Memo to: Netbeheer Nederland	**Memo Nr.:**	10132353-PSA 21-0725 rev. 3
	From:	Energy Systems
	Date:	17-7-2025
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Explanation BLOS load flow tool Type B PGM revision 2-7-2025

1 INTRODUCTION

In the Netbeheer Nederland document "Power-Generating Modules compliance verification" for Type B, C and D, a simulation is prescribed to show that the Netcode requirements for reactive power capability are met. This BLOS tool (type **B LO**ad flow **S**imulation) has been developed as a tool in the Compliance process for Type B Power Park Modules. This can be used for this purpose if it concerns a "Basic Park Type B" (definition see below). Based on the rated capacities of the inverters (PV inverter, wind turbine), transformers and cables to be filled in, the tool calculates the active and reactive power (MW, Mvar) at the connection point and shows the results in table and graph form. This assesses whether the requirements of Netcode are met.

Note: The PPM owner/developer remains responsible for demonstrating Compliance to the network operator and cannot derive any rights or rely on the application or outcomes of this tool. DNV is not liable for any direct or indirect consequences when using this tool. It is not permitted to use this tool for purposes other than as a tool for Type B compliance activities, to copy and/or share with parties other than the network operator.

2 BLOS LOAD FLOW TOOL FOR BASIC PARK PPM TYPE B

In this tool a simple park grid configuration can be modeled if this grid meets the principles of a basic park, see chapter 3: Connection point - MV connection - MV installation - MV connection - MV/LV transformer – LV connection – inverters. An MV or LV connection consists of one or more parallel three-phase cables or, in the case of single-core cables, one or more parallel three-phase circuits. A MS connection between the Connection point and the central medium voltage distribution station on the park is modelled separately. Furthermore, the average length of the MV and LV connections to the transformers in the park is to be determined. You specify the number of parallel cables between transformers and central MV park installation in the model per transformer. The same applies to the LV connection, which connects the transformer to the inverters/wind turbine.

You specify the number of transformers. In the base park we assume identical transformers that are connected to an equal number of parallel MS cables to the central MV distribution station and an equal number of parallel LV cables to the inverters. Short LV cables from the individual inverter to a collection cabinet are neglected.

The total number of inverters to be specified is the total number in the entire PV park, not per transformer. The number of inverters per transformer is therefore determined by a calculation. Again, for the model, we assume that the number of inverters per transformer is the same. The rated data of the inverter to be filled in must come from inverter certificates/data sheets.

The transformers are usually equipped with tapping selector switch. We assume a switch with 5 positions with a voltage change on the medium voltage side of 2.5% per step. The position must correspond to the actual position in the installation. If no switch is present, select position 0. Position adjustment gives a change of 2.5% per step in the primary voltage and results in a shift of the Q-U window. This may be necessary to demonstrate compliance.

3 STARTING POINTS FOR USE

3.1 Basic park

Starting points for using this simple BLOS load flow tool and basic park configuration shown schematically in Figure 1 (top scheme) are:

- Inverters of one type
- Connection inverters to MS/LS transformers via LS cable (one or more parallel) (LS cables). Maximum length of LS cables: 500 meters
- One or more MS/LS transformers of one type, equipped with a tapping selector switch. If no switch is installed, select position 0
- Equal distribution of inverters over MS/LS transformers. A difference in distribution of up to 2 inverters per transformer is acceptable
- Connection of individual MS/LS transformers via MS cable (MS-TR) to a central MS distribution station (MS). One or more cables in parallel. Length MS cable up to 2 km
- Connection Central MS distribution station (MS) via MS cables (OP-MS) to the connection point (OP). One or more cables in parallel. Length MS cable up to 10 km
- Grid operator MS station (“inkoopstation”/överdrachtspunt”/connection point) (OP)
- Radial cable network, not meshed, no crossings
- No reactive power compensation

3.2 Sub parks and shared MS connection

It might be the case that a park configuration does not meet the starting points, but consists of sections ("sub parks") that do comply. In that case, a BLOS model can be used per sub park. If all sub parks comply, the entire park will also comply. The BLOS tool for all sub parks must then be submitted to the grid operator.

Exceptionally, the BLOS tool can also be used for a park, where the transformers are connected to the connection point by a common medium voltage connection (shared MS connection). This is shown in the lower diagram in Figure 1. for the connections MS cable #1-2/#2-3/#3-4. However, the total length of the connection between 1st transformer (MS#1) and last transformer (MS#4) shall not exceed 2000 meters. When entering cable connection OP-MS, the cable type connected to the connection point (purchasing station) must be chosen with a length from the grid operator station to the first transformer station (MS#1) plus half of the total length of the connection from the transformer station MS#1 to MS#4 (maximum 1000 meters). Set the MS-TR cable to 0 meters in this case.

If the PV/wind turbine park does not meet these principles, you must use a dedicated load flow simulation package.

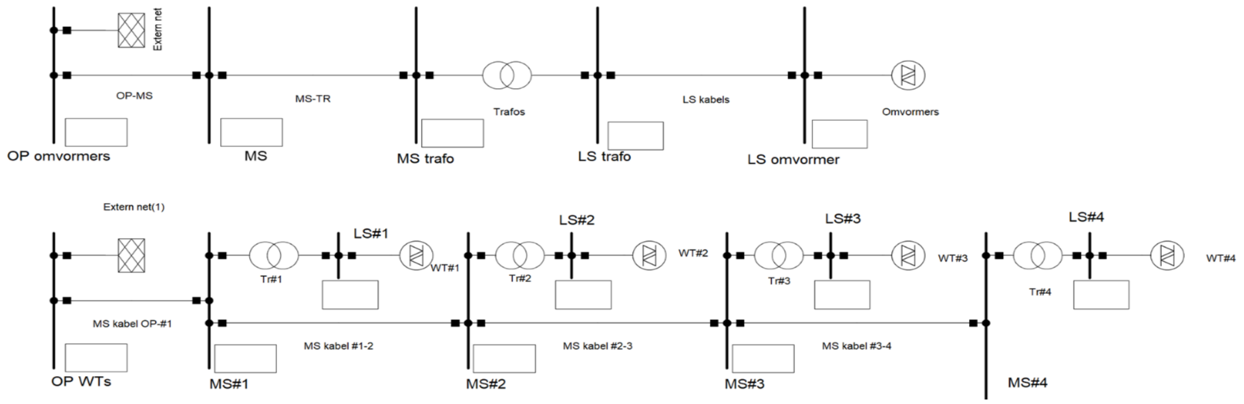


Figure 1 Schematic representation of the base parks

3.3 3-winding transformers

In storage installations and partly also in PV installations, it is common to use 3-winding transformers with 1 primary (medium voltage) winding and 2 secondary (low voltage) windings. Although the BLOS tool has not been set up for this purpose, this tool can still be used under certain conditions. The conditions are:

- The rated power of the two secondary windings is identical and is half the rated power of the primary winding
- Both low-voltage windings have the same rated voltage
- The short-circuit impedance between primary and the individual secondary windings is identical
- The short-circuit impedance between the 2 secondary windings is more than 1.5 times the short-circuit impedance between the primary and one secondary winding, based on the rated power of the secondary winding. This value is usually missing from the data sheet and must then be provided by the supplier of the transformer.
- Data sheets, factory tests or other manufacturer documentation show that the above conditions are met.

If these conditions are met, an "eigen type" transformer must be entered in the BLOS tool. The parameters for this can be derived from a data sheet or factory test report with:

- Power (“Vermogen”): primary winding rated power in kVA
- No-load loss (“Nullastverlies”): in accordance with data sheet
- Short-circuit loss (“Kortsluitverlies”): according to datasheet with rated load of primary winding of the transformer
- Short-circuit impedance (“Kortsluitspanning”): the short-circuit impedance measured with both secondary windings short-circuited. This is usually the short-circuit voltage according to the datasheet if only one short-circuit impedance is specified in the datasheet.

In addition, data sheet, factory test report or other manufacturers’ documentation stating the short-circuit impedance between the secondary windings of the transformer must be attached to the final PGMD form.

4 SHEETS IN BLOS TOOL

4.1 Input and Results sheet ("Invoer en resultaten")

4.1.1 Input data

In the "Invoer en resultaten" sheet, the data of the park must be entered: inverters/wind turbines, low and medium voltage cables and transformers. The input cells are shown in Figure 2. There is an internal library with cables and transformers, from which you can choose. In addition, it is possible to add medium voltage cables (2 types), low-voltage cables (1 type) and transformer (1 type) with corresponding parameters yourself. The white colored fields are to be used to enter the corresponding data yourselves.

The block OP-MS cables concern the cables from the connection point to the central MS park installation. The block MS-TR cables concern the cables from the central MS park installation to the transformer(s). If the connection point is located on the central MS park installation, fill in a length of 0 meters for the OP-MS cables, but choose a (random) type.

Fill in the rated primary and secondary voltage at the transformer. A tap selector switch with 5 positions (respectively +2, +1, 0, -1, -2) has been assumed. The selected position must correspond to the actual position in the installation. Position adjustment gives a change of 2.5% per step in the primary voltage and results in a shift of the Q-U window. This may be necessary to achieve compliance.

Each input field is accompanied by a note with a brief explanation. The text becomes visible when the cell is clicked.

Details:

- For inverters and wind turbines, enter values according to manufacturer's information. At maximum and minimum voltage, take into account the actual settings over and under voltage protection
- MS-TR cables and LS cables to transformers can have different lengths. Assume the average length of the cables
- If there is no OP-MS cable, because there is a connection point at the central MS installation of the park, to which the transformers are also connected, then choose a type for OP-MS cable but fill in length of 0 meters.
- If no tap selection switch is installed, select position

Invoergegevens		
Naam PGM	Demo park	
Type omvormers	Fabricaat/type	
Omvormers	Totaal aantal omvormers	50
	Schijnbaar vermogen omvormer Snom (kVA)	250
	Werkzaam vermogen omvormer Pnom (kW)	250
	Maximaal blindvermogen levering omvormer (kvar)	250
	Maximaal blindvermogen opname omvormer (kvar)	-250
	Nominale spanning Unom (V)	550
	Maximale stroom I max (A)	262
	Maximale spanning Umax (V)	605
	Minimale spanning Umin (V)	467
	Maximale kortsluitstroom (A)	270
LS kabels Omvormers naar transformatoren	aantal (driefasen)kabels parallel per transformator	10
	Lengte per kabel (km)	0.20
	Doorsnede geleider kabel (mm2)	240 Al
MS trafos Transformatoren	aantal transformatoren	5
	Schijnbaar vermogen S (kVA)	2500
	Nominale spanning primair Ums (kV)	10.50
	Nominale spanning secundair Uls (kV)	0.55
	Positie aftakschakelaar (0=nom. overzetverhouding)	+2
MS TR kabel Transformatoren naar MS verzamelstation	Aantal (driefasen)kabels parallel per transformator	1
	Lengte per kabel (km)	0.50
	Doorsnede geleider kabel (mm2)	95 Al
OP-MS kabels MS verzamelstation naar overdrachtspunt	Aantal (driefasen)kabels parallel naar overdrachtspunt	2
	Lengte per kabel (km)	5.00
	Doorsnede geleider kabel (mm2)	500 Al
NET	Toegekende netspanning Uc (kV):	10.50

BLOS Excel load flow tool Type B PGM revisie per 17-07-2025
Alleen voor eenvoudige basisparken/ only for simple basic parks

Rechts kunnen 2 eigen typen MS-kabels ingevoerd worden

Ruimte voor 2 typen eigen MS kabels				
Geleider (mm2)	Weerstand R (Ω/km)	Reactantie X (Ω/km)	Capaciteit C (μF/km)	Belastbaarheid (A)
830test	0.053	0.106	0.470	580
95test	0.322	0.110	0.230	245

Rechts kan 1 eigen type LS-kabel ingevoerd worden

Ruimte voor 1 type eigen LS kabel			
Geleider (mm2)	Weerstand R (Ω/km)	Reactantie X (Ω/km)	Belastbaarheid (A)
95test	0.322	0.069	230

Rechts kan 1 eigen type transformator ingevoerd worden
Bij 3-wikkelingstransformator zie memo toelichting gebruik BLOS

Ruimte voor 1 type eigen Transformator			
Vermogen (kVA)	Nullastverlies (kW)	Kortsluitverlies (kW)	Kortsluitspanning (%)
5200test	4.00	42.50	10.00

Figure 2 Overview of the input sheet of the BLOS tool

4.1.2 Results load flow calculations

On the right side of the sheet "Invoer en resultaten" the results of the load flow calculation are shown, see Figure 3. These include:

- the results of the 13 load flow cases from the "Netbeheer Nederland RfG compliance verification Power generating modules type B, C and D, version 2.0", page 82
- Pmax case. The starting point here is the maximum active power that the PPM can deliver at 100% voltage and power factor 1 at the terminals of the unit. **The calculated active power at the connection point for his case (cell J15) is the Pmax of the PGM when all criteria for all cases are met (no red coloured cells).**
- Load flow cases 0.4P/+Qm and 0.4Pm/-Qm representing points 3 and 4 of the PPM simulations on page 79 (30-50% Pmax, maximum lagging/leading). Points 1, 2, 5, 6 from this table are covered with cases 1 to 4.

The following are shown per case:

- the calculated and target value per unit at the connection point of the voltage, active and reactive power
- the calculated value in per unit at the inverter terminals of apparent, active and reactive power, voltage and current

The target values are colored blue. The calculated values are coloured green if the calculation criteria are met and the limit values of the inverter are not exceeded. **If starting points are not met or limit values are exceeded, the colour of the cell in question changes to red. In that case, the requirements have not been met. Depending on the deviation, an adjustment must be made to the input data. Please note that this adjustment may have consequences for the maximum permissible operating active power of the inverter, the position of the transformer's tap changer, or increasing the capacity/rating of cables or transformers.**

In the lower part, the calculated values of the power at connection point and total of the inverters in MW and Mvar are shown. Underneath is an indication of the loading of the cables and transformer. If the load is higher than 100% (1 per unit), the cell will turn orange. This is for information purposes only and does not constitute a violation of an assessment criterion.

Load Flow Case NBNL CVD	Pmax	1	2	3	4	5	6	7	8	9	10	11	12	13	0.4Pm/+Qm	0.4Pm/-Qm
	Evaluatie resultaten en criteria load flow cases															
Netspanning (p.u.)	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.10	1.05	0.95	0.95	0.90	0.90	0.85	1.00	1.00
Netspanning doelwaarde NBNL CVD (p.u.)	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.10	1.05	0.95	0.95	0.90	0.90	0.85	1.00	1.00
Werkzaam vermogen overdrachtspunt (P/Pmax)	1.00	0.93	0.93	0.20	0.20	0.00	0.93	1.00	0.93	0.93	0.93	0.88	0.88	0.80	0.40	0.40
Werkzaam vermogen doelwaarde NBNL CVD (p.u.)	1.00	≥0.93	≥0.93	0.20	0.20	0.00	≥0.93	1.00	≥0.93	≥0.93	≥0.93	geen	geen	≥0.80	≥0.4	≥0.4
Blindvermogen overdrachtspunt (Q/Pmax)	-0.09	-0.33	0.33	-0.33	0.33	0.00	-0.33	0.00	0.33	0.33	-0.33	0.33	0.00	0.40	0.33	-0.33
Blindvermogen doelwaarde NBNL CVD (p.u.)	-0.09	-0.33	0.33	-0.33	0.33	0.00	-0.33	0.00	0.33	0.33	-0.33	≥0.20	0.00	geen	0.33	-0.33
Schijnbaar vermogen omvormer (p.u.)	1.00	0.96	1.01	0.37	0.37	0.01	0.95	0.99	1.00	1.02	0.96	0.98	0.89	0.94	0.51	0.49
Werkzaam vermogen omvormer (p.u.)	1.00	0.93	0.93	0.20	0.20	0.00	0.92	0.99	0.93	0.94	0.94	0.89	0.88	0.82	0.39	0.39
Blindvermogen omvormer (p.u.)	0.00	0.22	0.39	0.31	0.31	0.01	0.24	0.07	0.38	0.41	0.21	0.41	0.09	0.48	0.32	0.29
Klempanning omvormer (p.u.)	1.00	0.98	1.05	0.93	1.00	0.95	1.07	1.11	1.09	1.00	0.94	0.96	0.92	0.92	1.01	0.94
Stroom omvormer(p.u.)	1.00	0.98	0.97	0.39	0.37	0.01	0.89	0.90	0.92	1.02	1.03	1.02	0.96	1.03	0.51	0.52
	Belangrijke parameters load flow cases															
Werkzaam vermogen overdrachtspunt (MW)	11.74	10.92	10.92	2.35	2.35	0.00	10.92	11.74	10.92	10.92	10.92	10.33	10.33	9.40	4.70	4.70
Blindvermogen overdrachtspunt(Mvar)	-1.11	-3.88	3.88	-3.88	3.88	0.00	-3.88	0.00	3.88	3.88	-3.88	3.88	0.00	4.70	3.88	-3.88
Werkzaam vermogen omvormers totaal (MW)	12.50	11.65	11.64	2.48	2.47	0.02	11.53	12.37	11.58	11.71	11.72	11.13	11.04	10.20	4.91	4.92
Blindvermogen omvormers totaal (Mvar)	0.00	-2.81	4.93	-3.84	3.90	-0.15	-3.05	0.84	4.80	5.07	-2.67	5.10	1.06	5.95	4.05	-3.69
Belasting kabel naar overdrachtspunt (p.u.)	0.68	0.67	0.68	0.26	0.26	0.01	0.61	0.62	0.65	0.72	0.71	0.73	0.67	0.73	0.35	0.35
Belasting MS kabel transformator (p.u.)	0.57	0.56	0.55	0.22	0.21	0.01	0.51	0.51	0.53	0.58	0.58	0.58	0.55	0.59	0.29	0.30
Belasting transformator (p.u.)	1.00	0.92	0.95	0.37	0.36	0.01	0.84	0.86	0.90	1.00	0.97	1.01	0.93	1.03	0.49	0.49
Belasting LS kabel omvormer (p.u.)	0.55	0.55	0.55	0.22	0.21	0.01	0.50	0.51	0.52	0.58	0.58	0.59	0.55	0.59	0.28	0.29

Kleurcodering		
	(blue)	Doelwaarde volgens Netbeheer Nederland PGM Compliance Verification Document tabellen "Reactive power capability Simulations"
	(green)	Wordt voldaan aan Netcode Compliance-eis en geen overschrijding van de grenzen van de omvormers
	(red)	Wordt niet voldaan aan Netcode Compliance-eis of boven grenswaarde van de omvormer
	(orange)	Overschrijding van grenzen transformatoren of kabels

Figure 2 Results load flow calculations

4.2 Sheet Criteria windows

In addition to the table of calculation results (see 4.1.2), the sheet "Criteria windows" also contains a graphical presentation of the results.

Figure 3 shows at a glance whether the maximum values for apparent, active and reactive power and current of the unit has been exceeded (greater than 1.0 per unit).

Figure 4 makes it easy to see whether the calculated voltages on the low voltage terminals of the unit remain within the permissible limit values.

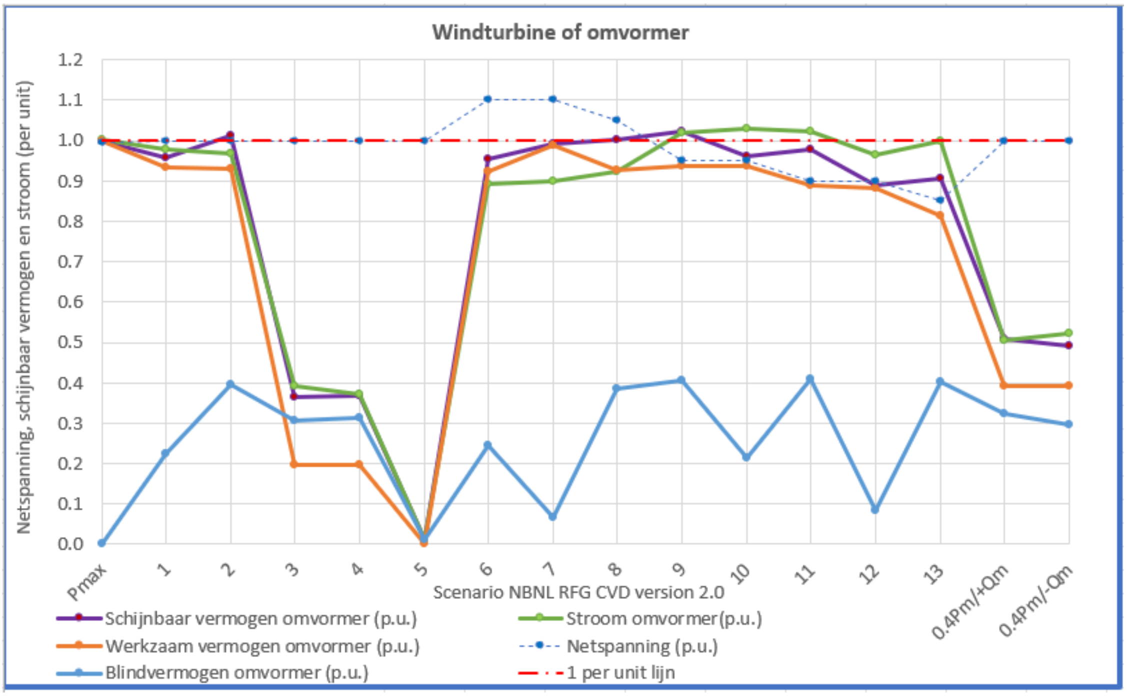


Figure 3 Grid voltage and calculated powers and current generating unit

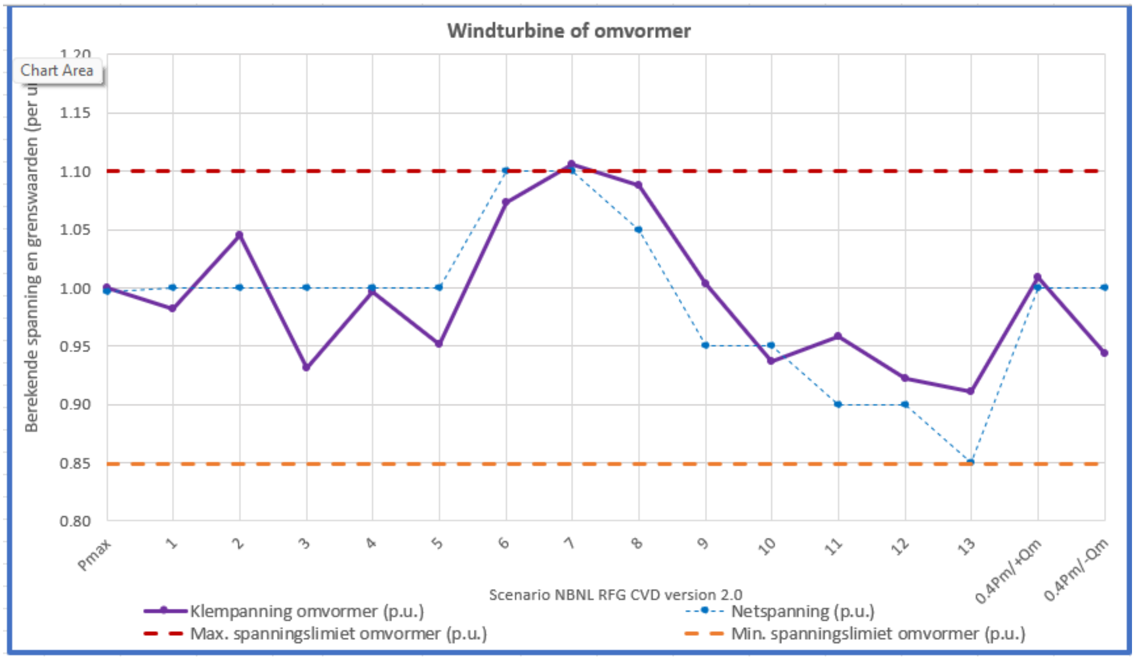
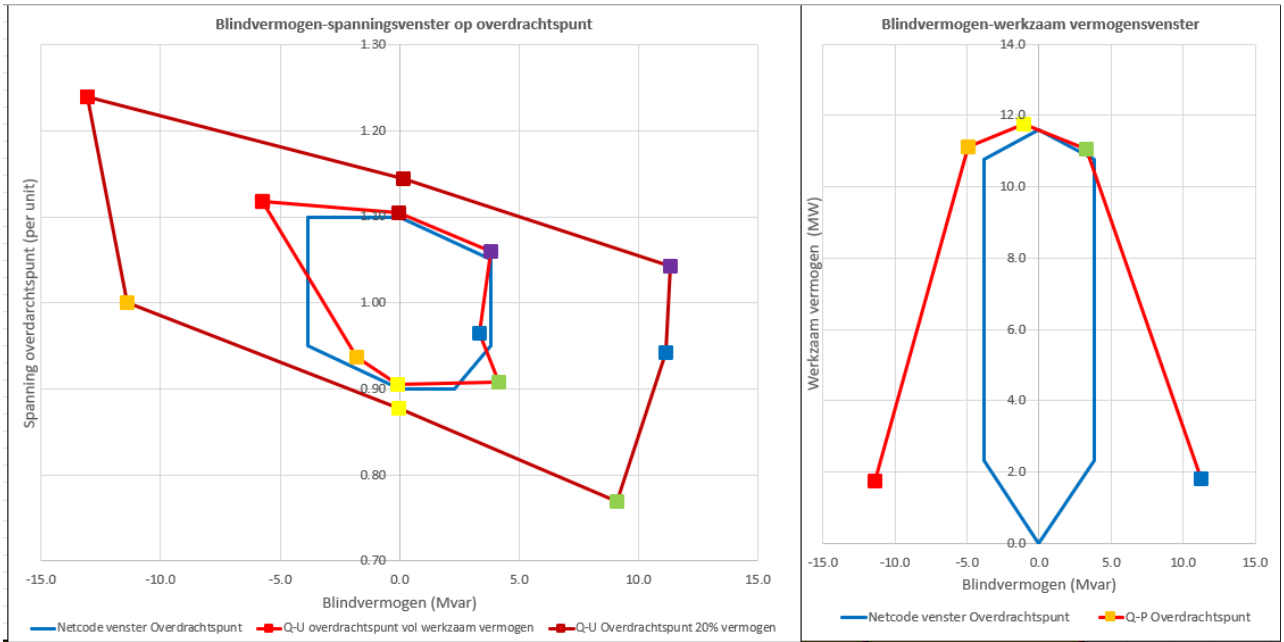


Figure 4 Calculated and limit values voltage at low voltage terminals generating unit

4.3 Sheet Q-U and Q-P windows

In the sheet "Q-U en Q-P vensters" the reactive power range of the PGM at the connection point is shown as an indication, see Figure 6. This is intended as information and not as a benchmark for the assessment of the compliance requirements.

The blue window corresponds to the minimum requirements of the grid code. The red and brown windows are calculated values at the connection point, based on the data entered, at a maximum (taking into account permissible reduction) or 20% of the maximum active power of the park.



	In blindvermogen-spanningsdiagram dienen rode en bruine venster het blauwe venster geheel af te dekken																Blindvermogen-werkzaamvermogen				
Uc netspanning (p.u.)	1.12	0.94	0.90	0.91	0.96	1.06	1.11	1.12	1.24	1.00	0.88	0.77	0.94	1.04	1.14	1.24	1.00	1.03	1.02	1.01	1.01
Pc overdrachtspunt (MW)	10.87	10.92	10.75	9.98	10.92	10.93	11.87	10.87	1.86	1.76	2.44	1.74	1.75	1.85	2.45	1.86	1.76	11.12	11.77	11.05	1.82
Qc overdrachtspunt (Mvar)	-5.74	-1.79	-0.08	4.13	3.35	3.82	-0.01	-5.74	-13.08	-11.42	-0.03	9.12	11.13	11.35	0.15	-13.08	-11.41	-4.92	-1.06	3.25	11.28
Uomv (p.u.)	1.07	0.94	0.92	0.96	1.00	1.09	1.11	1.07	1.10	0.85	0.85	0.85	1.00	1.09	1.10	1.10	0.85	1.00	1.02	1.04	1.06
Pomv omvormers totaal (MW	11.53	11.68	11.51	10.74	11.68	11.58	12.50	11.53	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	11.88	12.50	11.75	2.50
Qomv omvormers totaal (Mv	-4.82	-0.66	1.06	5.27	4.46	4.71	0.84	-4.82	-12.25	-10.30	-0.08	10.30	12.25	12.25	-0.01	-12.25	-10.29	-3.82	0.00	4.26	12.25

Uc (p.u.)	1.12	0.94	0.90	0.91	0.96	1.06	1.11	1.12	1.24	1.00	0.88	0.77	0.94	1.04	1.14	1.24	1.00	1.03	1.02	1.01	1.01
Pc/Pmax (p.u.)	0.93	0.93	0.92	0.85	0.93	0.93	1.01	0.93	0.16	0.15	0.21	0.15	0.15	0.16	0.21	0.16	0.15	0.95	1.00	0.94	0.16
Qc/Pmax(p.u.)	-0.49	-0.15	-0.01	0.35	0.29	0.33	0.00	-0.49	-1.11	-0.97	0.00	0.78	0.95	0.97	0.01	-1.11	-0.97	-0.42	-0.09	0.28	0.96

	Netcode venster Overdrachtspunt							
Un (p.u.)	0.90	0.95	1.05	1.10	1.10	0.95	0.90	0.90
Pmax (MW) bij Qc=0:	11.59	11.59	11.59	11.59	11.59	11.59	11.59	11.59
$Q/P_{max,\ Qc=0}$	0.20	0.33	0.33	0.00	-0.33	-0.33	0.00	0.20
Qmax	2.32	3.82	3.82	0.00	-3.82	-3.82	0.00	2.32

	Netcode venster Overdrachtspunt						
Pmax (MW) bij Qc=0:	11.59	10.78	2.32	0.00	2.32	10.78	11.59
Q/Pmax, Qc=0	0.00	0.33	0.33	0.00	-0.33	-0.33	0.00
Qmax	0.00	3.82	3.82	0.00	-3.82	-3.82	0.00

Figure 6 Calculated Q-U and Q-P windows

4.4 Sheet LF-model CVD 2.0 cases

This sheet contains the calculations and formulas of the 15 load flow cases in accordance with NBNL RFG CVD 2.0 and Pmax case. The voltage at the connection point and the requirements for active and reactive power at the connection point are taken into account. Voltages, currents and powers for units, cables and transformers are calculated. The power losses in cables and transformers have also been calculated. The results are incorporated i in the "Invoer en resultaten" and "Criteria vensters" sheet.

An example of the presentation of the calculation results is shown in Figure 7. The main results of the calculations are automatically provided with a cell color. The meaning of this is explained below the table. In the case of an orange colour, the operating point of the units is exactly at the limit or the limit is active. For cables and transformer, an orange color is an indication of possible overload. If a cell is coloured red, an adjustment must be made by, for example, installing more units, cables or transformers, reducing the maximum active power per unit, adjusting the tap changer.

The 1st block, with indices "c" represents the calculated values at the connection point.

The 2nd block, with indices "ms-op" concerns the kW and kvar losses in the cables from the transfer point to the MV park installation. The relative loading of the cables is also indicated. The transformers are connected to the MV-park installation via MV-TR cables (3rd block, indices ms-tr). The kW and kvar losses and the relative loading of the cables were also calculated. The kvar losses can be negative: in that case, the MV cable generates more reactive power than it consumes.

The 4th block, with indices "tr", concerns kW and kvar losses and the relative loading of the transformers. The voltage on the MV or LV side of the transformers is shown in the row above (Ums) and below (Uls) this block.

The 5th block, with indices "ls", concerns kW and kvar losses and the relative load of the cables between transformers and units.

The 6th and 7th blocks, with indices "omv", represent the generated active, reactive and apparent power of all units together (6th block) and of the individual unit (7th block). Below this are the absolute (Uomv (V)) and relative (Uomv (p.u.) voltage and the relative current (Iomv (p.u.)) of the unit.

Resultaten loadflow		1	2	3	4	5	6	7	8	9	10	11	12	13	40%Pmax/-Qmax	40%Pmax/+Qmax
Uc netspanning (p.u.)	0.996	1.000	1.000	1.000	1.000	1.000	1.100	1.100	1.050	0.950	0.950	0.900	0.900	0.850	1.000	1.000
Uc netspanning (kV)		10.500	10.500	10.500	10.500	10.500	11.550	11.550	11.025	9.975	9.975	9.450	9.450	8.925	10.500	10.500
Pc overdrachtspunt (MW)	11.74	10.92	10.92	2.35	2.35	0.00	10.92	11.74	10.92	10.92	10.92	10.33	10.33	9.40	4.70	4.70
Qc overdrachtspunt (p.u.)	-0.09	-0.33	0.33	-0.33	0.33	0.00	-0.33	0.00	0.33	0.33	-0.33	0.33	0.00	0.40	0.33	-0.33
Qc overdrachtspunt (Mvar)	-1.11	-3.88	3.88	-3.88	3.88	0.00	-3.88	0.00	3.88	3.88	-3.88	3.88	0.00	4.70	3.88	-3.88
Sc overdrachtspunt (MVA)	11.80	11.59	11.59	4.53	4.53	0.00	11.59	11.74	11.59	11.59	11.59	11.04	10.33	10.50	6.09	6.09
Ic overdrachtspunt (A)	651	637	637	249	249	0	579	587	607	671	671	674	631	680	335	335
Pms-op (kW)	259.4	249.7	249.7	38.2	38.2	0.0	206.4	211.9	226.5	276.7	276.7	279.7	245.2	284.0	69.0	69.0
Qms-op (kVAr)	217.2	209.1	209.1	-82.4	-82.4	-135.0	121.1	128.7	163.3	259.5	259.5	276.0	228.5	293.8	-40.0	-40.0
Ims-op kabelstroom totaal (A)		639.2	634.2	255.6	243.0	7.4	581.8	586.7	603.9	667.7	672.5	671.2	630.8	675.7	330.2	339.6
Ims-op kabelstroom (p.u.)	0.68	0.67	0.68	0.26	0.26	0.01	0.61	0.62	0.65	0.72	0.71	0.73	0.67	0.73	0.35	0.35
Umsop-tr (kV)		10.62	10.83	10.44	10.65	10.50	11.66	11.77	11.34	10.32	10.10	9.80	9.69	9.31	10.70	10.49
Pms-tr (kW)	52.5	50.4	49.6	8.1	7.3	0.0	41.7	42.4	45.0	55.0	55.8	55.5	49.1	56.3	13.4	14.2
Qms-tr (kVar)	-1.5	-1.9	-3.0	-16.0	-17.1	-19.0	-8.9	-9.1	-6.5	0.7	1.8	2.7	0.9	4.6	-15.1	-14.0
Ims-tr kabelstroom (A)		639.2	634.2	255.6	243.0	7.4	581.8	586.7	603.9	667.7	672.5	671.2	630.8	675.7	330.2	339.6
Ims-tr kabelstroom (p.u.)	0.57	0.56	0.55	0.22	0.21	0.01	0.51	0.51	0.53	0.58	0.58	0.58	0.55	0.59	0.29	0.30
Ums (kV)		10.658	10.876	10.444	10.663	10.496	11.690	11.807	11.381	10.373	10.143	9.855	9.732	9.356	10.720	10.501
Ums (p.u.)	1.019	1.015	1.036	0.995	1.016	1.000	1.113	1.125	1.084	0.988	0.966	0.939	0.927	0.891	1.021	1.000
Ptr (kW)	112.9	110.4	109.9	35.4	34.9	21.5	99.7	101.5	104.0	117.2	117.7	116.2	104.4	115.6	46.0	46.4
Qtr (kVAr)	750.1	715.3	704.1	114.4	103.3	0.1	592.4	602.6	638.4	780.4	791.6	788.5	696.4	799.2	190.9	201.8
Itransformer (A)		631.7	650.6	251.2	248.4	7.5	576.1	590.7	618.2	686.7	663.9	692.1	636.2	702.2	338.0	334.2
Itransformer (p.u.)	1.00	0.92	0.95	0.37	0.36	0.01	0.84	0.86	0.90	1.00	0.97	1.01	0.93	1.03	0.49	0.49
Uls (V)	535	527	559	511	543	523	579	594	583	535	502	510	492	489	547	515
Uls (p.u.)	0.974	0.959	1.017	0.929	0.988	0.951	1.052	1.081	1.061	0.973	0.913	0.928	0.895	0.888	0.995	0.937
Pls (kW)	331.2	316.1	310.3	51.1	45.5	0.1	262.3	266.5	281.6	343.5	349.4	346.8	307.1	350.9	84.3	89.9
Qls (kVAr)	148.8	142.0	139.4	22.9	20.4	0.0	117.8	119.7	126.5	154.3	156.9	155.8	138.0	157.6	37.9	40.4
Ils-kabelstroom (A)		13116.8	13052.8	5161.5	4907.9	171.5	11900.4	12037.8	12405.9	13770.2	13826.7	13857.4	13010.2	13958.8	6714.3	6887.8
Ils-kabelstroom (p.u.)	0.55	0.55	0.55	0.22	0.21	0.01	0.50	0.51	0.52	0.58	0.58	0.59	0.55	0.59	0.28	0.29
Pomv omvormers totaal (MW)	12.50000	11.64858	11.64157	2.48150	2.47471	0.02156	11.53220	12.36655	11.57913	11.71444	11.72157	11.13297	11.04055	10.20207	4.91030	4.91708
Qomv omvormers totaal (Mvar)	0.00000	-2.81113	4.92520	-3.83667	3.89990	-0.15391	-3.05321	0.84189	4.79721	5.07043	-2.66571	5.09854	1.06374	5.95282	4.04925	-3.68738
Somv omvormers totaal (MVA)	12.50	11.98	12.64	4.57	4.62	0.16	11.93	12.40	12.53	12.76	12.02	12.24	11.09	11.81	6.36	6.15
Pomv omvormer (kW)	250	233	233	50	49	0	231	247	232	234	234	223	221	204	98	98
Qomv omvormer (kVar)	0	-56	99	-77	78	-3	-61	17	96	101	-53	102	21	119	81	-74
Somv omvormer (kVA)	250	240	253	91	92	3	239	248	251	255	240	245	222	236	127	123
Uomv (V)	550	540	575	512	548	523	590	608	598	552	515	527	507	505	555	519
Uomv (p.u.)	1.000	0.982	1.045	0.931	0.997	0.951	1.073	1.106	1.088	1.004	0.937	0.958	0.922	0.919	1.009	0.944
Iomv (p.u.)	1.00	0.98	0.97	0.39	0.37	0.01	0.89	0.90	0.92	1.02	1.03	1.02	0.96	1.03	0.51	0.52

Figure 7 Calculations load flow cases NBNL CVD 2.0 and Pmax