# Remarks about Spanish Network (The one without the distribution transformer)

1. The provided Spanish network data refers to only deterministic single-period. Furthermore, no issues (over-voltage and/or congestions) are observed in the network. In order to validate the S-MP-OPF tool, following changes are made in the given data.
2. Active and reactive load profiles are developed for 24-hour period using the low-voltage load profile data provided by Comillas team.
3. Voltage at few 20 kV nodes is restricted to 0.95 – 1.05 bounds. The nodes where the voltage is restricted are:

|  |  |
| --- | --- |
| 7969 | 8486 |
| 7970 | 8577 |
| 7971 | 8611 |
| 7972 | 8633 |
| 7973 | 8634 |
| 7974 | 8646 |
| 7975 | 8680 |
| 7976 | 8689 |
| 7977 | 8729 |
| 7978 |  |

1. After restricting the voltage bounds at these nodes, renewable energy resources are connected at the following nodes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 7969 | 7970 | 7971 | 7972 | 7977 |
| 7973 | 7974 | 7975 | 7976 | 7978 |

Initially, solar PVs were connected at these nodes in a bid to create overvoltage problem. However, it is noted that no over-voltage was observed even when 6MW solar PV is connected at each node. As such I changed the renewable energy type to wind (even though there might not be wind turbine connected in the low-voltage system in near future) in order to see whether overvoltage problem can be occurred during the night or in early morning time. As such, the over-voltage was observed at multiple nodes during time-period 2, 3, 4, 5 and 6 hrs.

1. To maintain the network safe operation, various flexible options are used to remove the over voltage. The considered flexible options are active power curtailment and its combination with OLTC tap ratio, flexible loads, storages and adaptive power factor.
2. Flexible loads are connected at nodes

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 7966 | 7967 | 7968 | 7969 | 7970 | 7971 | 7973 | 7975 |
| 7976 | 7977 | 7979 | 7980 | 7981 | 7983 | 7984 |  |

1. Storages are connected at nodes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 7969 | 7970 | 7971 | 7972 | 7973 |
| 7974 | 7975 | 7976 | 7977 | 7978 |

1. It is observed that over-voltage problem is removed by utilizing each flexible option and/or multiple combination of flexible options. This shows that the developed tool can procure flexibility from different distributed energy resources to maintain the safe operation of the network.