A Modified Version of The IEEE 24-bus Reliability Test System

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October 30, 2018

This document provides the network model used in the out-of-sample analysis of [1]. We build our model upon the IEEE 24-bus Reliability Test System [2] and the economic data available in [3]. The system is represented in Fig. 1.

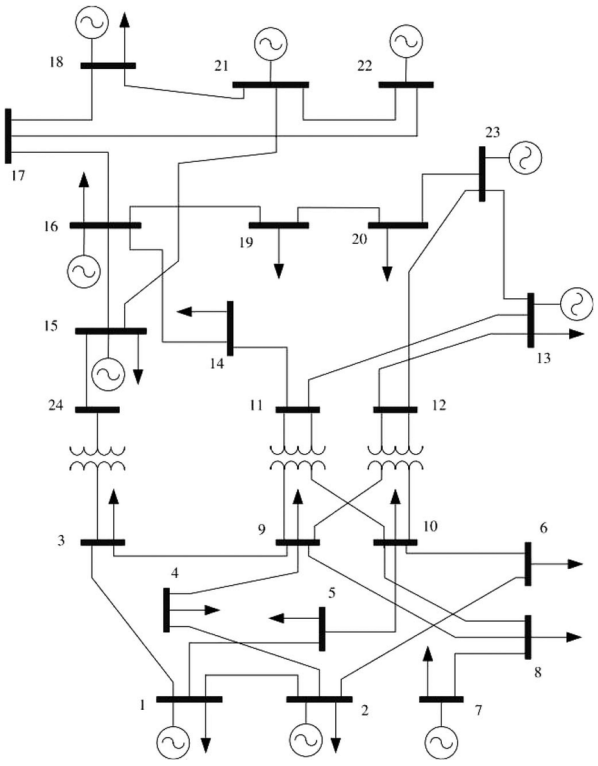

Fig. 1: IEEE RTS 24-bus network case study

The network data given by Table 1 has been updated. It includes generator parameters such as location bus, production cost C_g in €/MWh, upward regulation power cost C_g^{U} in €/MWh, downward regulation power cost C_g^{D} in €/MWh, maximum capacity $P_g^{\max}$ in MW, maximum upward regulation capability $R_g^{\mathrm{U,max}}$ in MW and maximum downward regulation capability $R_g^{\mathrm{D,max}}$ in MW. The 12 generators total capacity is 2,362 MW, including 672 MW of upward

or downward total flexibility.

Wind farms are also connected to network on buses 3, 5, 16 and 21 enabling power system studies with high share of renewable generation. The corresponding day-ahead wind forecast P_q in MW, maximum wind farm capacity $P_q^{\max}$ in MW, expected value in MW and uncertainty level are also given in Table 1. For a total capacity of 3,200 MW, the wind penetration level is equal to 29.6 %.

The 17 loads gather 2,207 MW of power demand. Their respective location node, consumption P_l in MW and value of curtailed load V_l^{curt} in €/MWh are referred in Table 1. The lines are characterized by the buses they connect, their per-unit reactance X_{mn} as well as their maximum line capacity $F_{mn}^{\max}$ in MW.

Table 1: Network parameters

Generators						1	2	3	4	5	6	7	8	9	10	11	12
Bus						1	2	7	13	15	15	16	18	21	22	23	23
C_g [€/MWh]						13.32	13.32	20.7	20.93	26.11	10.52	10.52	6.02	5.47	7	10.52	10.89
C_g^{U} [€/MWh]						15	15	24	25	28	16	16	11	11	15	14	16
C_g^{D} [€/MWh]						11	11	16	17	23	7	7	1	0.5	1	8	8
$P_g^{\max}$ [MW]						106.4	106.4	245	413.7	42	108.5	108.5	280	280	210	217	245
R_g^{U} [MW]						40	40	70	180	42	30	30	50	50	40	60	40
R_g^{D} [MW]						40	40	70	180	42	30	30	50	50	40	60	40
Wind farms														1	2	3	4
Bus														3	5	16	21
P_q [MW]														245	240	115	85
$P_q^{\max}$ [MW]														1000	1000	600	600
Expected value [MW]														239.5	231.0	106.9	76.9
Uncertainty level [%][a]														63.0	60.1	59.2	78.5
Loads	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Bus	1	2	3	4	5	6	7	8	9	10	13	14	15	16	18	19	20
P_l [MW]	84	75	139	58	55	106	97	132	135	150	205	150	245	77	258	141	100
V_l^{curt} [€/MWh]	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Lines: From bus	1	1	1	2	2	3	3	4	5	6	7	8	8	9	9	10	10
To bus	2	3	5	4	6	9	24	9	10	10	8	9	10	11	12	11	12
X_{mn} [pu][b]	0.0146	0.2253	0.0907	0.1356	0.205	0.1271	0.084	0.111	0.094	0.0642	0.0652	0.1762	0.1762	0.084	0.084	0.084	0.084
F_{max} [MW]	175	175	350	175	175	175	400	175	350	175	350	175	175	400	400	400	400
Lines: From bus	11	11	12	12	13	14	15	15	15	16	16	17	17	18	19	20	21
To bus	13	14	13	23	23	16	16	21	24	17	19	18	22	21	20	23	22
X_{mn} [pu]	0.0488	0.0426	0.0488	0.0985	0.0884	0.0594	0.0172	0.0249	0.0529	0.0263	0.0234	0.0143	0.1069	0.0132	0.0203	0.0112	0.0692
F_{max} [MW]	500	500	500	500	250	250	500	400	500	500	500	500	500	1000	1000	1000	500

[a] Uncertainty level is computed as the ratio between standard deviation and expected value.
[b] $X_{mn} = 1/B_{mn}$

References

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[3] C. Ordoudis, P. Pinson, J. M. Morales and M. Zugno, "An Updated Version of the IEEE RTS 24-Bus System for Electricity Market and Power System Operation Studies", Technical University of Denmark (DTU), 2016.