substituting components which appear to be similar may result in dynamic performance shifts of the assembly.

For example:

Separable contacts are made from formulations unique to each circuit breaker which are proprietary and commercially unavailable.



Spring materials specified by the original manufacturer are designed to withstand high temperature and other special operating stresses, with those design considerations and material specifications unavailable to refurbishers.

Insulating materials used for arc chutes and baffles have outgassing characteristics that are critical to the performance of the circuit breaker and should only be purchased from the original manufacturer.

Any alterations to the original circuit breaker design, or use of components not purchased from the original circuit breaker manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

Circuit breakers are tested and calibrated by the original manufacturer on equipment specifically designed to perform this function. These specialized systems not only check functionality but also make measurements of key performance indicators, the parameters of which are unknown to refurbishers. Without this functional step, there is no guarantee that the circuit breaker will perform as intended.

For example:

Circuit breaker operating speed and contact pressure are critical to rated operating performance.

Circuit breakers are critical components of a larger power distribution system. Any repair or customization of such a component – outside of the control of the original circuit breaker manufacturer in possession of the necessary

intellectual property and components – is an extremely risky activity, and should only be undertaken by those with the most precise history and understanding of the internal workings of the device: the original manufacturer. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

provided but also the insulation used. Without the original manufacturer's involvement (providing material properties and clearance guidelines which are often proprietary), requiring the refurbisher to perform some level of conformance testing is highly recommended but eliminating the possibility of refurbishment is not necessary.

Any alterations to the original design, or use of components not purchased from the original manufacturer, is not a refurbishment – but a conversion. All conversions must be validated in accordance with ANSI/IEEE Std C37.59.

Lastly, when it comes to arc-resistant switchgear, refurbishment by someone other than the original manufacturer should never be permitted. Only the original manufacturer has the most precise history and understanding of the internal workings of the system and the risks associated with the equipment. Failure to understand and mitigate these risks properly will result in a high risk of death, injury, equipment damage, and property damage.

**Notes:**

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