cigre Nederland

1 February 2024

Towards net-zero emission of T&D grids

CONDUCTOR EFFICIENCY

For more sustainable energy transport

Bringing connections to life

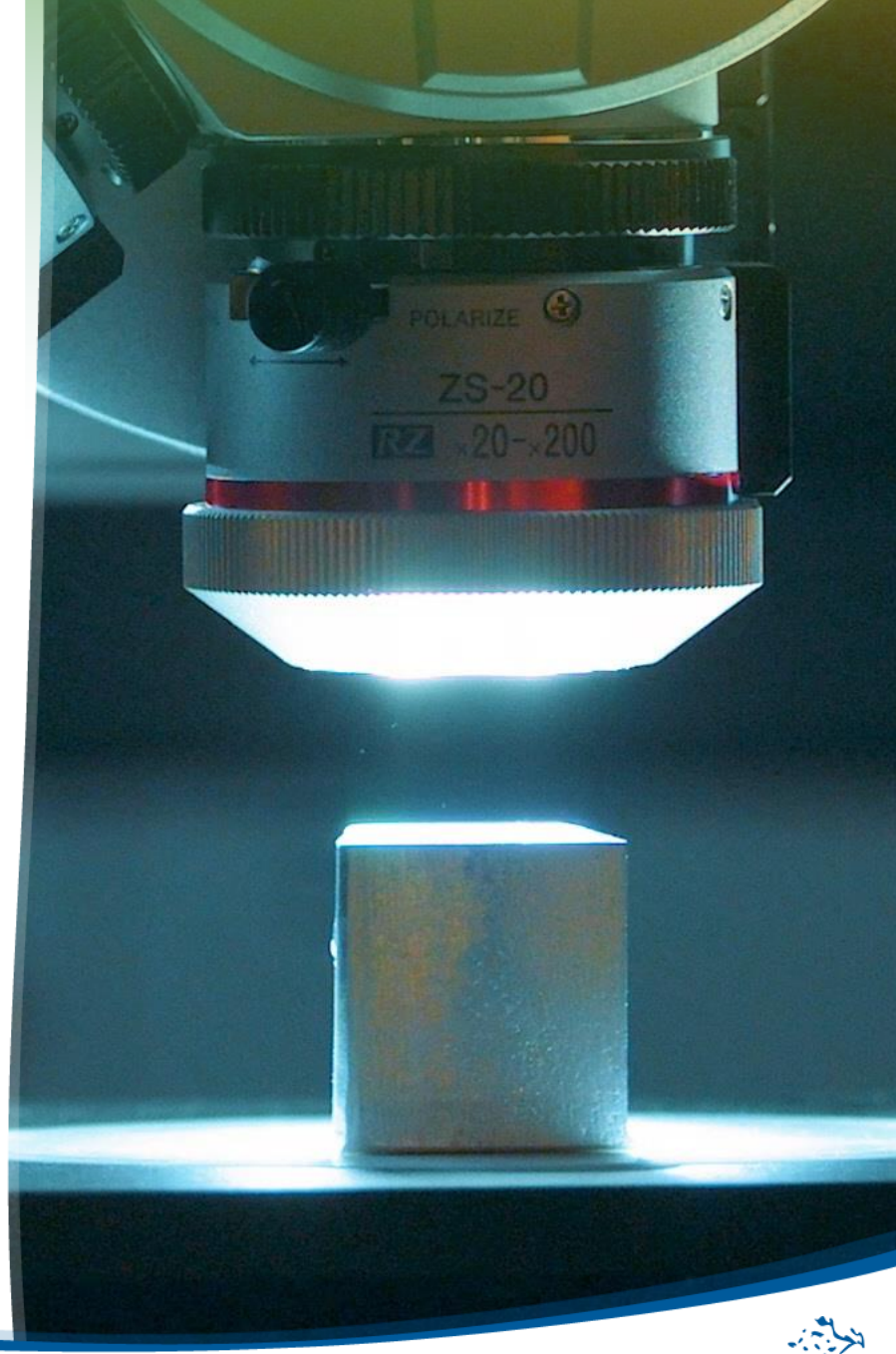
ABSTRACT

CONDUCTOR EFFICIENCY: ABSTRACT

- Very often the choice of conductor is fixed.
  - Conductor technology
  - Conductor characteristics

- It is sometimes forgotten that over the last two decades developments have occurred that need the attention of technical decision makers
  - To choose a better technology
  - To optimise performance within a technology

- Often these choices do not require tower reinforcements.



THE BOBOLINK CASE

From ACSR to AAAC

THE BOBOLINK CASE

THE BOBOLINK CASE

- In the Netherlands a ACSR BOBOLINK was once a solution for a network constraint
- The conductor characteristics that matter for this presentation are:

	Core	Aluminium	Total Conductor
Diameter (mm)	9,06	36,24	36,24
Section (mm²)	50,1	725,3	775,4
Weight (g/m)	0,4	2,0	2,4
RTS (kN)	55	116	163
Resistance (Ohm/km)	-	0,0399	0,0399

THE BOBOLINK CASE

- Although the project did not take this intermediate step and went straight for the nest step, this is what an AAAC could do:
-

	Core	Aluminium	Total Conductor	AAAC
Diameter (mm)	9,06	36,24	36,24	36,24
Section (mm²)	50,1	725,3	775,4	775,4
Weight (g/m)	0,4	2,0	2,4	2,4
RTS (kN)	55	116	163	217
Resistance (Ohm/km)	-	0,0399	0,0399	0,0428

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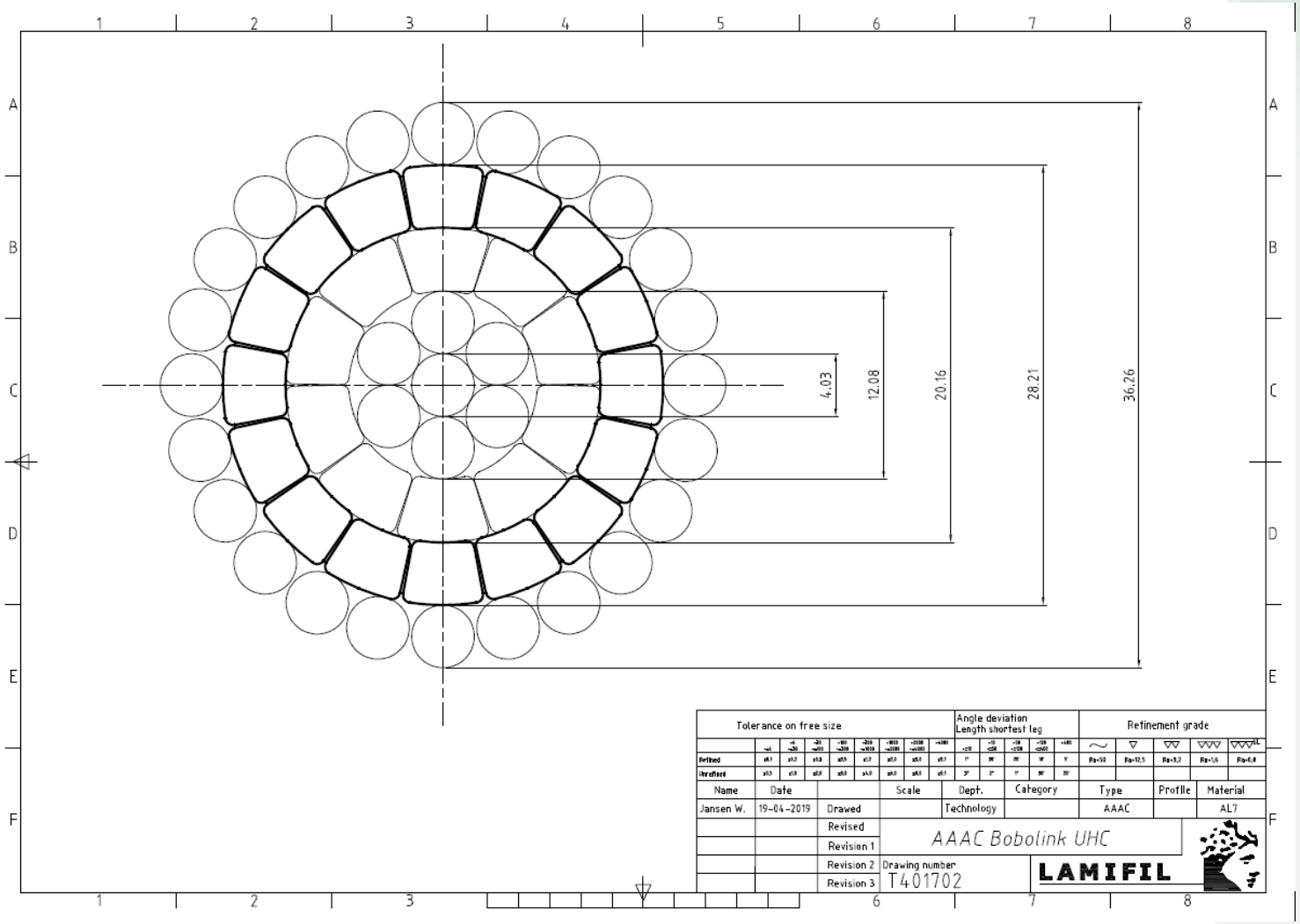
From AAAC to Closed AAAC

THE BOBOLINK CASE

› The design step that was immediately taken was to go for a closed AAAC design:

	Core	Aluminium	Total Conductor	Closed AAAC
Diameter (mm)	9,06	36,24	36,24	36,24
Section (mm²)	50,1	725,3	775,4	882,3
Weight (g/m)	0,4	2,0	2,4	2,4
RTS (kN)	55	116	163	247
Resistance (Ohm/km)	-	0,0399	0,0399	0,0378

THE BOBOLINK CASE



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From Closed AAAC to EHC Closed AAAC

THE BOBOLINK CASE

- By introducing highly performant alloys further noticeable improvements can be made:
-

	Core	Aluminium	Total Conductor	Closed AAAC
Diameter (mm)	9,06	36,24	36,24	36,24
Section (mm²)	50,1	725,3	775,4	882,3
Weight (kg/m)	0,4	2,0	2,4	2,4
RTS (kN)	55	116	163	218
Resistance (Ohm/km)	-	0,0399	0,0399	0,0341

IMPROVEMENT

THE BOBOLINK CASE

Conductor specifications		ACSR Bobolink	AAAC Bobolink	AAAC Bobolink EHC
Resistivity of al or alloy	nOhmm	28,27	32,5	29,5
Tensile strenght al or alloy	Mpa	160	295	260
Resistance	Ohm/km	0,03994	0,0378	0,0341
Current (50°C; 50Hz)	A	767	799	839
Current (80°C; 50Hz)	A	1293	1344	1415
Current (90°C; 50Hz)	A	x	1472	1550
Improvement of current at 80°C	%		4%	9%
Improvement of current at max T = 90°C	%		14%	20%

Current calculations with environment Temp: 25°C; Emissivity = Absorption coefficient = 0,5; Sun radiation = 1000W/m² and wind velocity = 0,5m/s

THE BOBOLINK CASE

Calculation of Joule losses for 500A 50Hz; ambient temperature of 20°C

Conductor specifications		ACSR Bobolink	AAAC Bobolink	AAAC Bobolink EHC
Joule losses	W/km	11292	10047	8967
Temperature at 500A 50Hz	°C	36,4	35,9	35,4
Improvement of Joule losses	%		11%	21%
Joule losses over a year	MWh/km	99	88	79
Costs of 1 MWh	€	50 €	50 €	50 €
Total cost losses	€	4.946 €	4.401 €	3.928 €
Costs saved	€		545 €	1018 €
Costs saved for a single circuit	(/year/km)		1.636 €	3.055 €

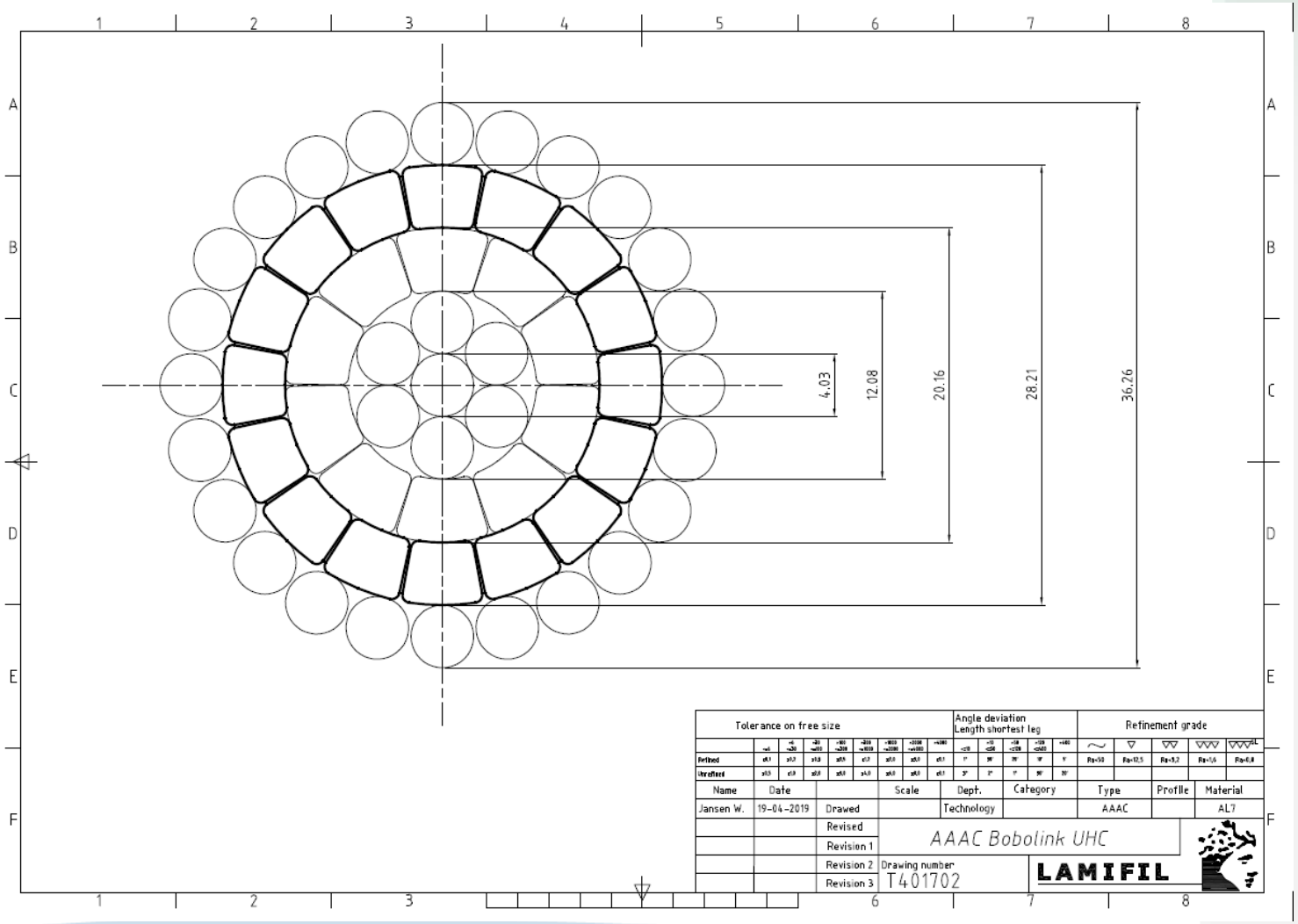
THE BOBOLINK CASE

Calculation of Greenhouse gasses reduction

kWh/km over a year	kWh/km	98920	88013	78551
weight of CO2 per kWh	kg	0,35	0,35	0,35
Total CO2	T/ykm	34,62	30,80	27,49
Total CO2 reduction	T/ykm		3,82	7,13

Total CO2 reduction for a single circuit	T/ykm	11	21
Amount of cars that produce together the same CO2 quantity during one year. (Each car produces 115g/km CO2 and does 20.000km a year)		5	9

THE BOBOLINK CASE



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THE GENERAL CASE

- ACSR can successfully be replaced by UHC closed AAAC:
  - The section of steel is not too high.
    (e.g. a 100% steel core cannot be replaced)
  - The section of steel is too low.
    (e.g. a pure aluminium conductor cannot be replaced)
  - For standard ACSR conductors the replacement will always be successful.

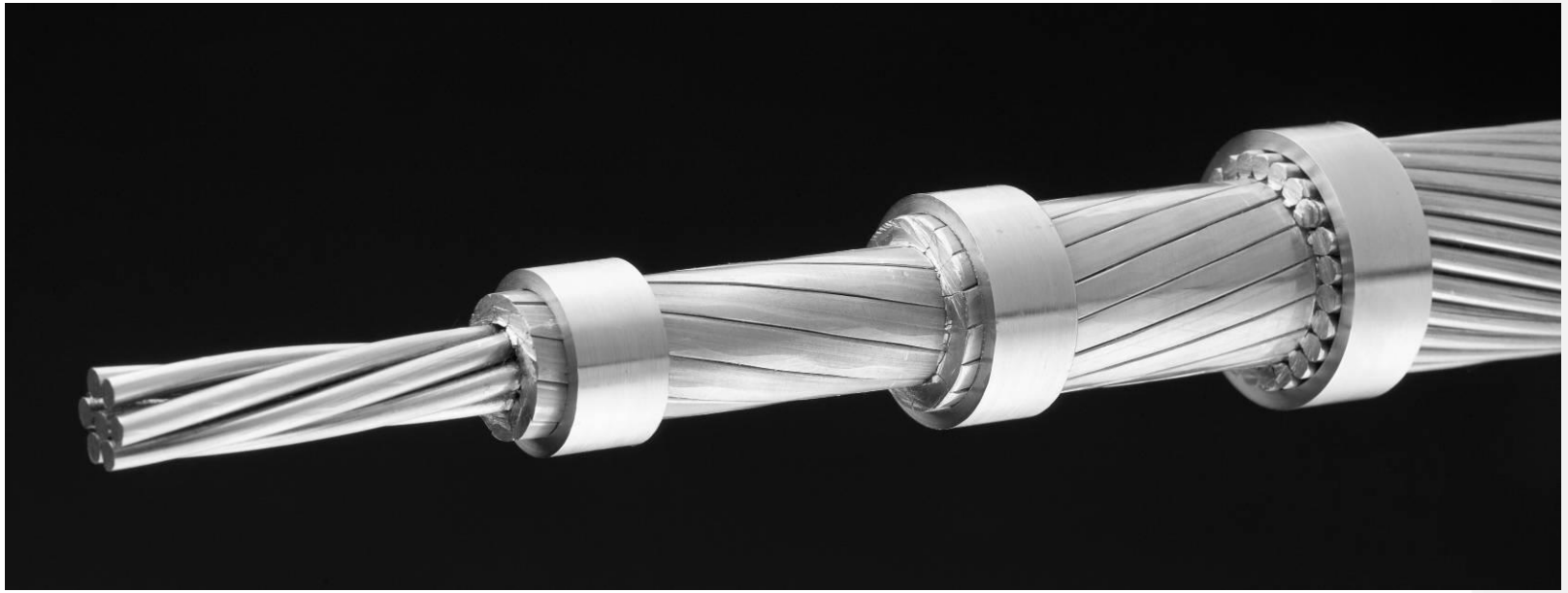
EPILOGUE

- In a world where sustainability cannot be ignored,
- efficiency is ever more important
  - Tenders should encourage efficiency improvements by means of award systems so that:
    - Suppliers have incentives to put their brains at work for better design and materials
    - Long term benefits are generated at comparably nearly no cost

EPILOGUE

CASE AAAC UHC BOBOLINK- TENNET TSO

Yearly cost saving for 710km of conductor	678.222 €
CO_2 reduction over 30 years	142.427 tonnes CO_2
Generation capacity reduction	1,548 MW



LAMIFIL

LET'S BRING CONNECTIONS TO LIFE

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