MEMO

AAN ProRail

STATUS Vrijgegeven
VERSIE 2.0
ONDERWERP Drukberekening HVI-module
DATUM 22 maart 2023

Onderdeel van de ontwikkeling van het modulaire onderstation is een beschouwing op de krachten bij een kortsluiting op de rail van de Hoogspanningsverdeler. Beschouwing richt zich op de negatieve gevolgen van deze krachten.

Siemens heeft een drukberekening opgesteld van de situatie dat er een kortsluiting op de rail van de Hoogspanningsverdeler plaats vindt. In deze berekening is uitgegaan van de situatie dat er een 'Pressure Absorber' aanwezig is.

Resultaten drukberekening:

- Kortsluiting: 21kA
- Ruimte: 53 m³
- Geeft een maximale druk van 15,9 hPa

Siemens heeft ter vergelijk ook nog een berekening gemaakt zonder de "Pressure Absorber", die geeft een druk van 30,7 hPa in de ruimte.

Door Movares is, aan de hand van deze gegevens, een beschouwing uitgevoerd of de module constructief bestand is tegen deze krachten. Op basis van dit gegeven voorziet Movares geen issue dat de module de druk niet zou aan kunnen. De windbelasting betreft namelijk druk en zuiging. Zonder de "Pressure Absorber" ontstaat een druk van 30,7 hPa (0,0031MPa) in de ruimte. Deze druk valt ver onder de beschouwde overdruk vanuit windbelasting (0,14MPa).

Met vriendelijke groet,

Bijlagen:

- BAM_MOS_Prorail_Berghuis__Richard_(RC-NL_SI_EA_S)
- Zonder absorber BAM_MOS_Prorail_Berghuis__Richard_(RC-NL_SI_EA_S)_1

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Smart Infrastructure
Electrification & Automation

Pressure Calculation for Internal Arc Faults

for switchgear type 8DJH (up to 24 kV)

The pressure calculation works with approximations, among others concerning the time-related pressure characteristic and the geometry of the switchgear room as well as its pressure relief outlets. Therefore, the result of this pressure calculation can differ from the actually arising pressure values, and does not contain any statements about the pressure load capacity of the building and its structural components (e.g. doors, windows). The evaluation of the pressure load capacity of the building must be performed by a structural engineer.
Siemens is not liable for any damages resulting from the utilization of the calculation results.
This does not apply if a liability is legally defined, e.g. in case of premeditation.

This calculation is based on measured values from type tests and results from 3D simulations according to the Finite Element Method (FEM).

The approach estimates the average room pressure as an ideal case; the following criteria are not considered:

- Geometry of the switchgear room
- Position of the pressure relief outlets in the switchgear room
- Position of the switchgear body in the switchgear room
- Obstacles and partitions
- Dynamic processes such as reflection, deflection, interference
- Pulsating arc power (assumed as constant instead)
- Period of time until the pressure wave reaches the pressure relief outlet (pressure relief immediately starts through the opening)

The average pressure does not allow to determine any local pressure peaks of the first pressure increase in the room.
These effects, however, frequently generate the pressure load on the walls of the building.

For small room volumes (10 $m^3 \leq Vr \leq 50\ m^3$) with pressure relief outlet (Arel $\geq 0.4\ m^2$), the method offers a good approximation when the room is uniformly filled with pressure.

Pressure Calculation for Internal Arc Faults

for switchgear type 8DJH (up to 24 kV)

Room volume [Vr] in m³:	**50**	Pressure relief:	**with pressure absorber system**
Free pressure relief cross-section [Apr] in m²:	**0,4**	Panel types:	**gas-insulated panels only**
Short-circuit current [Isc''] in kA:	**21**	Maximum pressure [pmax]:	**15,9 hPa**

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Free pressure relief cross-section [Apr] in m²:	Maximum pressure [pmax]:
0,4	15,9 hPa
0,5	13,7 hPa
0,75	10,5 hPa
1	8,7 hPa
1,5	6,6 hPa

Pressure Calculation for Internal Arc Faults

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Permissible pressure in buildings depending on the wall material in as-new condition

Wall type	Permissible relative pres-sure in the room in hPa
Bricks (massif brick, perforated brick, gas concrete)	3-10
Reinforced brick wall	30
Prefabricated concrete parts	50
In-situ concrete	70
Concrete modules	130

According F. Pigler [Energiewirtschaftliche Tagesfragen, 26th edition, 1976, book 3 (94-98)]

Pa	- Pascal
hPa	- Hektopascal
mbar	- millibar
1 bar	= 10^5 Pa
1 mbar	= 1 hPa

The table above contains guide values for the permissible pressure in buildings depending on the wall material in as-new condition.

The result of the above pressure diagrams contains no statements about the pressure withstand capability of the building and its constructional parts (e.g., doors, windows). The layout of the building regarding the calculated pressure must be done by the structural engineer.

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Pressure Calculation for Internal Arc Faults

for switchgear type 8DJH (up to 24 kV)

Room volume [Vr] in m³:	**50**	Pressure relief:	**without pressure absorber system (standard)**
Free pressure relief cross-section [Apr] in m²:	**0,4**	Panel types:	**gas-insulated panels only**
Short-circuit current [Isc''] in kA:	**21**	Maximum pressure [pmax]:	**30,7 hPa**

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Free pressure relief cross-section [Apr] in m²:	Maximum pressure [pmax]:
0,4	30,7 hPa
0,5	27,4 hPa
0,75	22,2 hPa
1	19 hPa
1,5	15,2 hPa

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