AUTODESK **UNIVERSITY** 2015

ES11201

BIMelec, the BIM Electrical Process

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Learning Objectives

- Explain the BIM electrical process in your electrical design
- Learn how to develop a BIM electrical process in your building project
- Learn how to design and manage electrical installation in Revit MEP
- Learn how to create schematics and get electrical calculation results into your BIM model,

Description

In this class we will present the process of integrating Building Information Modeling (BIM) in order to manage the electrical design of a building project—what we call, “BIMelec.”

Your AU Experts

Product manager in ALPI, an European software editor in the field of Electrical design, ***Marseille Beltrey*** *is an expert in Electrical design in BIM models. He uses to speak in differences conferences in Europe, to spread the word on Alpi and Autodesk offering. He provides BIM implementation and training for the company’s engineering design software, including Autodesk Revit, AutoCAD MEP, and AutoCAD Electrical. He has 10 years of experience in both the electrical design and Autodesk VAR, spending 6 years working as an instructor consultant for ALPI’s solutions based on the Autodesk building design product. After his first experience as an Autodesk Speaker in Las Vegas in 2012, proposing a class on electrical design on revit;* ***Marseille****, has also contributed in 2013,as an author to an official French treaty book, outlining the different aspects of the ongoing revolution in the building.*

Yannick Poupon is an Electrical Engineer based in Boston, Massachusetts.
He has over nine years of electrical engineering, design and project management experience working for multi-discipline engineering contractors.
Responsible for providing technical guidance to engineering with regard to complex risk, alternative analysis studies and conceptual design.
He also collaborated with ALPI International to develop a Revit-Caneco (Electrical Engineering Solution).

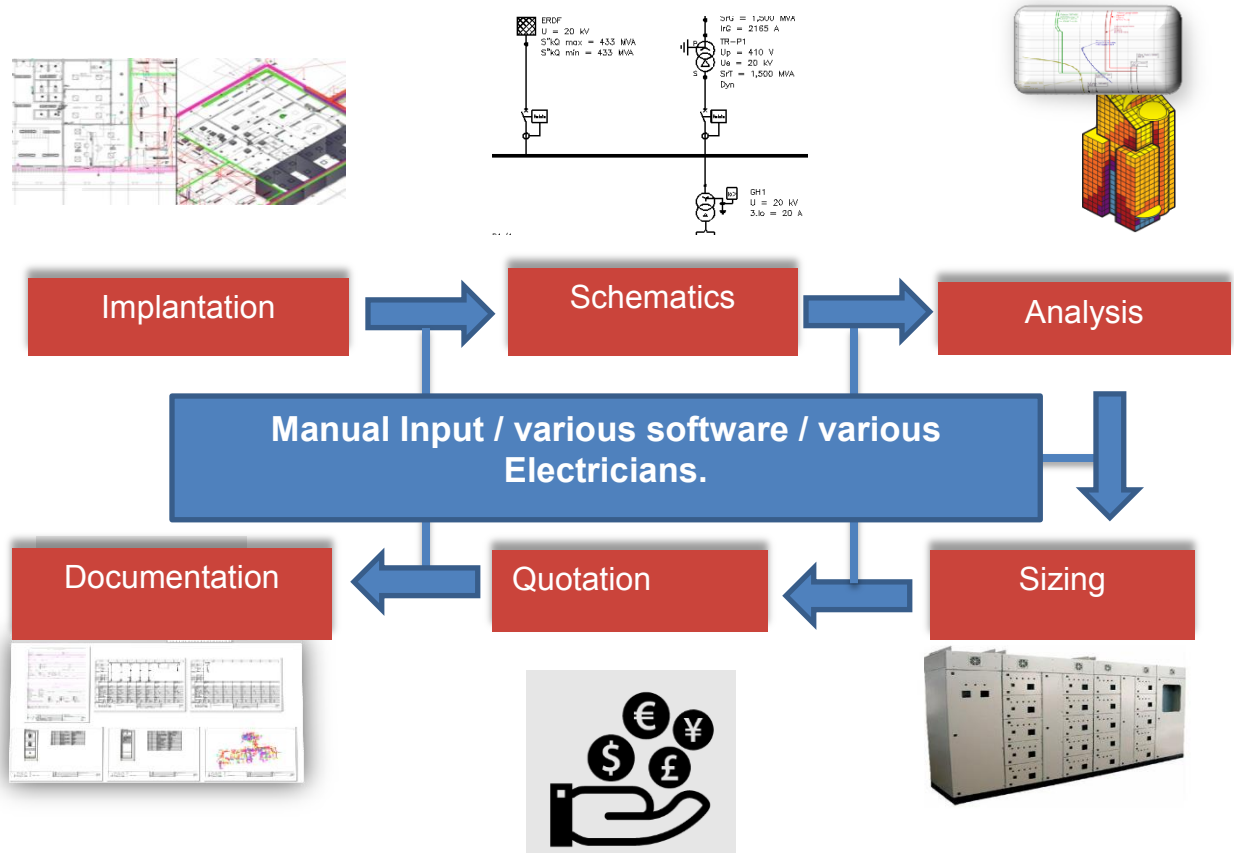
1. Talk about the BIM electrical process in your electrical design

What do we call BIMelec?

BIMelec is a process defined by Alpi, which allows engineers to share information and work on the same system, analyze the project continuously, without interruption in the design phase. It enables engineers and designers to focus on the profession value and not waste time rekeying the same information several times with risk to input errors. So the Electrical data of a BIM project should ideally pass into different phases without rekeying.

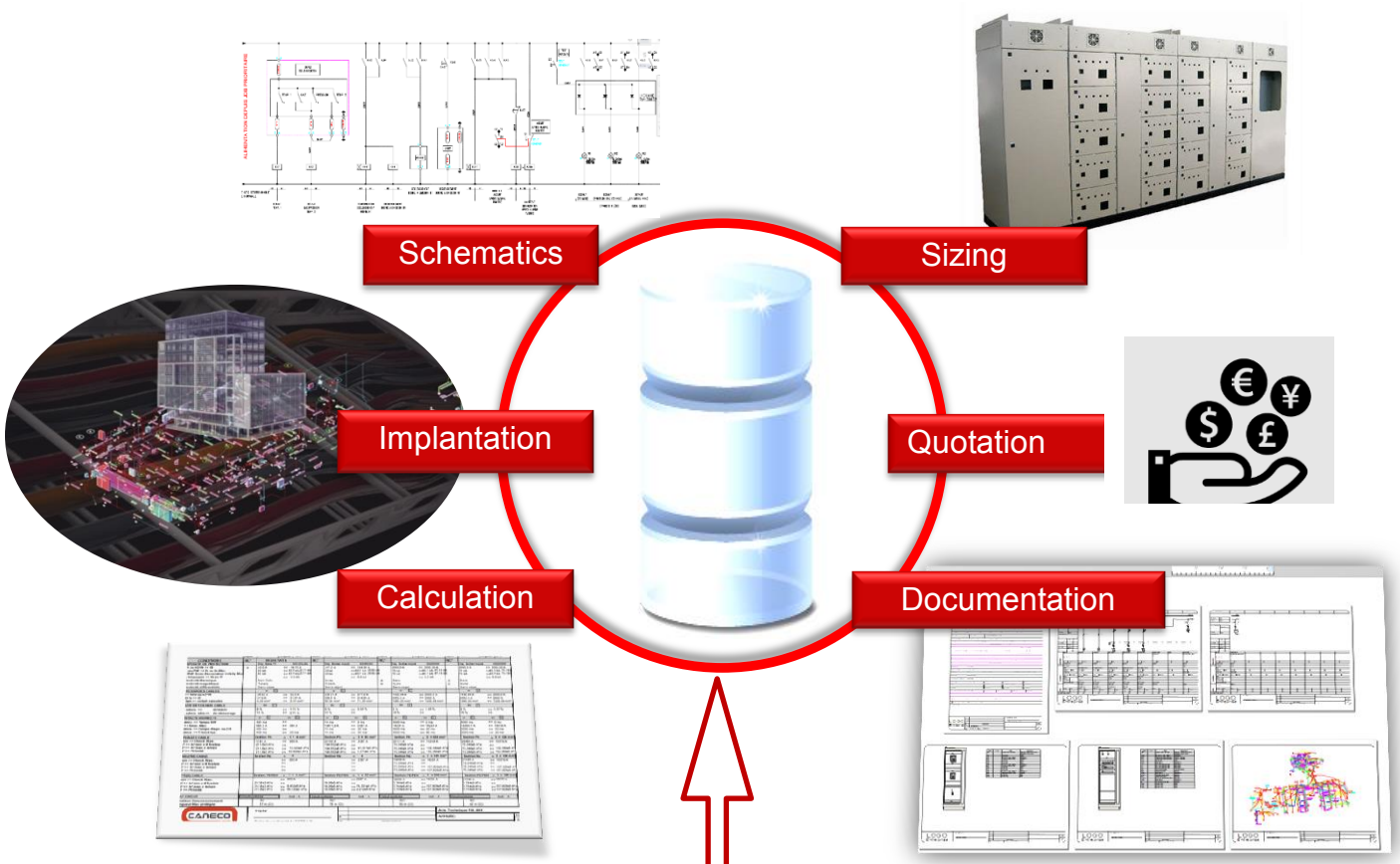
The main difficulty to have a continuous process is that the same information is treated in electricity under different aspects: From Implantation in the 3D model or in an electrical cabinet, to the calculation and sizing, costing, quotation, order, the schematic and finally all the documentations related to the different phases. In all these aspects, one object can be approached, described and treated differently by various software and electricians.

Working in the traditional CAD method = manual input in every step = input errors =Wasted time = more verification = less efficiency



Adopting a BIMelec process = Maintain the continuity and integrity of the data all through the analysis phases of the electrical installation.

The ALPI software solution reads and analyses a BIM model. It studies very quickly using an automated design process, compares and offers major electrical manufacturers on the market: ABB, Legrand, Schneider Electric, Siemens based on the specifications of the model.



Partnership with mains manufacturers:

ABB
legrand
SQUARE D by Schneider Electric
SIEMENS
EATON Powering Business Worldwide
GE

Local standards usability:

International **IEC 364**, European **HD 384**
French **NFC15-100**, UK **BS 7671**, German **VDE**, Italian **CEI 64-8**,
Spanish **REBT & A 20460,** Austrian **ÖNORM**, Belgian **RGIE / RINA** and Swiss **NIBT-NIN,** Marine **IEC 60092**

NEC support is in progress and is not available today

How the interface between Autodesk and Alpi cover the main needs of the BIM Electrical Process?

Today to completely describe an electrical installation we need several software and several business profiles. This separation between software and business profiles is the hurdle to overcome in the Bim electrical design.

The solutions proposed by Autodesk and Alpi "Caneco BT connected to Revit " will remove any repetition or re-keying of information, source of unnecessary costs and more costly mistakes.

It paves the way for a strong promotion of the profession of the designer of electrical installations, which will have to master alone all the different aspects of his craft.

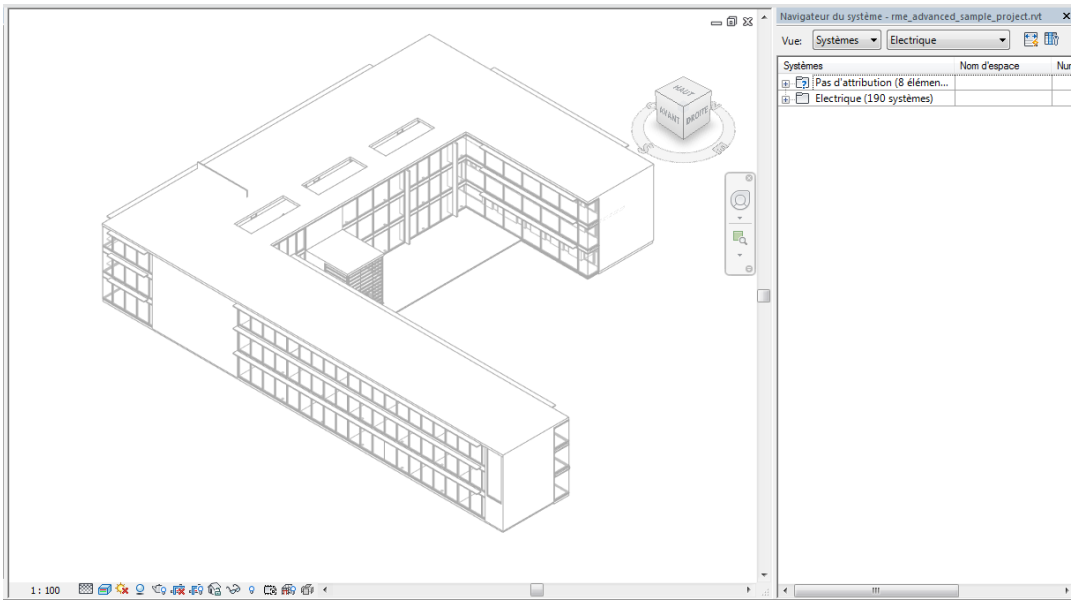
Define your electrical installation in Revit then use the ALPI solution to analyze and generates all the documentation necessary.

The ALPI solution operates a BIM modeling, with a generic and neutral view of the building. It studies very quickly the needs in a fully automated design process.

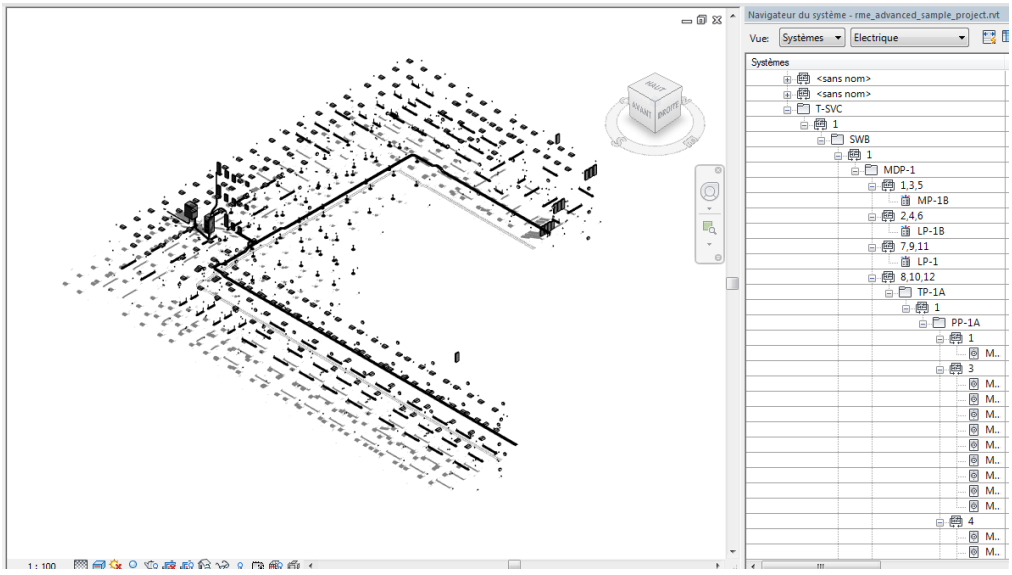
utodesk Revit	***Alpi Caneco***
Describe and manage Electrical systems	***Check, and Control, the Revit Electrical network.***
Update the Revit Model, ***Create new values properties as Project Parameters*** ***Resize Cable Trays*** ***Complete the Revit project with all the documentations as details view***	***Analyze the Cable routing*** ***more accurate definition of cable length*** ***Automatically Generate the single line diagram corresponding*** ***Calculation based on local Standards*** ***predetermination of cabinets*** ***Cost Estimation*** ***Generate automatically:*** ***Legends*** ***Details Cables list*** ***nomenclature*** ***Synoptic*** ***Cable trays calculation*** **Power and control Schematic** **Flexibility in the choice of manufacturers**

Cables routing

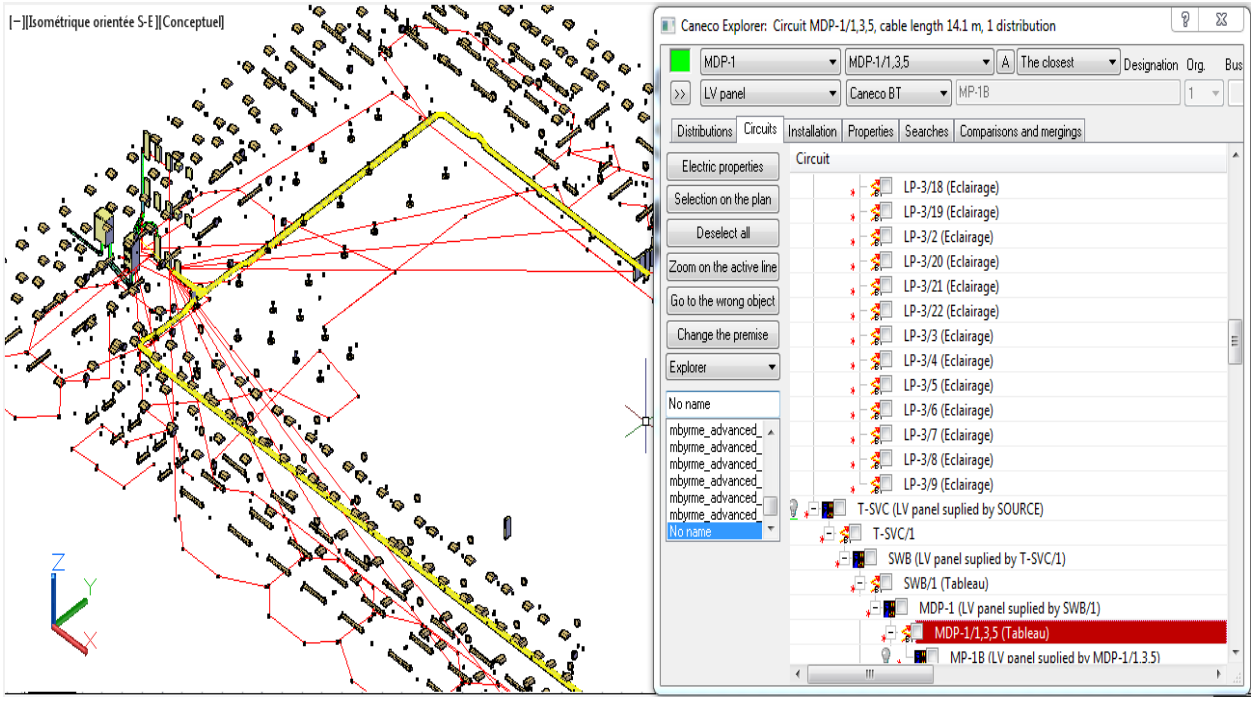
Define electrical design in Revit



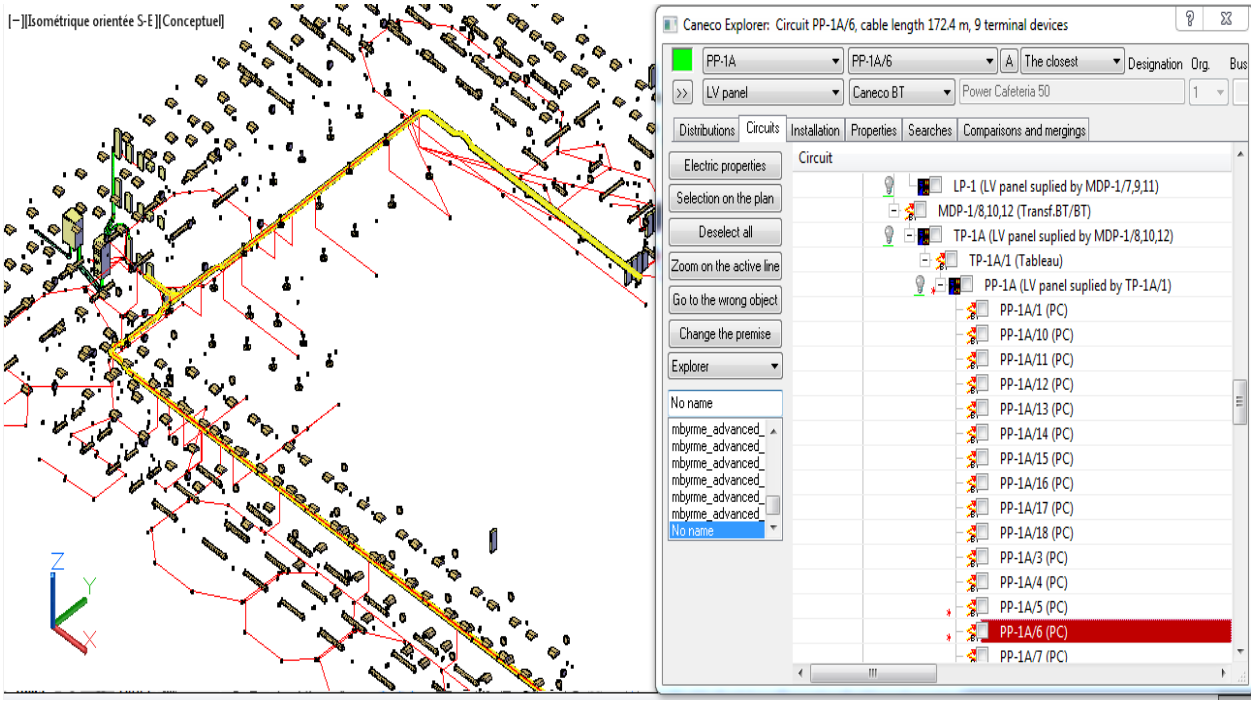
Caneco recognizes every Revit families, equipped with electric connectors,



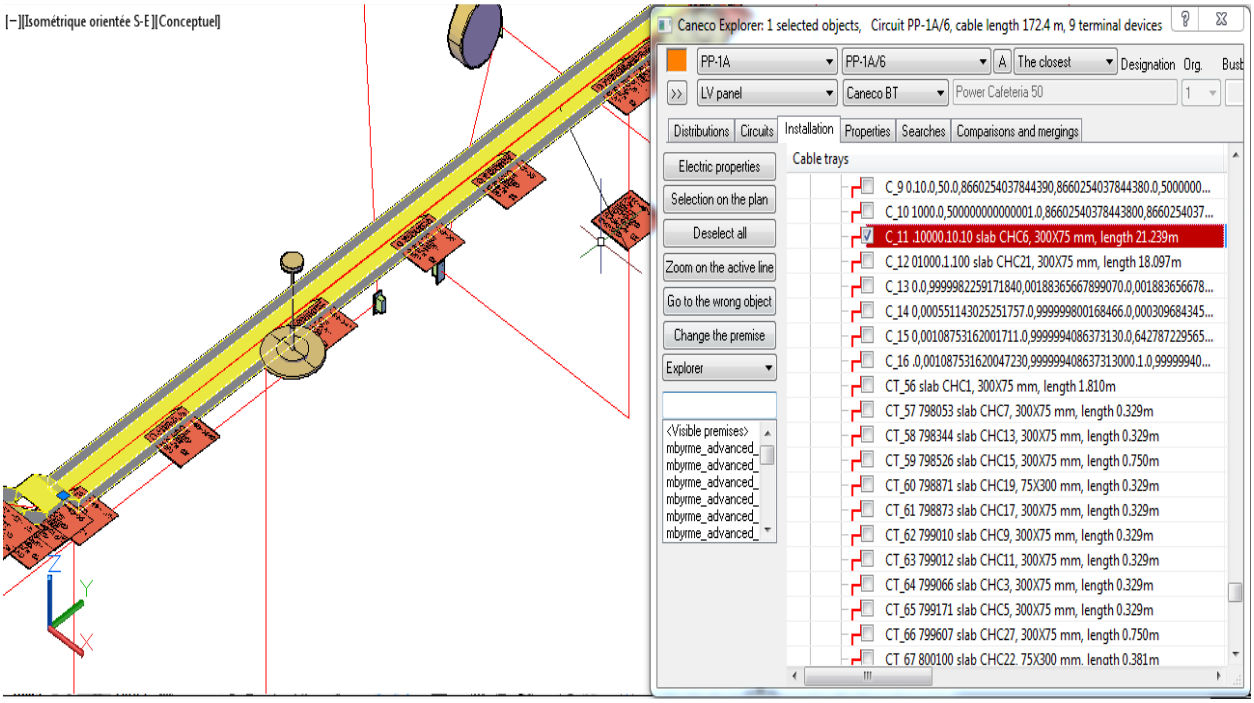
Caneco Generate automatically all the cables corresponding to the revit systems



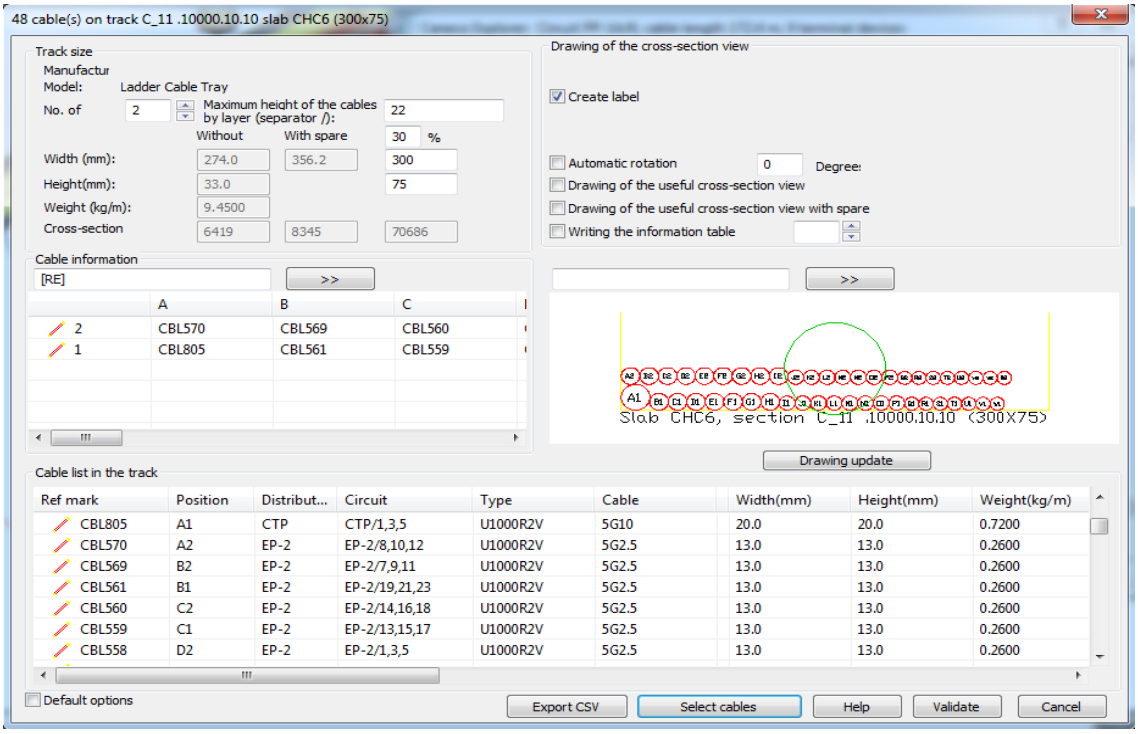
All Cables are automatically routing through Cables trays



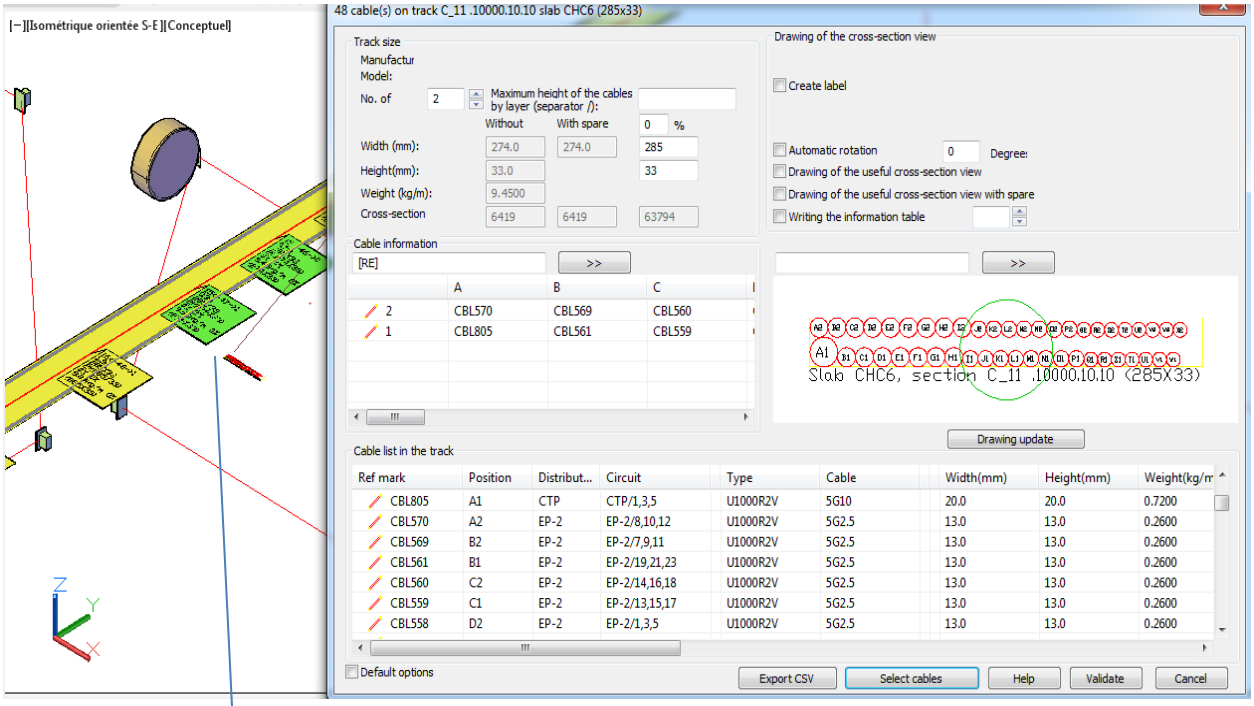
Cable trays can be analyzed to define the right size corresponding to the needs

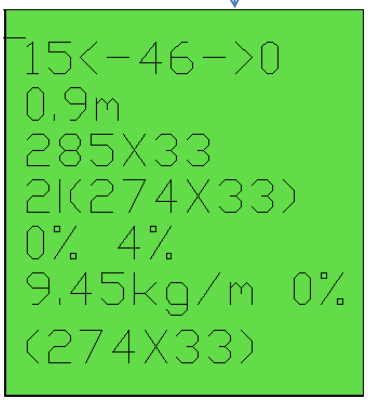


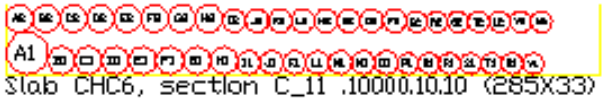
Define rules to organize automatically cables inside their tracking



Resize automatically the cable trays, basing in manufacturers' parameters

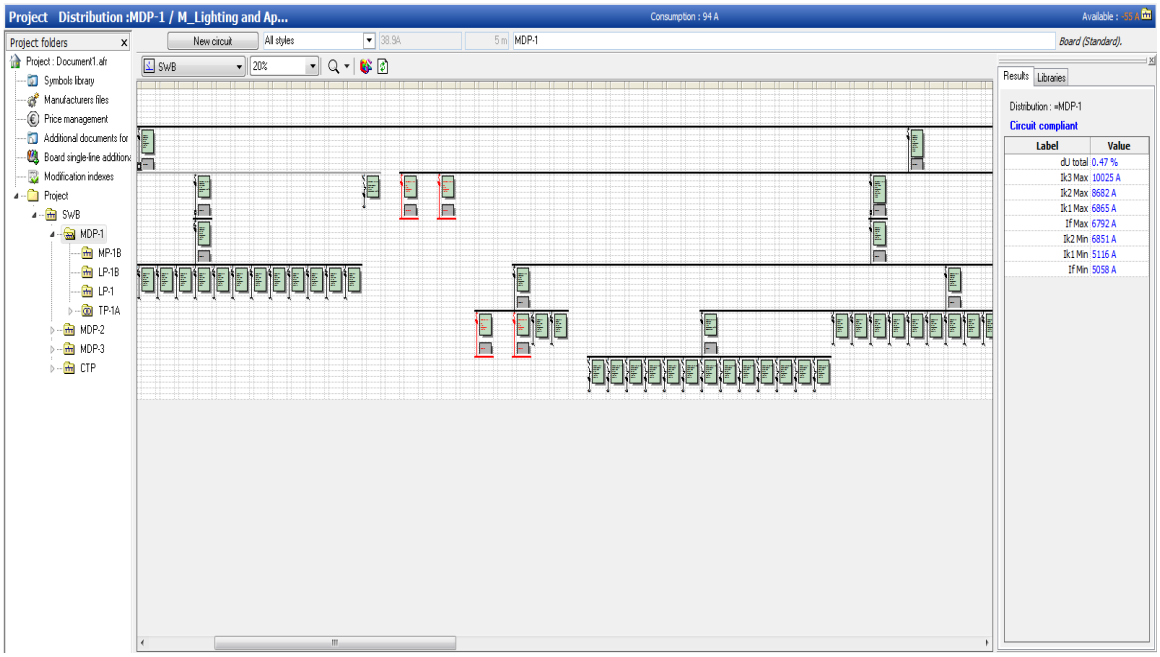

[−][Isométrique orientée S-E][Conceptuel]
48 cable(s) on track C_11 .10000.10.10 slab CHC6 (285x33)
Track size
Manufactur
Model:
No. of
2
Maximum height of the cables by layer (separator /):
Without
With spare
0
%
Width (mm):
274.0
274.0
285
Height(mm):
33.0
33
Weight (kg/m):
9.4500
Cross-section
6419
6419
63794
Drawing of the cross-section view
Create label
Automatic rotation
0
Degree
Drawing of the useful cross-section view
Drawing of the useful cross-section view with spare
Writing the information table
Cable information
[RE]
>>
A
B
C
2
CBL570
CBL569
CBL560
1
CBL805
CBL561
CBL559
A1
Slab CHC6, section C_11 .10000.10.10 (285X33)
Drawing update
Cable list in the track
Ref mark
Position
Distribut...
Circuit
Type
Cable
Width(mm)
Height(mm)
Weight(kg/m
CBL805
A1
CTP
CTP/1,3,5
U1000R2V
5G10
20.0
20.0
0.7200
CBL570
A2
EP-2
EP-2/8,10,12
U1000R2V
5G2.5
13.0
13.0
0.2600
CBL569
B2
EP-2
EP-2/7,9,11
U1000R2V
5G2.5
13.0
13.0
0.2600
CBL561
B1
EP-2
EP-2/19,21,23
U1000R2V
5G2.5
13.0
13.0
0.2600
CBL560
C2
EP-2
EP-2/14,16,18
U1000R2V
5G2.5
13.0
13.0
0.2600
CBL559
C1
EP-2
EP-2/13,15,17
U1000R2V
5G2.5
13.0
13.0
0.2600
CBL558
D2
EP-2
EP-2/1,3,5
U1000R2V
5G2.5
13.0
13.0
0.2600
Default options
Export CSV
Select cables
Help
Validate
Cancel


15<-46->0
0.9m
285X33
2I(274X33)
0% 4%
9.45kg/m 0%
(274X33)

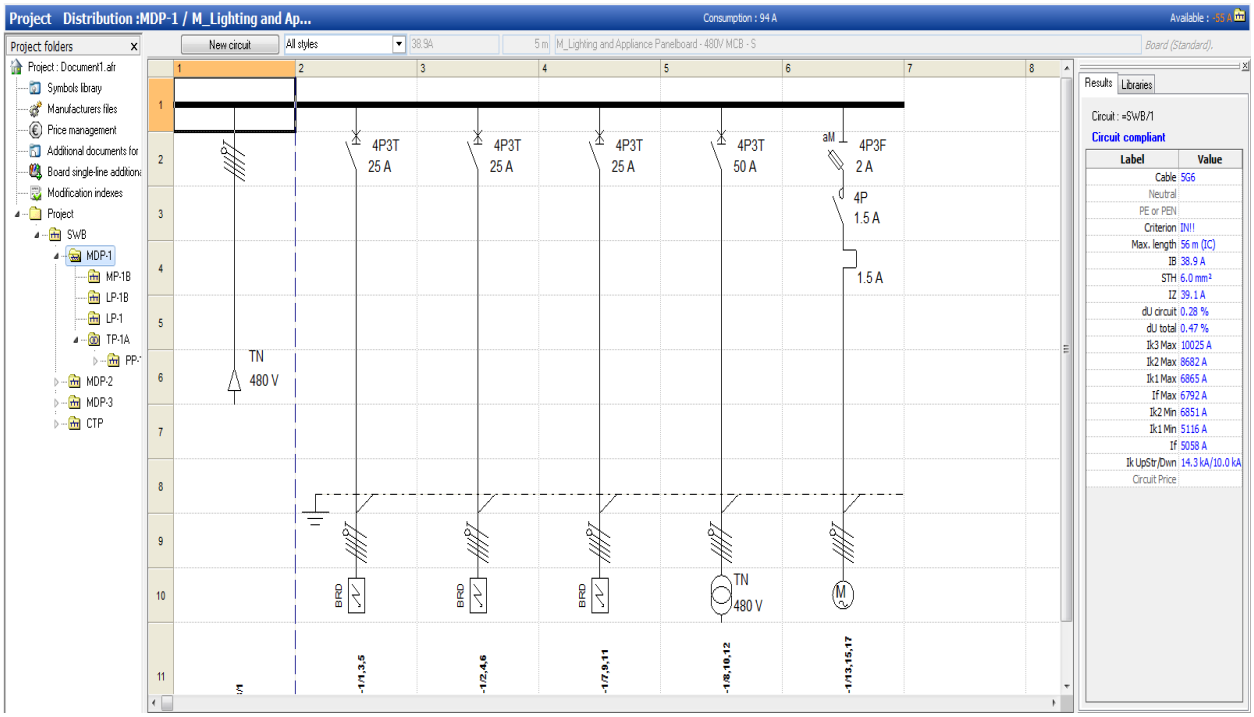

A1
Slab CHC6, section C_11 .10000.10.10 (285X33)

Analysis, Schematics, quotation, sizing

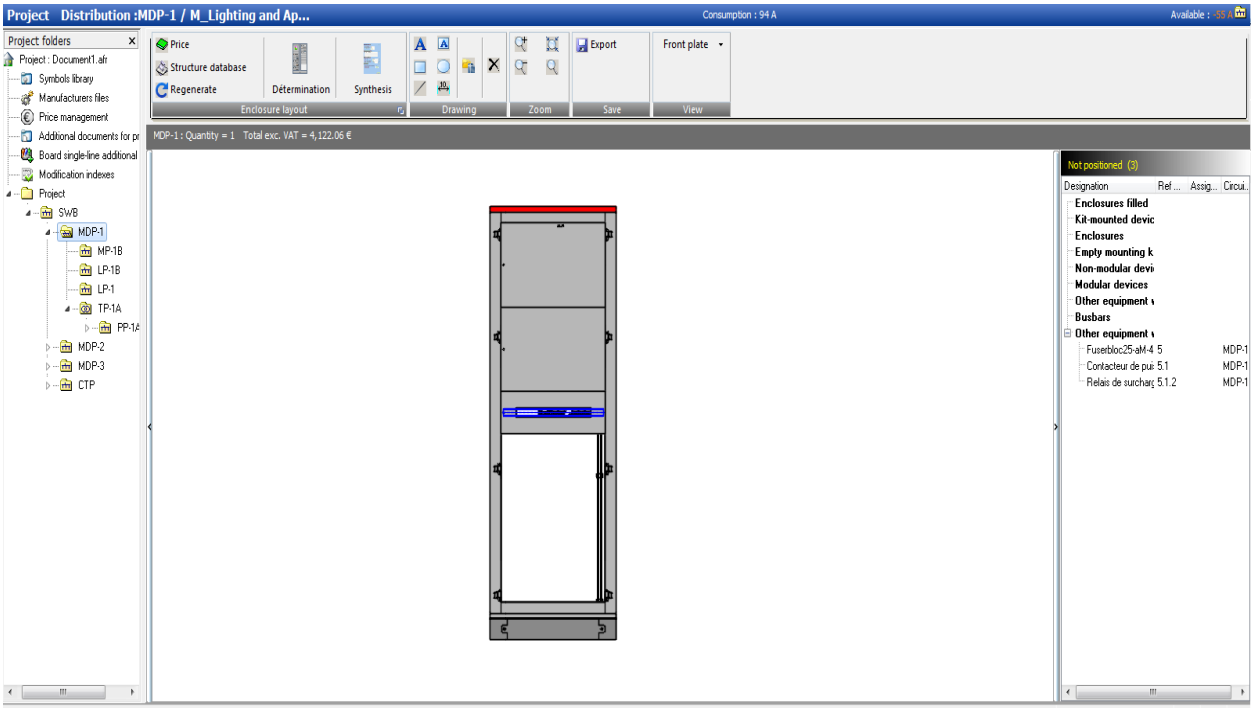
The single line diagram is automaticly generate



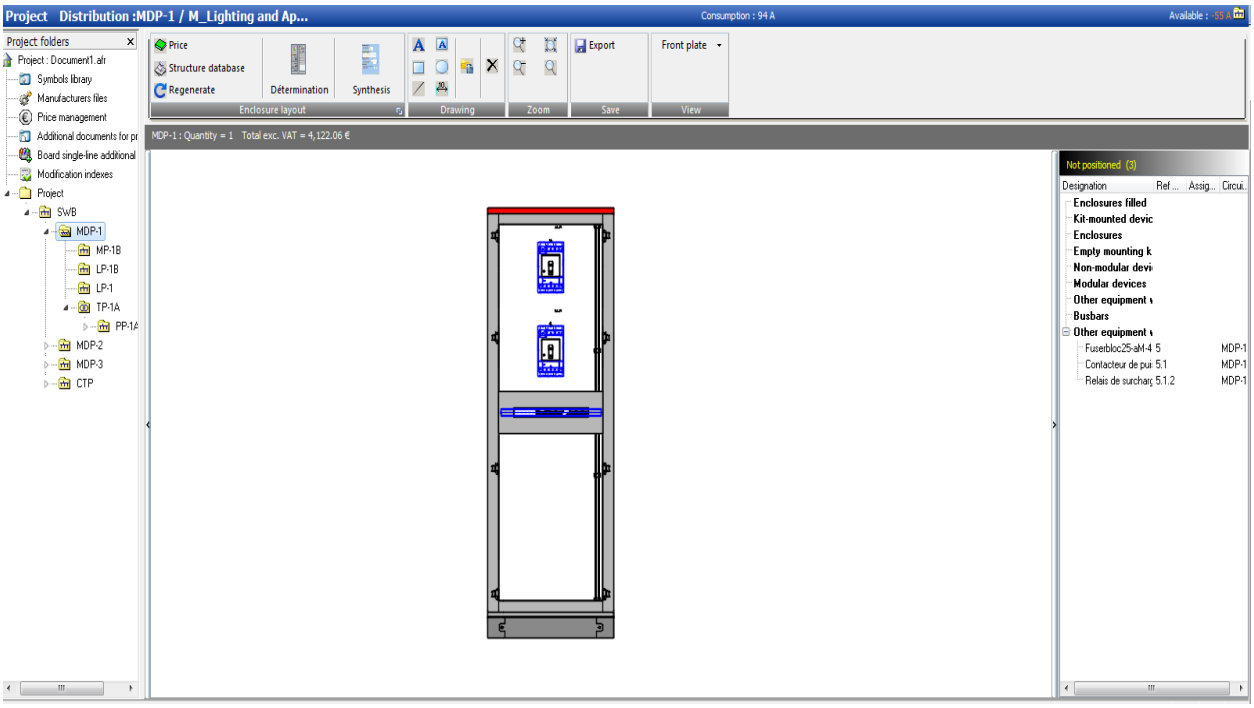
All the protection device can be automaticly define, base on multi manifacturers debases



Electrical Cabinets can be predetermined

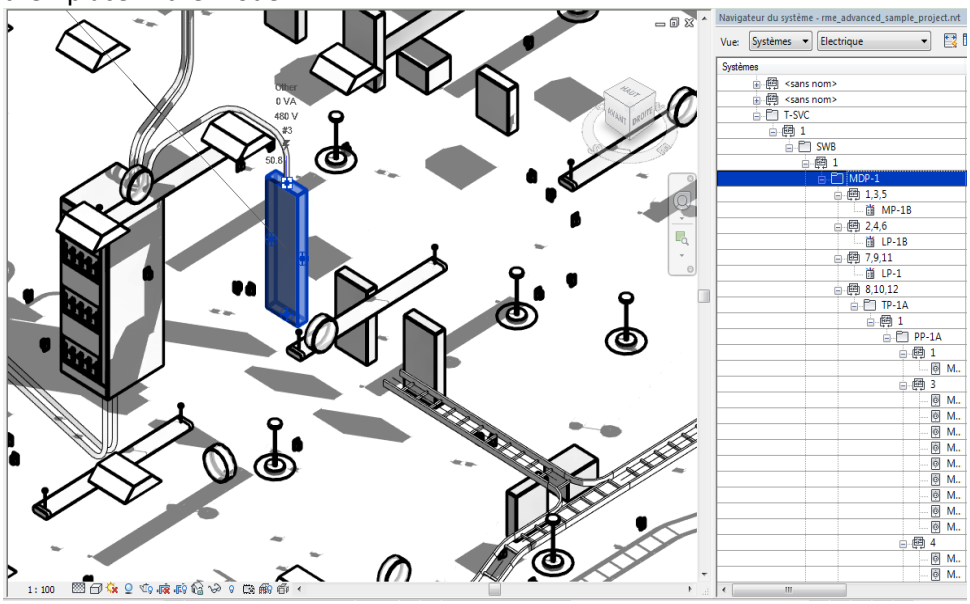


Display different view of the cabinets

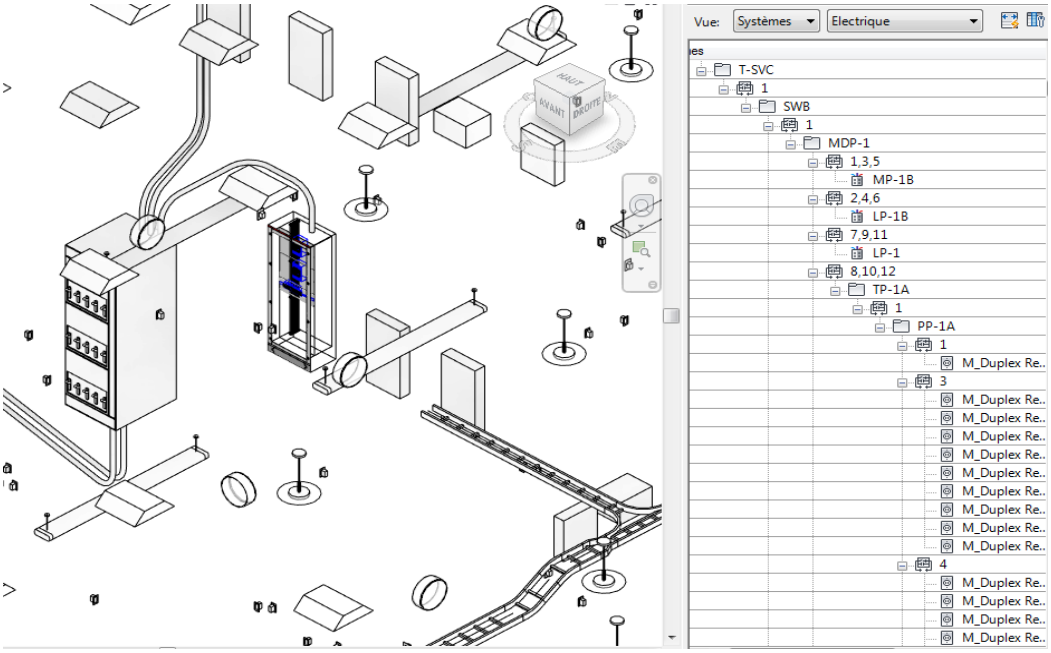


Update the Revit Model

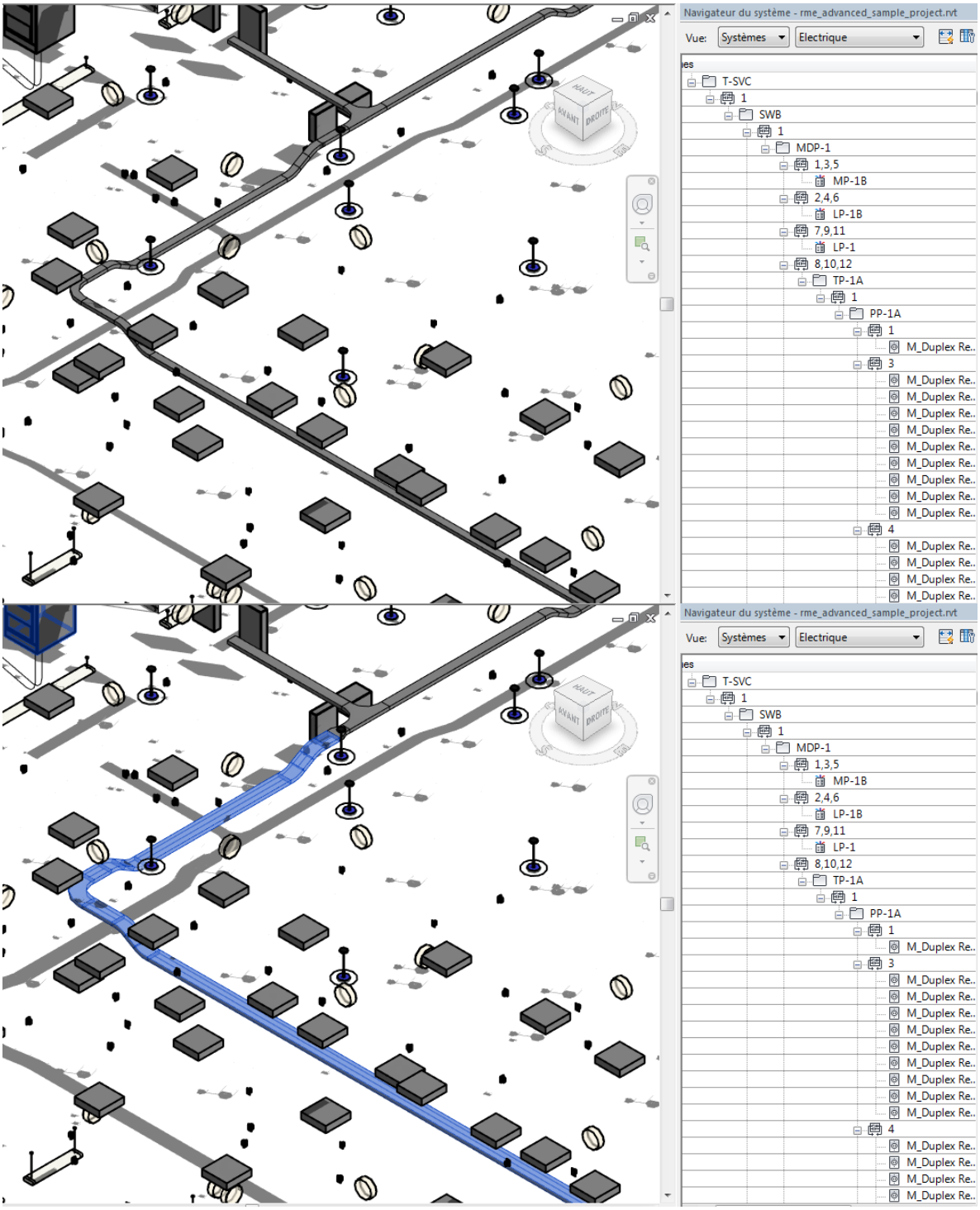
Panels would have to be updated in the Revit model, this functionality is on progress
But to keep the logic of the Bimelec process, it would have to be proposed in the next release.
However, the important is, we would have to have the possibility to define equipment size to define their place in the model.



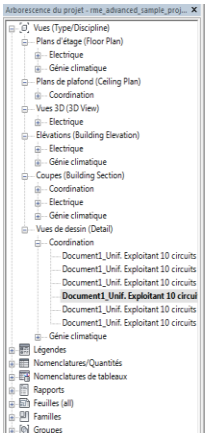
Panel size should be updated in the model

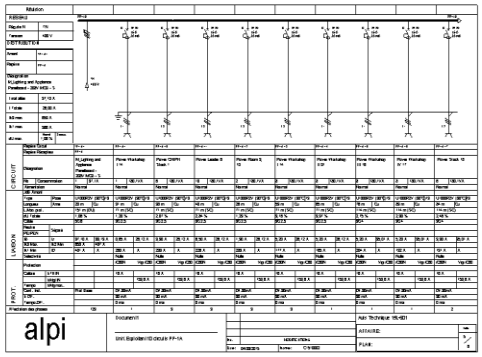


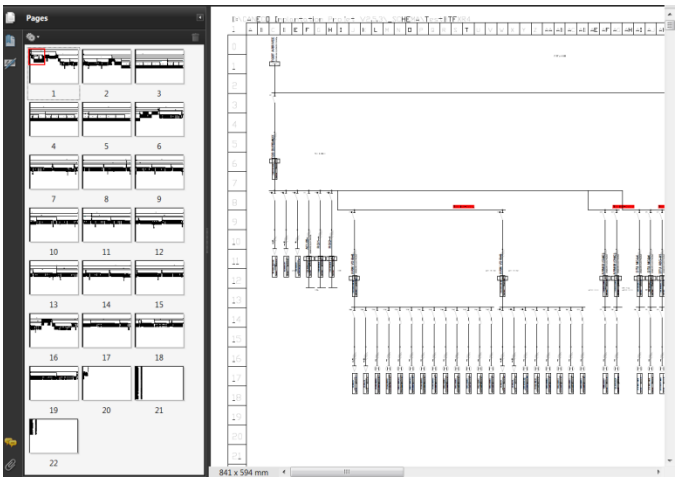
Cable trayz are updated after cables routing analysis



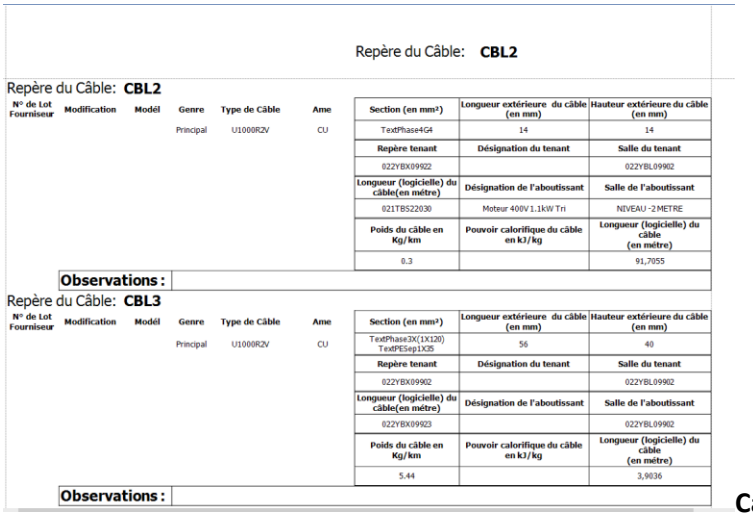
Manage all the documentation into the Revit Model







Schematics / synoptic



Repère du Câble: **CBL2**

Repère du Câble: **CBL2**

N° de Lot Fourniseur	Modification	Modél	Genre	Type de Câble	Ame	Section (en mm²)	Longueur extérieure du câble (en mm)	Hauteur extérieure du câble (en mm)
			Principal	U1000R2V	CU	TextPhase4G4	14	14

Repère tenant	Désignation du tenant	Salle du tenant
022YBX09922		022YBL09902

Longueur (logicielle) du câble(en mètre)	Désignation de l'aboutissant	Salle de l'aboutissant
021TBS22030	Moteur 400V 1.1kW Tri	NIVEAU -2METRE

Poids du câble en Kg/km	Pouvoir calorifique du câble en kJ/kg	Longueur (logicielle) du câble (en mètre)
0.3		91,7055

Observations :

Repère du Câble: **CBL3**

N° de Lot Fourniseur	Modification	Modél	Genre	Type de Câble	Ame	Section (en mm²)	Longueur extérieure du câble (en mm)	Hauteur extérieure du câble (en mm)
			Principal	U1000R2V	CU	TextPhase3X(1X120) TextPESep1X35	56	40

Repère tenant	Désignation du tenant	Salle du tenant
022YBX09902		022YBL09902

Longueur (logicielle) du câble(en mètre)	Désignation de l'aboutissant	Salle de l'aboutissant
022YBX09923		022YBL09902

Poids du câble en Kg/km	Pouvoir calorifique du câble en kJ/kg	Longueur (logicielle) du câble (en mètre)
5.44		3,9036

Observations :

Cable lists

Récepteurs		
Quantité	Nom	Nom du symbole
1	Equipement de génie climatique M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Back Dischorge : 11 kW	
1	Equipement électrique M_Dry Type Transformer - 480-208Y120 - NEMA Type 2 : T-SVC	
1	Equipement électrique M_Lighting and Appliance Panelboard - 480V MCB - Surface : MDP-3	
6	Installations électriques M_Duplex Receptacle : Standard	
1	M_Centrifugal Fan - Rooftop - Uplast:1383-2808 LPS	
1	M_Cooling Tower - Closed Circuit - Counterflow - 67-189 kW:177 kW	
8	M_Duplex Receptacle:GFCI	
409	M_Duplex Receptacle:Standard	
6	M_Lighting Switches:Single Pole	
1	M_Outdoor AHU - Horizontal:5.7 Square Meters of Coil	
38	M_Pendant Light - Disk:100W - 277V	
8	M_Pendant Light - Linear - 2 Lamp:1200mm - 277V	
6	M_Pendant Light - Linear - 2 Lamp:2400mm - 277V	
195	M_Plain Recessed Lighting Fixture:600x600 - 277	
1	M_Quadruplex Receptacle:Plain	
44	M_Sconce Light - Flat Round:60W - 277V	
1	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Back Dischorge:11 kW	
5	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Back Dischorge:14 kW	
5	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Right Dischorge:11 kW	
5	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Right Dischorge:14 kW	
2	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Right Dischorge:18 kW	
4	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Left Return - Right Dischorge:7 kW	
3	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Right Return - Back Dischorge:11 kW	
1	M_WSHP - Horizontal - High Efficiency - 7-18 kW - Right Return - Back Dischorge:7 kW	
36	M_Wall Occupancy Sensor - Regulor Voltage:Passive Infrared - 277 V	
1	M_Water Heater - Tankless:2.3 L	
6	Sprinklers M_Sprinkler - Pendent - Hosted : 15 mm Pendent on Drop with Guard	
1	Symboles de cote d'élévation M_Spot Elevation - Target Filled	

Legend

2 How David Bremec the Manager of SNEF Paris has developed a BIM electrical process in his Agency around large building project.

What about Snef ?

The SNEF Group is one of the French leaders contractors in the electrical field, with over 9000 people, the group achieved in 2012 a turnover of 929 million euros and employs more than 9000 people worldwide.

SNEF Group operates on Medium and Low voltage installations for industry, building, naval, healthcare, infrastructure and public projects. SNEF covers projects from pre design to implementation and maintenance.

Due to its history and experience, SNEF group is a driving force in terms of technical innovation, but also in terms of work process organization at the service of expertise in major tertiary projects.

Snef always searches to increase tthe efficiency for electrical and HVAC design that's why we've build a strong partnership with to ALPI.

The use of Caneco software offers a significant time saving, a better reliability of data, flexibility in the software use and a suitable solution to meet requirements of all kind of installations.

Significant time gains were recorded; however the time-executions are mainly due to the poor definition of the initial project. This fact emphasizes the advent of the digital model what allows to define to its best, a project before its encryption phases and execution.

Visit the website: http://www.snef.fr/index.php?lang=fr

What was the workflow in David Bremec agency when the design was based on a CAD PROCESS?

Working with a CAD process requires minimum hardware and software means.

This method involves preparation of tasks independent of each other.

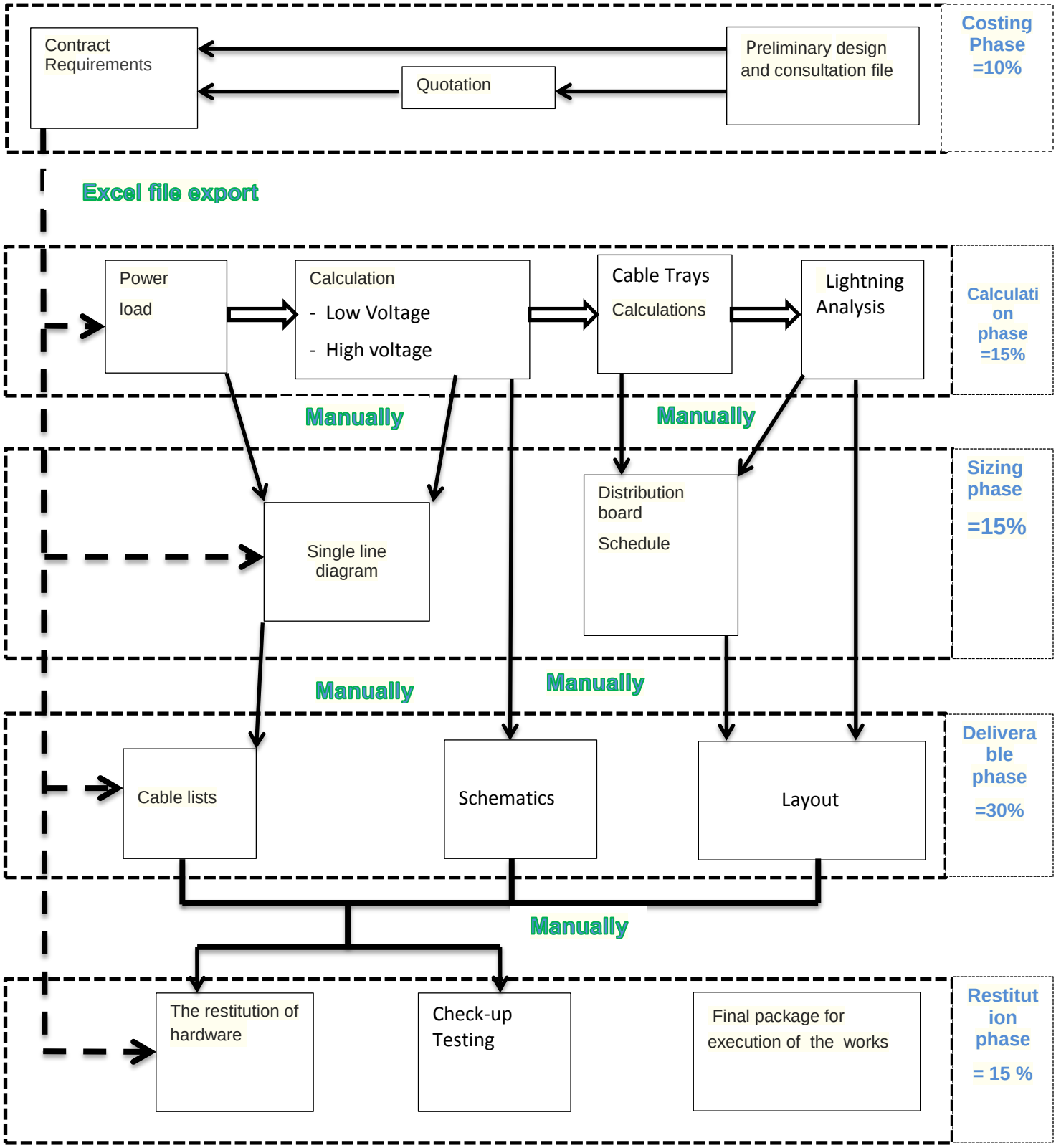
These tasks are performed with a large risk of errors and imply important non-added value times.

The reason is because each output data has to be put manually as input data of another task.

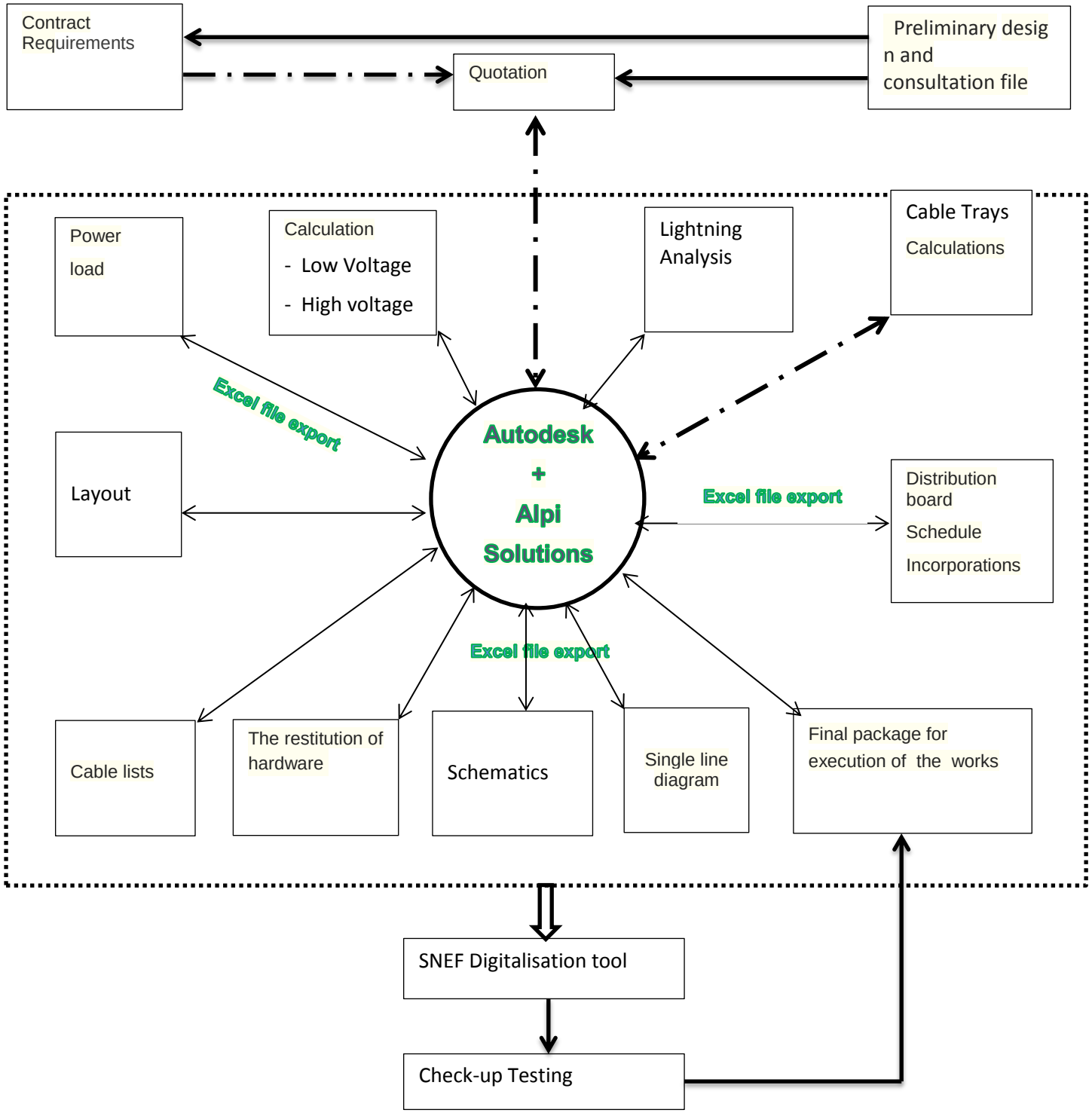
A calculations result has to be updated manual update on many documents because there is no interaction between the different spots.

This method involves several different software and manual entries. (See diagram 1)

Diagram 1: WorkFlow based on CAD.



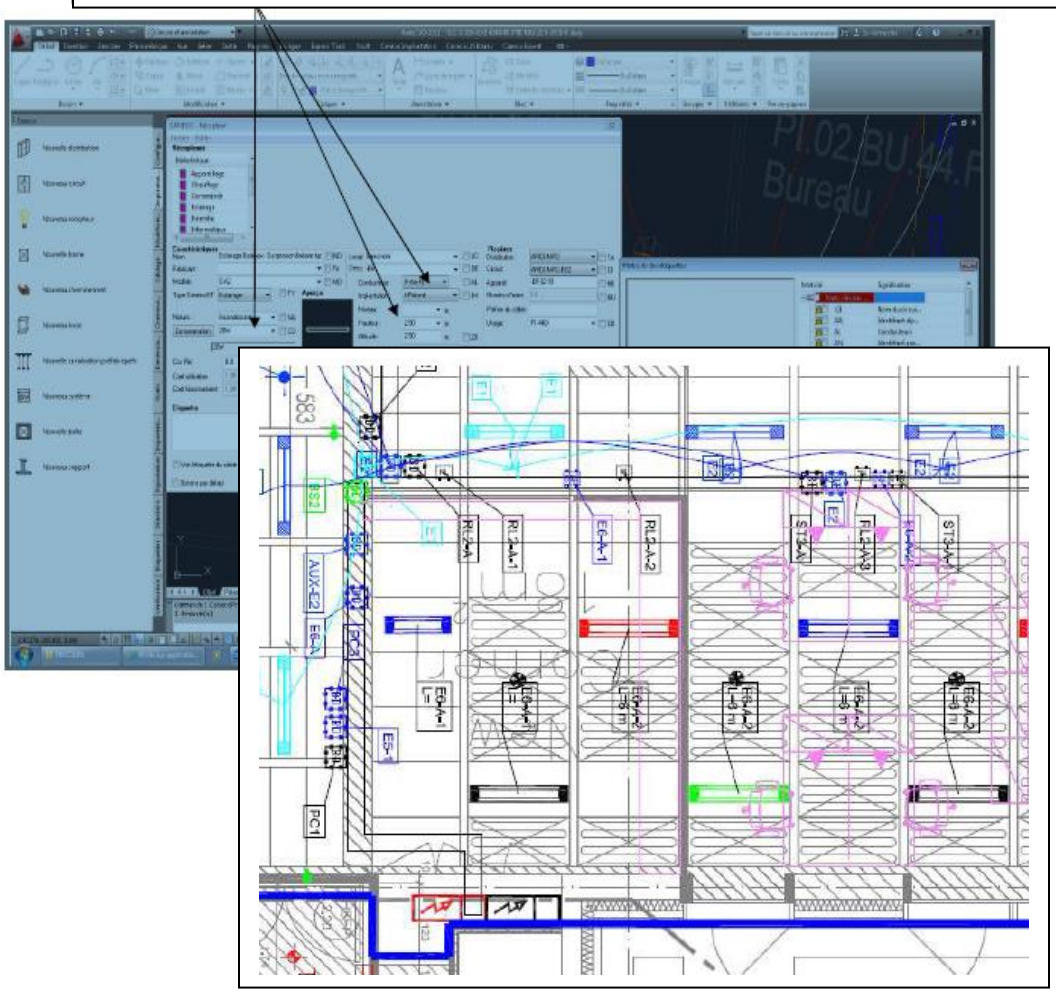
How did David BREMEC decided to improve their methodology adopting a BIMelec Process



Some points that definitely change the way we analyze an electrical Project

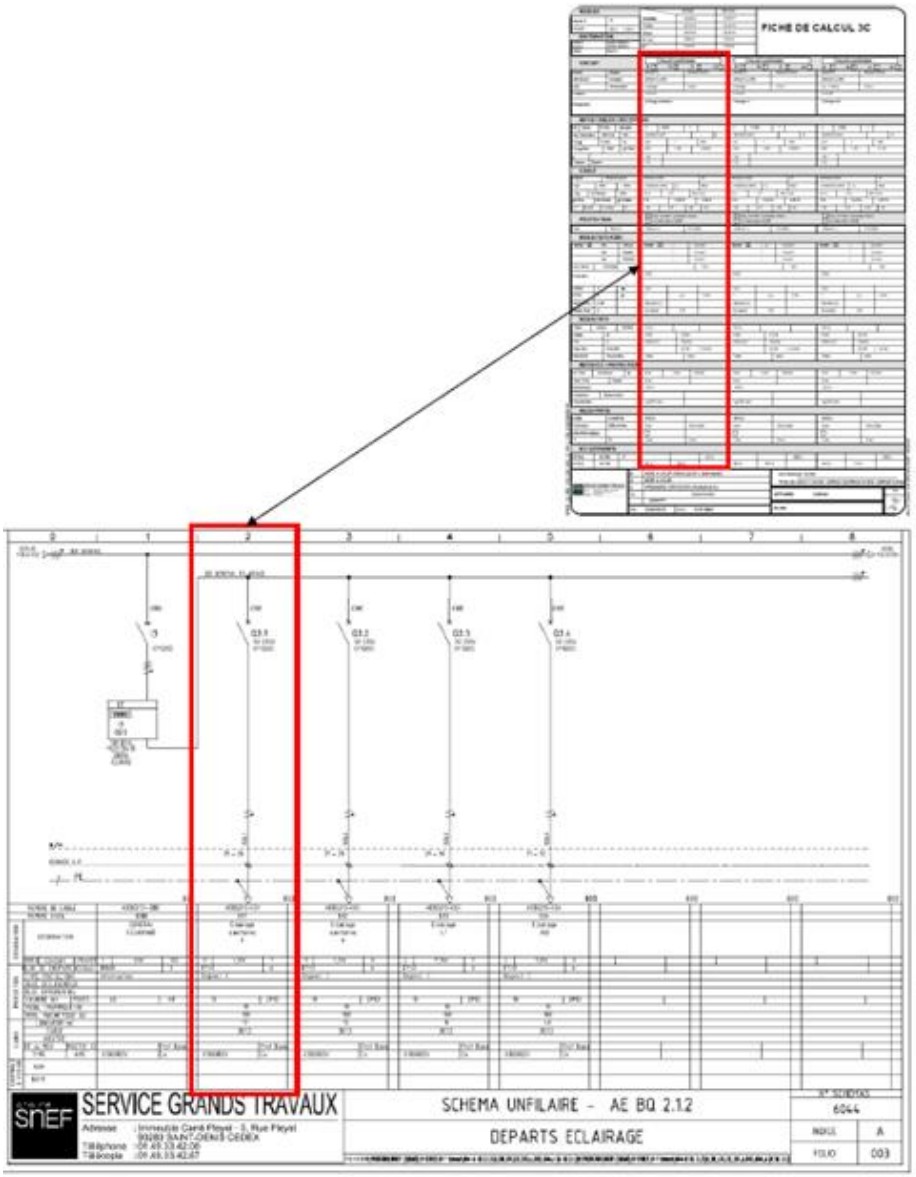
- **Implantation :** The principle fundamentally adopted by SNEF is the collection of electrical and Physical data regarding all the equipment from the 3D model

We identified each equipment by its:
- Unique name - Tag
- Description
- Electrical characteristic needed



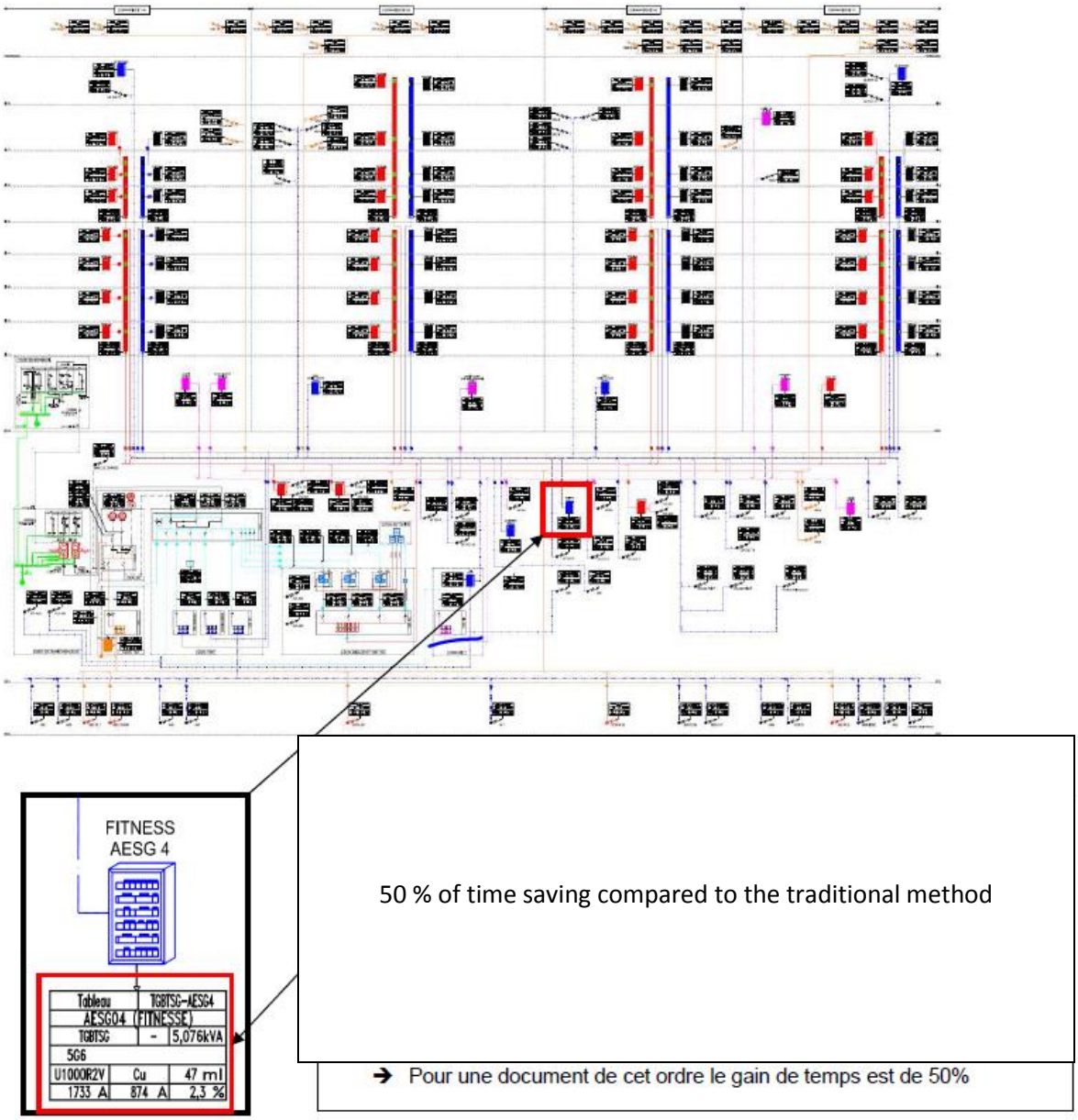
- **<u>Low Voltage calculation reports</u>**

- Unlike traditional study a method, the information needs to define Low Voltage calculation reports are taken directly from previous actions without manual inputs.



- **Synoptic generation**

  Unlike traditional study methods the input data required for developing the electrical distribution block are derived directly from the calculation reports.



- **BILL of material**

Unlike standard study methods, the data required to create equipment schedules are produced directly from digital model.

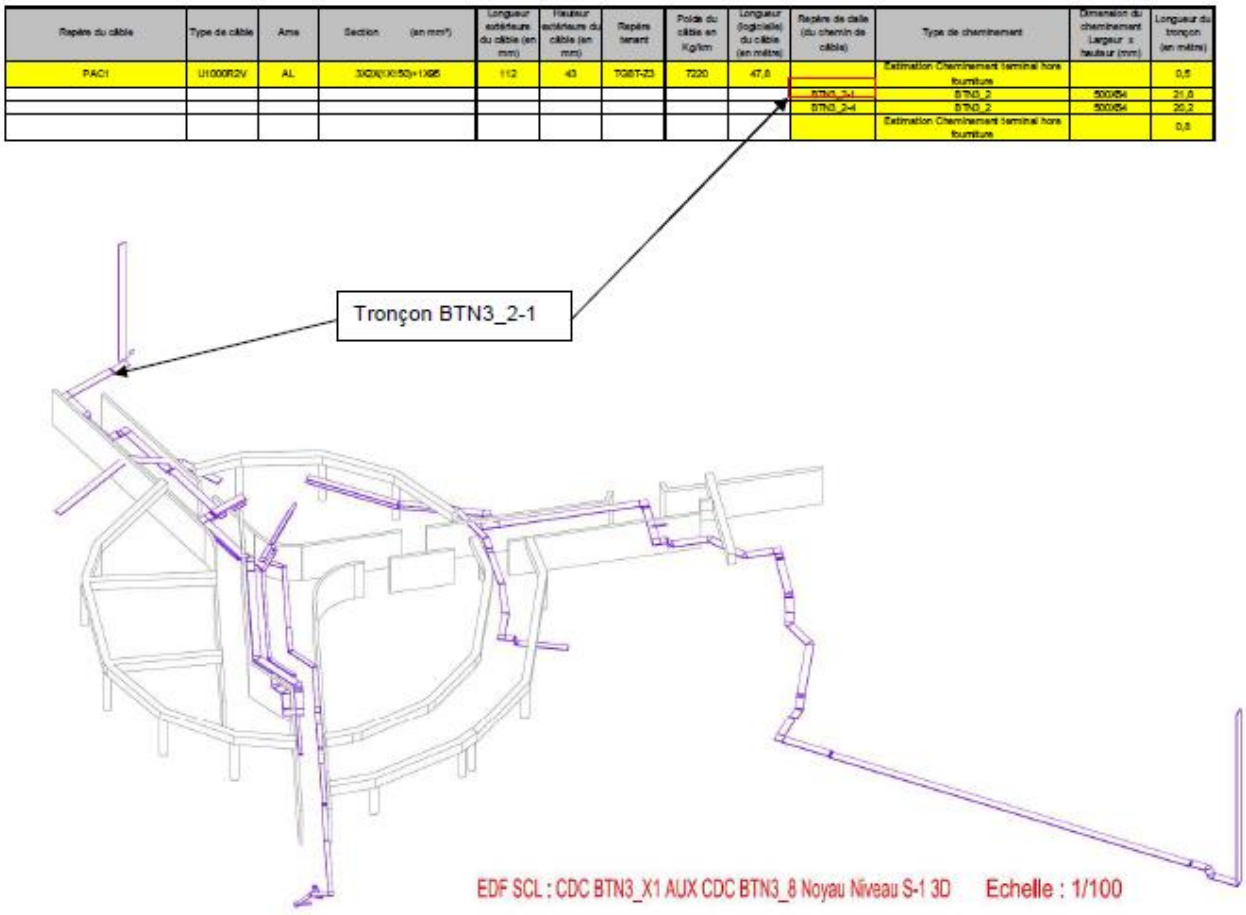
Quantities are exhaustive and there is no need to calculate by hand.

N° de fil du fournisseur	Modification	Repère du câble	Type de câble	Âme	Section (en mm²)	Largeur extérieure	Hauteur extérieure	Type d'cheminement	Repère Tenant	Désignation du tenant	Salle du tenant	Repère Aboutissant	Désignation de l'aboutissant	Salle de l'aboutissant	Poids du câble en kg	Pouvoir calorifique	Longueur	Charrette	Modèle	Ma couche	Rayon courbure mini	Usage/Aboutissant	Tension	Priorité	Famille	Circuit
		BQ3.2.2-ST1-Div	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST5	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST6	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/I	180.0000		7.8700				0.000					
		BQ3.2.2-ST1-Div1	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST6	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST14	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.6500				0.000					
		BQ3.2.2-ST1-Div2	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST6	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST9	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		7.3600				0.000					
		BQ3.2.2-ST1-Div3	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST6	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST10	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.1800				0.000					
		BQ3.2.2-ST1-Div4	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST6	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST11	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.2100				0.000					
		BQ3.2.2-ST1-Div5	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST5	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST7	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/I	180.0000		1.3600				0.000					
		BQ3.2.2-ST1-Div6	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST7	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST12	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.1100				0.000					
		BQ3.2.2-ST1-Div7	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST7	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST13	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.8900				0.000					
		BQ3.2.2-ST1-Div8	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST7	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST16	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		7.3600				0.000					
		BQ3.2.2-ST1-Div9	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST7	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST17	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.0100				0.000					
		BQ3.2.2-ST1-Div10	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST5	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST8	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/I	180.0000		3.2500				0.000					
		BQ3.2.2-ST1-Div11	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST8	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST15	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		7.4400				0.000					
		BQ3.2.2-ST1-Div12	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST4	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST5	BD-STR	VEGA/R+3/C2.2/I	180.0000		9.6400				0.000					
		BQ3.2.2-ST1-Div13	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST1	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST2	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/I	180.0000		0.6900				0.000					
		BQ3.2.2-ST1-Div14	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST2	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST1	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.2200				0.000					
		BQ3.2.2-ST1-Div15	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST2	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST3	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		7.8300				0.000					
		BQ3.2.2-ST1-Div16	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST2	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST4	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		9.7000				0.000					
		BQ3.2.2-ST1-Div17	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST1	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST3	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/I	180.0000		3.3700				0.000					
		BQ3.2.2-ST1-Div18	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST3	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST18	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		7.1900				0.000					
		BQ3.2.2-ST1-Div19	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST3	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST5	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.7600				0.000					
		BQ3.2.2-ST1-Div20	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST3	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST6	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		9.3300				0.000					
		BQ3.2.2-ST1-Div21	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST3	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST7	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		8.3900				0.000					
		BQ3.2.2-ST1-Div22	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST4	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST1	BD-STR	VEGA/R+3/C2.2/I	180.0000		18.9100				0.000					
		BQ3.2.2-ST1-Div23	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2	ARMOIRE ELECTRIQUE	VEGA/R+3/C2.2/BUREAUX 3	AEBQ3.2.2-ST4	BD-STR	VEGA/R+3/C2.2/I	180.0000		16.8100				0.000					BQ3.2.2-ST1
		BQ3.2.2-ST2-Div	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST9	BD-STR	VEGA/R+3/C2.2/CIRCULATION	AEBQ3.2.2-ST10	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/I	180.0000		14.3900				0.000					
		BQ3.2.2-ST2-Div23	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST10	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST30	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		7.9200				0.000					
		BQ3.2.2-ST2-Div24	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST10	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST19	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		4.7000				0.000					
		BQ3.2.2-ST2-Div25	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST10	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST20	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		5.2600				0.000					
		BQ3.2.2-ST2-Div26	U1000R2V	Cu	3G2.5	11.0	11.0	1@BTPH	AEBQ3.2.2-ST10	GTB-STR (HORS LOT)	VEGA/R+3/C2.2/BUREAUX 1	AEBQ3.2.2-ST21	ALIM. STORE	VEGA/R+3/C2.2/I	180.0000		6.3400				0.000					

- **Routing of Cable and List of Cables**

  The routing cable list identifies the passage of cables from the start to the end point. Cable trays are codified and sequence of sections determines the cable routing

Repère du câble	Type de câble	Ame	Section (en mm²)	Longueur extérieure du câble (en mm)	Hauteur extérieure du câble (en mm)	Repère tenant	Poids du câble en Kg/km	Longueur (logicielle) du câble (en mètre)	Repère de calle (du chemin de câble)	Type de cheminement	Dimension du cheminement Largeur x hauteur (mm)	Longueur du tronçon (en mètre)
PAC1	U1000R2V	AL	3X2X(1X50)+1X95	112	43	TGBT-Z3	7220	47,8		Estimation Cheminement terminal hors fourniture		0,8
									BTN3_2-1	BTN3_2	500X54	31,8
									BTN3_2-4	BTN3_2	500X54	20,2
										Estimation Cheminement terminal hors fourniture		0,8



- **Cable trays**

  Provide better visibility for understanding 2D drawings and therefore facilitates the realization of construction site.