**PROPOSALS FOR REDMINE 6811, MINNEAPOLIS MEETING 19 SEPTEMBER 2024 – V3**

**Definition for class Wires::ExternalNetworkInjection.**

Existing definition

This class represents the external network and is used for IEC 60909 calculations. It is only used if EquivalentInjection cannot provide the details required by IEC 60909 on short circuit equivalent of an external network.

Proposal Tokio June 2024

This is an open TODO as part of this issue.

Proposal Minneapolis September 2024

This class represents the external network for use in power flow and short‑circuit calculations.

In the power flow domain the external network is modelled as a power injection with power limits and a power-frequency bias. For short‑circuit calculations the external network is modelled as the “network feeders” element defined in section 6.2 of IEC60909-0:2016. Boolean flag ikSecond allows short‑circuit calculations using the superposition method to detect that the maximum and minimum initial symmetrical short-circuit currents have to be corrected for the fact that they were calculated according the IEC60909‑0 method.

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| **Attribute** | **Current description** | **New description** |
| ikSecond | Indicates whether initial symmetrical short-circuit current and power have been calculated according to IEC (Ik").  Used only if short circuit calculations are done according to superposition method. | Indicates whether the maximum and minimum initial symmetrical short-circuit currents (Ik” max and Ik” min) have been calculated according to the IEC 60909-0 method. Is only used in short‑circuit calculations done according to the superposition method. |
| maxInitialSymShCCurrent | Maximum initial symmetrical short-circuit currents (Ik" max) in A (Ik" = Sk"/(SQRT(3) Un)). Used for short circuit data exchange according to IEC 60909. | Maximum initial symmetrical short-circuit current (Ik" max) in A.  Ik” is defined in clause 3.5 of IEC60909‑0:2016. |
| maxQ | Maximum reactive power limit. It is used for modelling of infeed for load flow exchange and not for short circuit modelling. | Maximum reactive power of the injection. Used for modelling of infeed for load flow exchange. Not used for short‑circuit modelling. |
| maxR0ToX0Ratio | Maximum ratio of zero sequence resistance of Network Feeder to its zero sequence reactance (R(0)/X(0) max). Used for short circuit data exchange according to IEC 60909. | Maximum ratio of zero sequence resistance to zero sequence reactance (R(0)/X(0) max).  R0 and X0 are the real and imaginary parts of the zero sequence short‑circuit impedance Z0 defined in clause 3.19.3 of IEC60909-0:2016. |
| maxR1ToX1Ratio | Maximum ratio of positive sequence resistance of Network Feeder to its positive sequence reactance (R(1)/X(1) max). Used for short circuit data exchange according to IEC 60909. | Maximum ratio of positive sequence resistance to positive sequence reactance (R(1)/X(1) max).  R1 and X1 are the real and imaginary parts of the positive sequence short‑circuit impedance Z1 defined in clause 3.19.1 of IEC60909-0:2016. |
| maxZ0ToZ1Ratio | Maximum ratio of zero sequence impedance to its positive sequence impedance (Z(0)/Z(1) max). Used for short circuit data exchange according to IEC 60909. | Maximum ratio of zero sequence impedance to its positive sequence impedance (Z(0)/Z(1) max).  Z0 is the zero sequence short‑circuit impedance defined in clause 3.19.3 of IEC60909-0:2016. Z1 is the positive sequence short‑circuit impedance defined in clause 3.19.1 of IEC60909‑0:2016. |
| minInitialSymShCCurrent | Minimum initial symmetrical short-circuit currents (Ik" min) in A (Ik" = Sk"/(SQRT(3) Un)). Used for short circuit data exchange according to IEC 60909. | Minimum initial symmetrical short-circuit current (Ik" min) in A.  Ik” is defined in clause 3.5 of IEC60909‑0:2016. |
| minQ | Minimum reactive power limit. It is used for modelling of infeed for load flow exchange and not for short circuit modelling. | Minimum reactive power of the injection. Used for modelling of infeed for load flow exchange. Not used for short‑circuit modelling. |
| minR0ToX0Ratio | Indicates whether initial symmetrical short-circuit current and power have been calculated according to IEC (Ik"). Used for short circuit data exchange according to IEC 60909. | Minimum ratio of zero sequence resistance to zero sequence reactance (R(0)/X(0) min).  R0 and X0 are the real and imaginary parts of the zero sequence short‑circuit impedance Z0 defined in clause 3.19.3 of IEC60909-0:2016. |
| minR1ToX1Ratio | Minimum ratio of positive sequence resistance of Network Feeder to its positive sequence reactance (R(1)/X(1) min). Used for short circuit data exchange according to IEC 60909. | Minimum ratio of positive sequence resistance to positive sequence reactance (R(1)/X(1) min).  R1 and X1 are the real and imaginary parts of the positive sequence short‑circuit impedance Z1 defined in clause 3.19.1 of IEC60909-0:2016. |
| minZ0ToZ1Ratio | Minimum ratio of zero sequence impedance to its positive sequence impedance (Z(0)/Z(1) min). Used for short circuit data exchange according to IEC 60909. | Minimum ratio of zero sequence impedance to its positive sequence impedance (Z(0)/Z(1) min).  Z0 is the zero sequence short‑circuit impedance defined in clause 3.19.3 of IEC60909-0:2016. Z1 is the positive sequence short‑circuit impedance defined in clause 3.19.1 of IEC60909‑0:2016. |
| voltageFactor | Voltage factor in pu, which was used to calculate short-circuit current Ik" and power Sk".  Used only if short circuit calculations are done according to superposition method. | Voltage factor (c) in pu which has been used to calculate the maximum and minimum initial symmetrical short-circuit currents (Ik” max and Ik” min). Is only used in short‑circuit calculations done according to the superposition method.  The voltage factor is defined in clause 3.15 of IEC60909-0:2016. |

**Definition for class: Equivalent::EquivalentInjection**

Existing definition

This class represents equivalent injections (generation or load). Voltage regulation is allowed only at the point of connection. Using EquivalentInjection to model a distribution network equivalent is recommended practice instead of using ExternalNetworkInjection-s if it is not necessary that the equivalent contains detailed information representing a short circuit equivalent according to IEC 60909 which is relevant for short circuit studies.

Proposal Tokio June 2024

This class represents networks that have been equivalized using either the ward or extended ward method.

Proposal Minneapolis September 2024

This class represents networks that have been equivalized using either the Ward or extended Ward method.

A Ward equivalent is a combination of an impedance load and a PQ load. An extended Ward equivalent is a combination of an impedance load, a PQ load and as voltage source with an internal impedance.

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| **Attribute** | **Current description** | **New description** |
| maxQ | Maximum reactive power of the injection.  Used for modelling of infeed for load flow exchange. Not used for short circuit modelling. If maxQ and minQ are not used ReactiveCapabilityCurve can be used. | Maximum reactive power of the injection. Used for modelling of infeed for load flow exchange. Not used for short‑circuit modelling. If maxQ and minQ are not used ReactiveCapabilityCurve can be used. |
| minQ | Minimum reactive power of the injection.  Used for modelling of infeed for load flow exchange. Not used for short circuit modelling. If maxQ and minQ are not used ReactiveCapabilityCurve can be used. | Minimum reactive power of the injection. Used for modelling of infeed for load flow exchange. Not used for short‑circuit modelling. If maxQ and minQ are not used ReactiveCapabilityCurve can be used. |
| r | Positive sequence resistance. Used to represent Extended-Ward (IEC 60909).  Usage : Extended-Ward is a result of network reduction prior to the data exchange. | Positive sequence resistance. Used to represent (extended) Ward equivalent. |
| r0 | Zero sequence resistance. Used to represent Extended-Ward (IEC 60909).  Usage : Extended-Ward is a result of network reduction prior to the data exchange. | Zero sequence resistance. Used to represent (extended) Ward equivalent. |
| r2 | Negative sequence resistance. Used to represent Extended-Ward (IEC 60909).  Usage : Extended-Ward is a result of network reduction prior to the data exchange. | Negative sequence resistance. Used to represent (extended) Ward equivalent. |
| x | Positive sequence reactance. Used to represent Extended-Ward (IEC 60909).  Usage : Extended-Ward is a result of network reduction prior to the data exchange. | Positive sequence reactance. Used to represent (extended) Ward equivalent. |
| x0 | Zero sequence reactance. Used to represent Extended-Ward (IEC 60909).  Usage : Extended-Ward is a result of network reduction prior to the data exchange. | Zero sequence reactance. Used to represent (extended) Ward equivalent. |
| x2 | Negative sequence reactance. Used to represent Extended-Ward (IEC 60909).  Usage : Extended-Ward is a result of network reduction prior to the data exchange. | Negative sequence reactance. Used to represent (extended) Ward equivalent. |