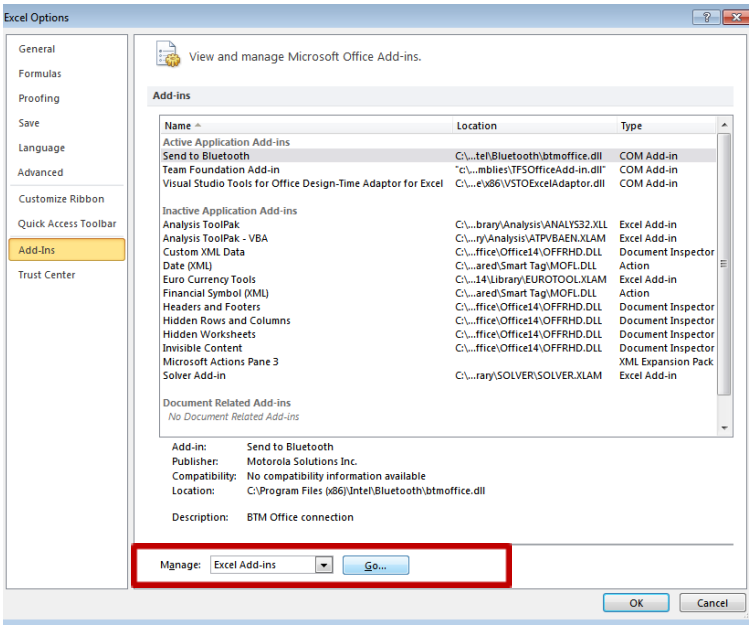
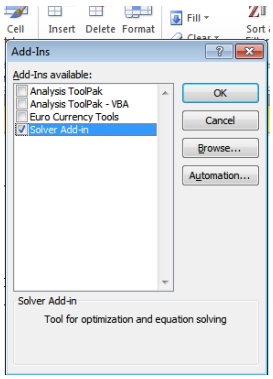
SETUP

1. Open Microsoft Excel. Navigate to File->Options->Add-Ins. Click Go in Manage excel add-ins.



2. Make sure the Solver Add-in is checked. Click OK.



3. In Excel, Navigate to Developer->Visual Basic

4. In Visual Basic, Navigate to Tools->References. If you see any of the “Available References” starting with “MISSING” – uncheck them and click OK.

*****Please be informed that this tool works well with Microsoft office 2010 or higher. There may be incompatibility issues with older versions.*****

TOOL SPECIFICS

RESET: *Clicking the* ***RESET*** *button will clear all the input fields with red colored text except for the grid side and MV transformer sequence impedances.*

CALCULATE: *Clicking the* ***CALCULATE*** *button will populate the current contributions in the cells with green colored text.*

The user can input information in the following cells per the requirements of Efffective grounding specific to the project:

Source voltage (V_S) for fault calculations in pu

This is the voltage that will be used to calculate fault contributions from the inverter and the user entered value for this field shall be between 0.95 and 1.05 pu.

Voltage at Inverter POI (V_{INV}) in kV

This is the L-L RMS rated voltage at the point of interconnection where the inverter(s) is(are) connected to. For Solectria SGI and PVI series inverters, the neutral reactor or grounding transformer can be connected either to the LV or HV side of the interface transformer.

Inverter model from drop down

The user can select the model of the Solectria inverters required. Only one model may be selected per project.

Number of inverters

The user can select the number of inverters required for the project from this drop down field

Effective grounding criterion

The user can enter either the X_0 value in pu or X_0/X_1 ratio according to the utility's grounding requirements. The user values shall be greater than 0.05 pu for X_0 and X_0/X_1.

The user can refer to the Whitepaper titled 'Effective Grounding For PV Plants' which is provided in the zip file downloaded from the Solectria website to learn further about the two approaches for effective grounding. Eq (1) having X_0/X_1 ratio is suggested in IEEE 142, whereas the Eq (2) with X_0 value in pu is the approach proposed in IEEE P1547.8.

% Voltage imbalance ($\%V_{imbalance}$)

This is the percent voltage imbalance at the point of interconnection as provided by the utility. This value should be between 0 and 20%.

$$V_{imbalance} = \frac{\max(|V_{average} - V_a|,\ |V_{average} - V_b|,\ |V_{average} - V_c|)}{V_{average}}$$

% Zero Sequence Voltage

This is the percent zero sequence voltage component at the point of interconnection as provided by the utility. This value is the result of the imbalance present at the POI during normal operating conditions. This value should be between 0 and 10%.

Grounding Device Option

The user can select the grounding device required for the project - namely neutral grounding reactor or grounding transformer

R_{L1}, R_{L2}, R_{L0}, X_{L1}, X_{L2}, X_{L0}

The user can enter the positive, negative and zero sequence resistance and reactance components of the line impedance Z_L, respectively as provided by the utility. The user-values for all these components shall be greater than or equal to 0.001 pu.

The user may note that the positive and negative sequence impedances on a distribution feeder are equal. Hence if the utilities provide only the positive sequence impedance, the user can copy this same value into the negative sequence impedance as well.

MVA base, kV base

These are the system base MVA and kV values used by the utility to provide the sequence impedances from the grid side.The user-values for these base values shall be between 0.5 and 100.

$Z_{MV\ XFMR}$, MVA, X/R

These are the percent leakage impedance, system base MVA and X/R values respectively of the medium voltage transformer. The user entered MVA value shall be between 0.5 and 100 and X/R value shall be between 0.01 and 10. The user entered leakage impedance shall be greater than equal to 0.001 pu.

The Calculated ground current contributions and grounding device impedances are provided in the following fields:

Neutral Grounding Reactor Impedance (X_{GR})

This is the impedance that is connected to the neutral of individual inverter(s)

Leakage impedance of Grounding transformer (X_{GXFMR})

This is the leakage impedance of the grounding transformer that is connected at the POI for the PV plant

Ground current contribution from voltage imbalance ($I_{imbalance}$)

This is the ground current at the POI in each grounding device resulting from imbalance. For neutral reactors, note that each individual neutral reactor will be subjected to this ground fault current.

Ground Fault current contribution from Grid (I_{F_GRID})

This is the ground current at the POI in the grounding devices contributed from the grid. For neutral reactors, note that each individual neutral reactor will be subjected to this ground fault current.

Ground Fault current contribution from inverter(s) (I_{F_INV})

This is the ground current at the POI for the PV plant from the inverter(s). For neutral reactors, note that each individual neutral reactor will be subjected to this ground fault current.

System Voltage Used for calculations at POI

This is the system voltage used for the fault current contributions at the point of interconnection - on the inverter(s) side of the MV transformer