Modification and development of the LRAIC model for fixed networks 2012-2014 in Denmark

SQL documentation

Danish Business Authority

Ref: 2012-55-DB-DBA - Fixed LRAIC

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Summary

1 How to use the SQL model?

1.1 Overview of the model

The SQL-model, which creates the inputs for the Excel Access model consists of 4 databases:

- Three databases are specific to the modelled network describing routes and assets (one for the copper and national FTTH scenario, one for the cable-TV scenario and one for the DONG network scenario)
- One database is used for the modelling, which fills itself with the relevant scenario and calculates the dimensioning of the network. This is the database called 'Denmark_Model'

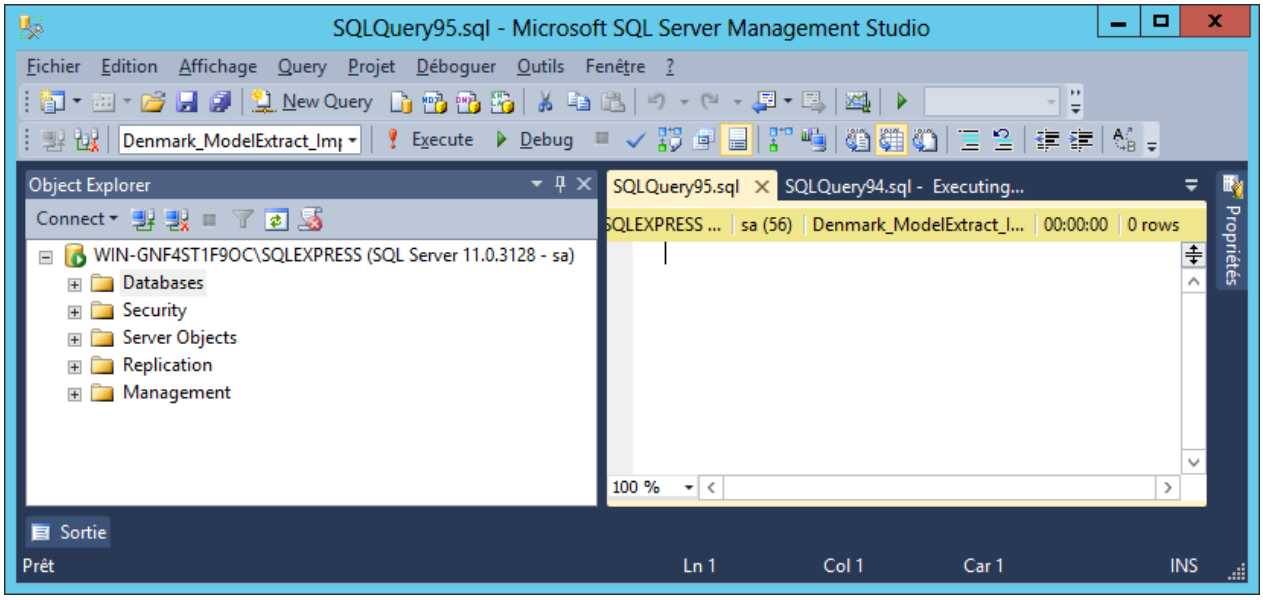
In order to use the model the following steps have to be followed:

- Open the SQL Server;
- import the model database;
- import one or all of the input databases, depending on the scenario(s) to model;
- open the 'Denmark_Model' database;
- update parameters if required; and
- execute the modelling of a scenario.

1.2 Open SQL Server

When the SQL Server is installed, the first step is to launch 'SQL Server Management Studio' software. The interface should be similar to the interface shown below in Figure 1.

Figure 1 – SQL Server Management Studio



Source: DBA

1.3 Restore the databases

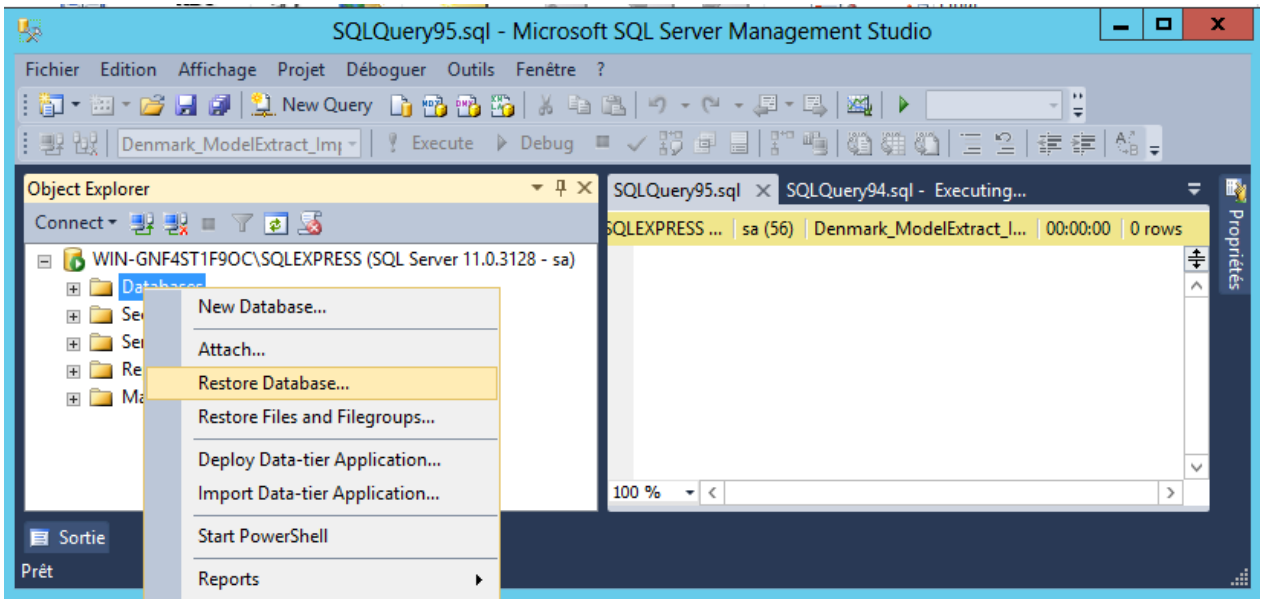
When the 'Management Studio' software is launched, the next step is to import the databases.

The database "Denmark_Model" is required to be imported, and at least one of the three input databases is required to be imported.

The following screenshots show how to import a database using the 'Management Studio' software:

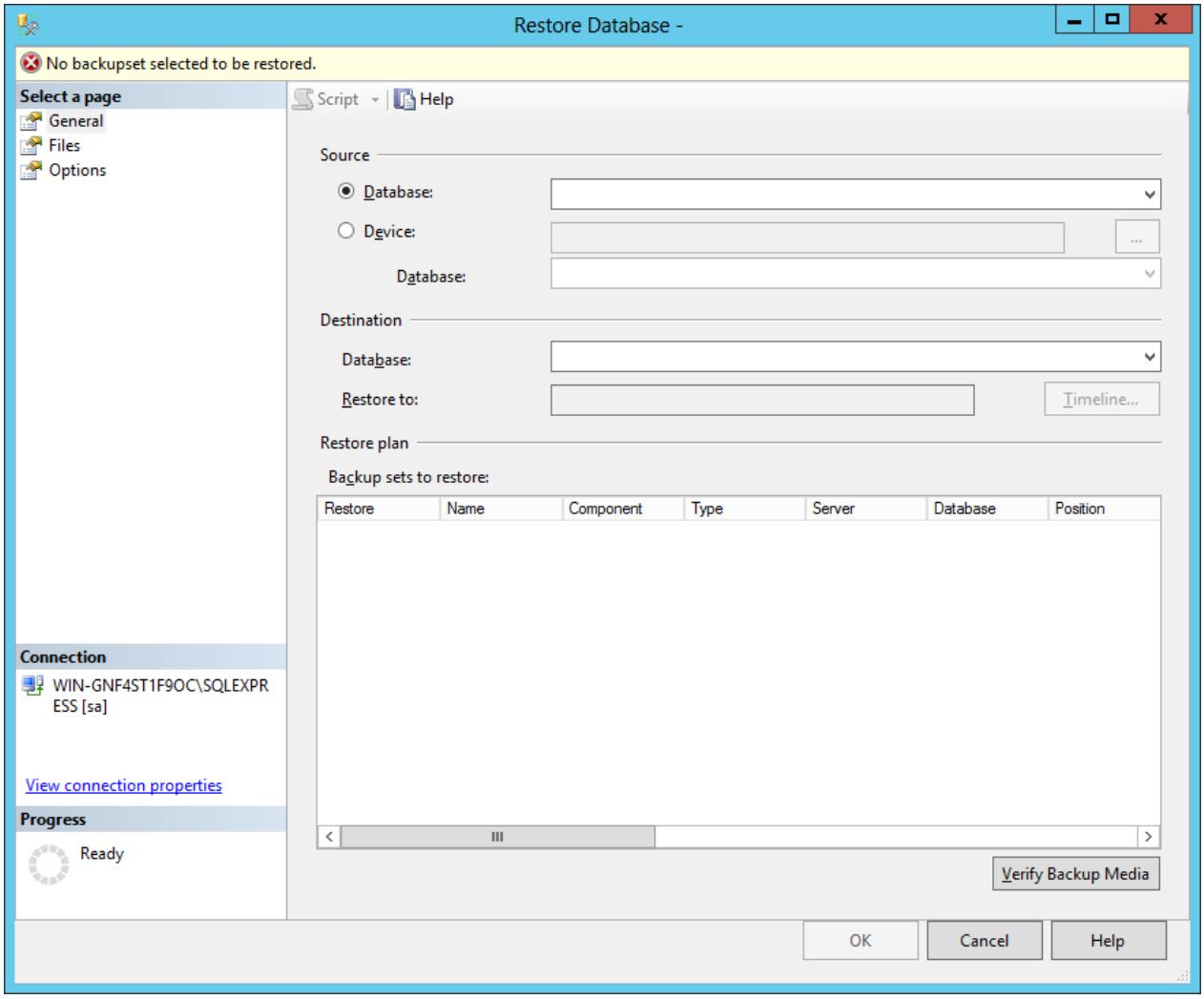
- Right click on 'Databases' (see Figure 2);
- Click on 'Restore Database' (see Figure 2);
- Select the backup file to import (see Figure 3, Figure 4, Figure 5);
- Click on 'Ok' and the database should appear in the list of databases (see Figure 6, Figure 7) ;
- Repeat the above 4 steps as many times it is required to import all databases needed.

Figure 2 – Click on Restore Database



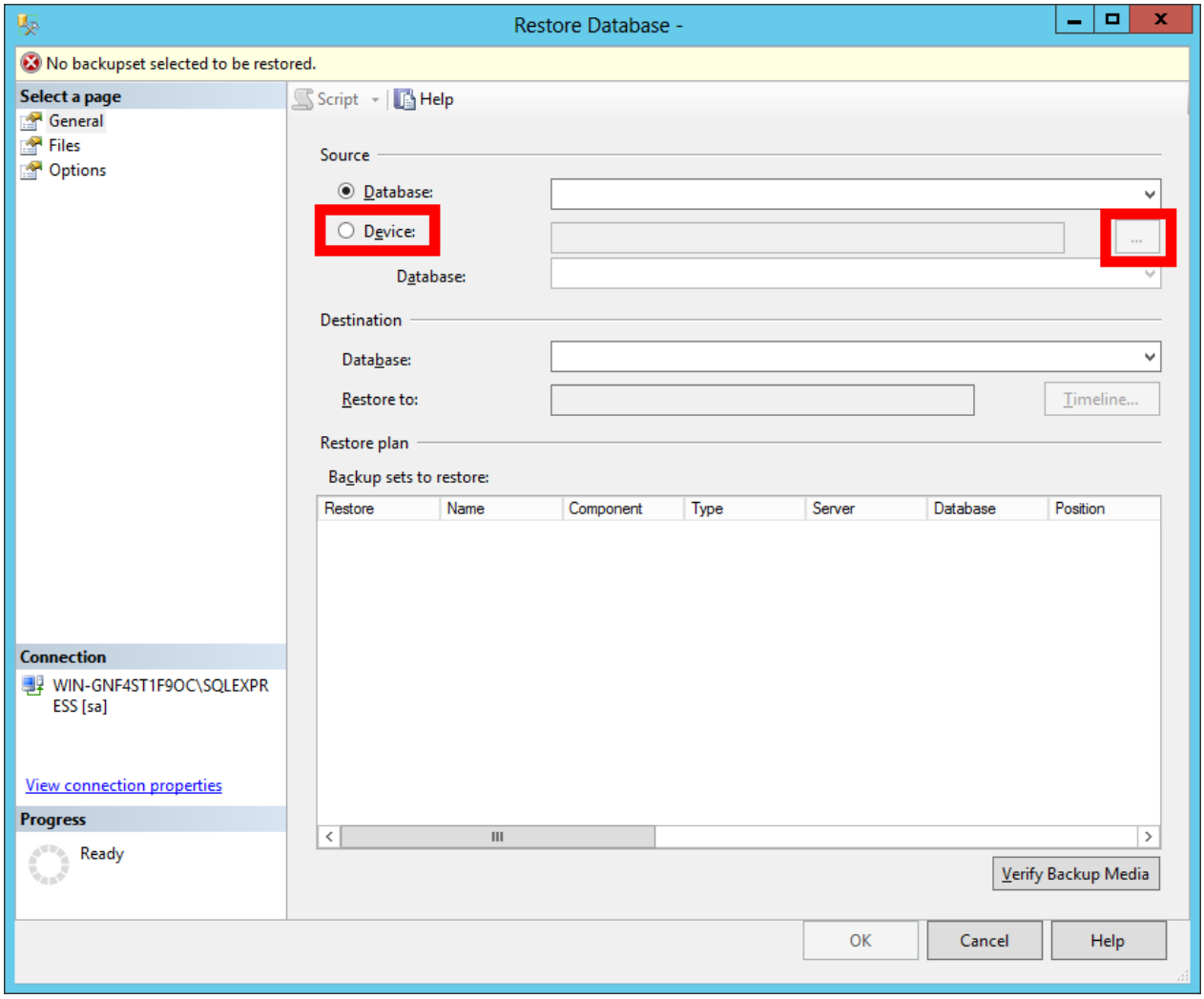
Source: DBA

Figure 3 – Restore database wizard



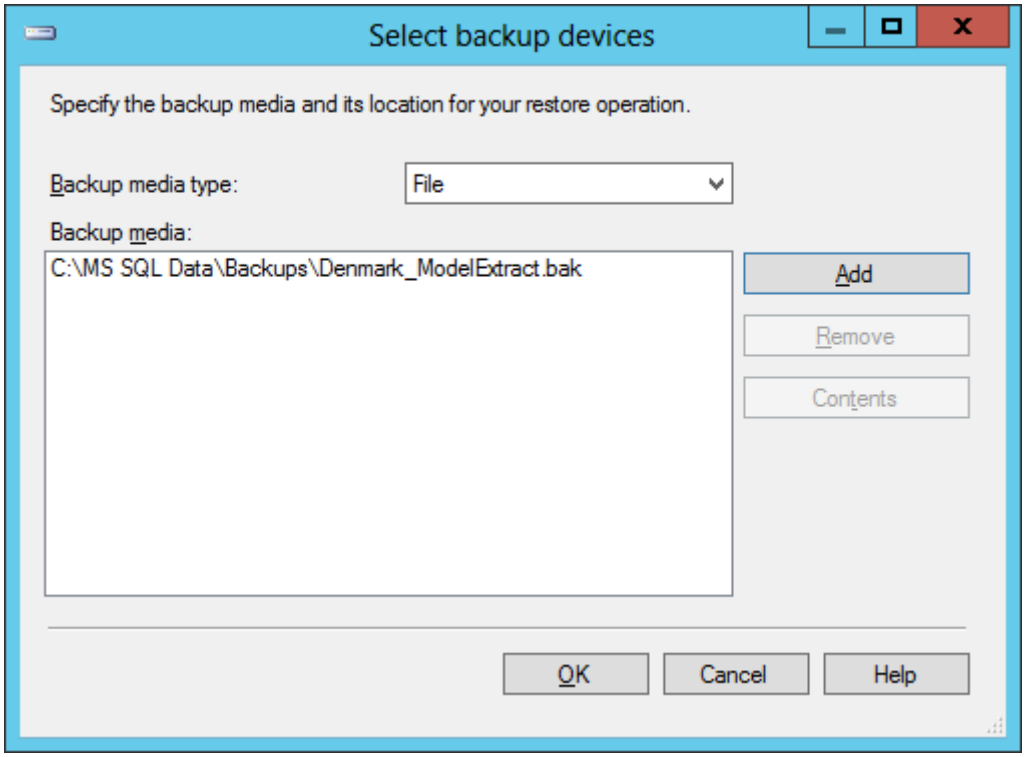
Source: DBA

Figure 4 – Select import from a file



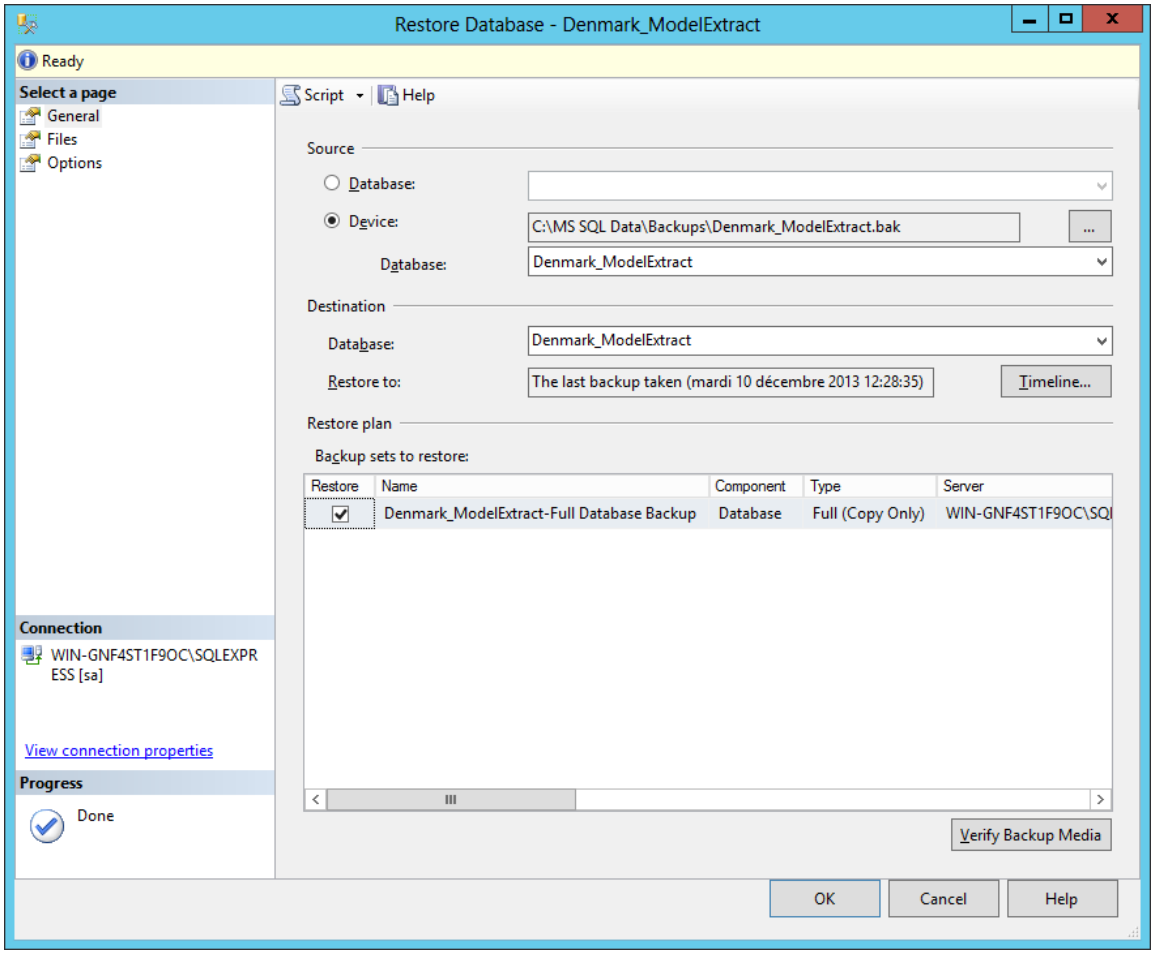
Source: DBA

Figure 5 – Select the database file



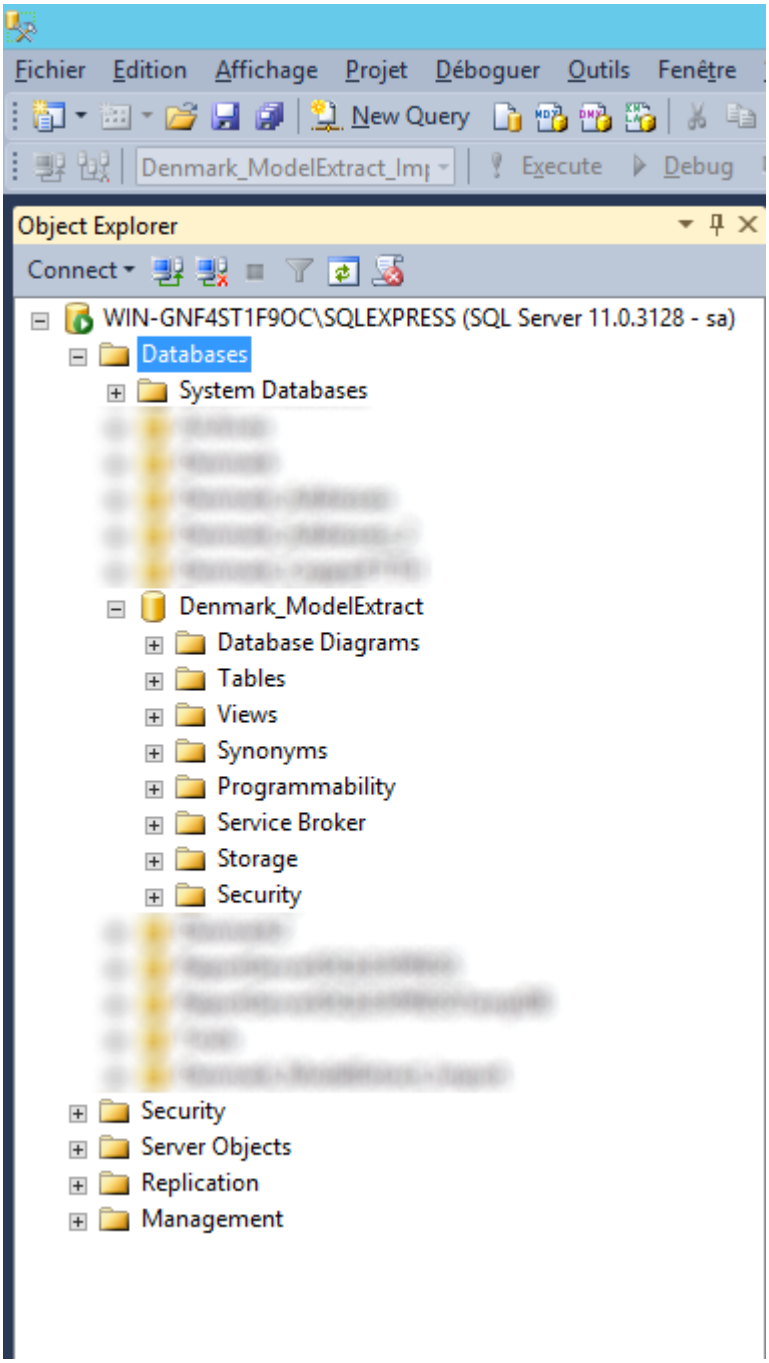
Source: DBA

Figure 6 – Validate the selected file



Source: DBA

Figure 7 – The new database appears in the databases tree



Source: DBA

1.4 Update parameters

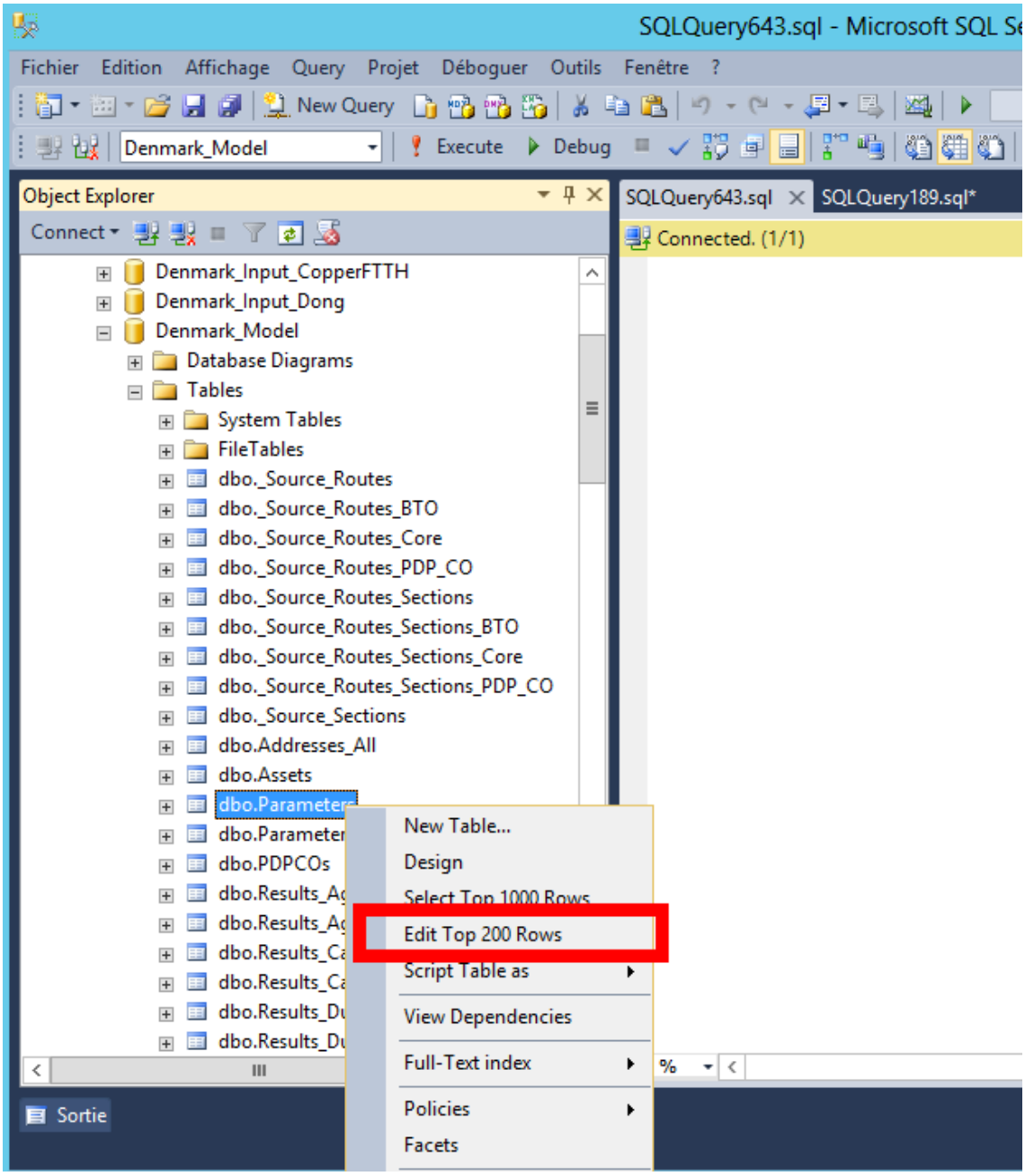
There are two tables of parameters that can be updated:

- The “Parameters” table that is describing the scenario to use, the second one is describing some common parameters such as trenches specifications and MDU dimensioning parameters.

- The “Parameters” table that has many columns. The NumericValue and StringValue columns are the ones used by the current scenario. There are some columns dedicated to each scenario to store the parameters values (e.g. Sc_Copper_Num, Sc_Copper_Str for copper).

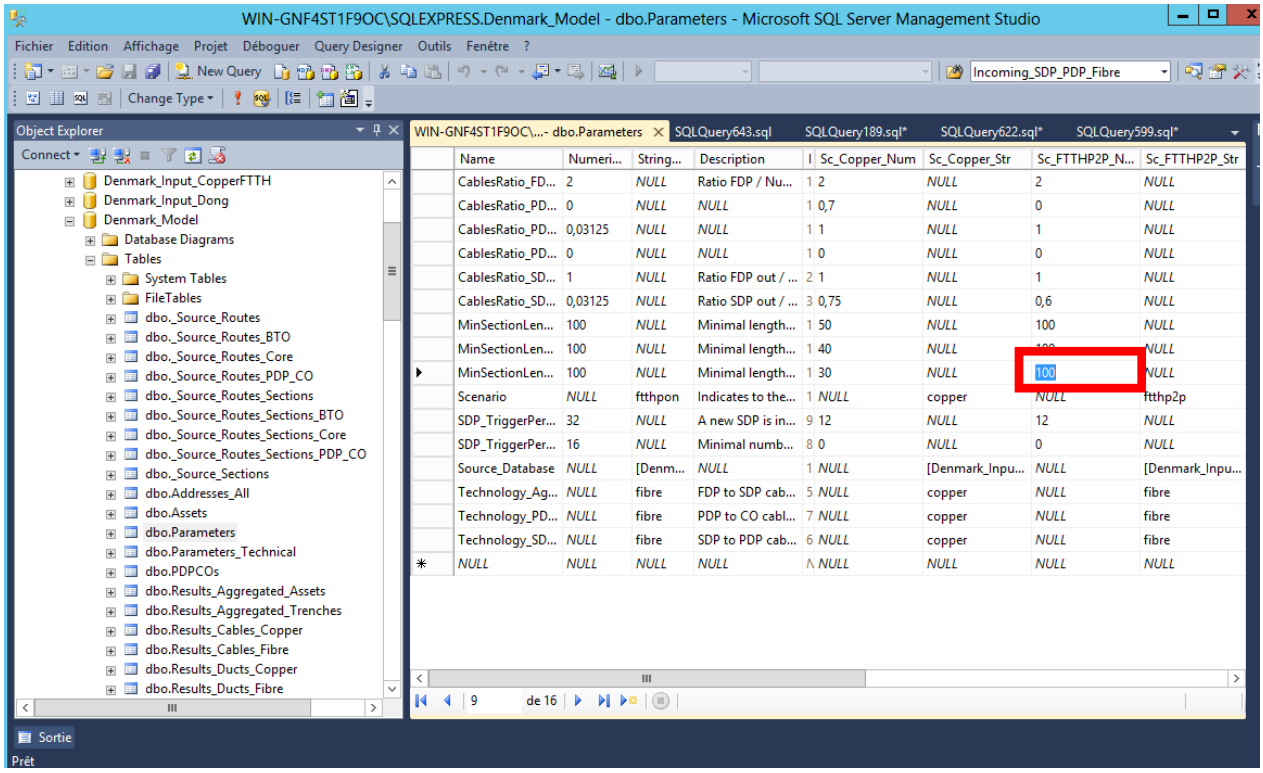
Updating parameters for a specific scenario can be done by editing the parameter table (see Figure 8) and changing the values on the columns specific to the considered scenario (see Figure 9) and pressing ‘enter’.

Figure 8 – Unfold the ‘Table’ tree of the Denmark_Model database, right click on dbo. Parameters and click on ‘Edit Top 200 Rows’



Source: DBA

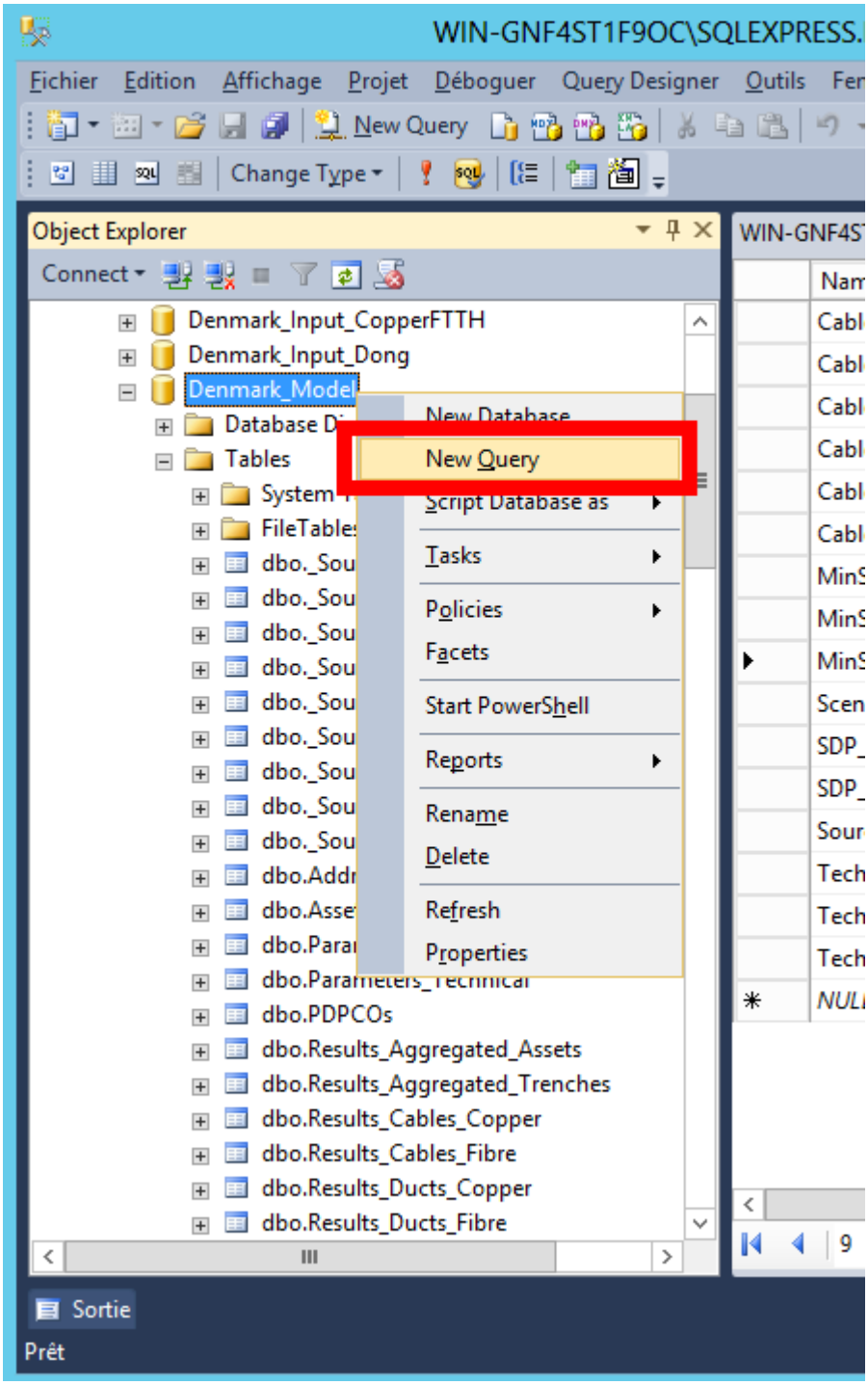
Figure 9 – Edit a scenario-specific parameter and press 'Enter'



Source: DBA

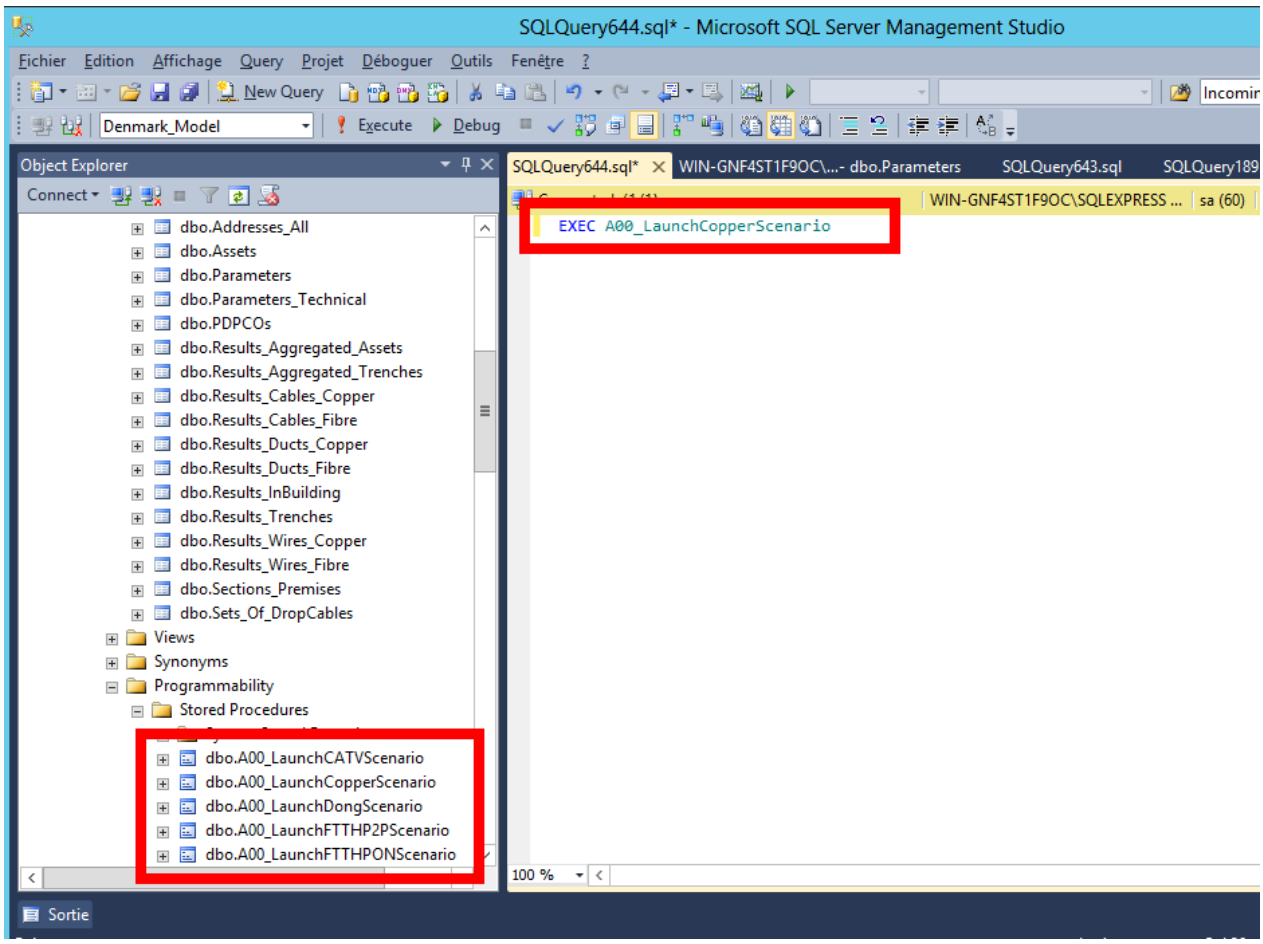
1.5 Launch the model calculation

Figure 10 – Right click on 'Denmark_Model' database and click on 'New Query'



Source: DBA

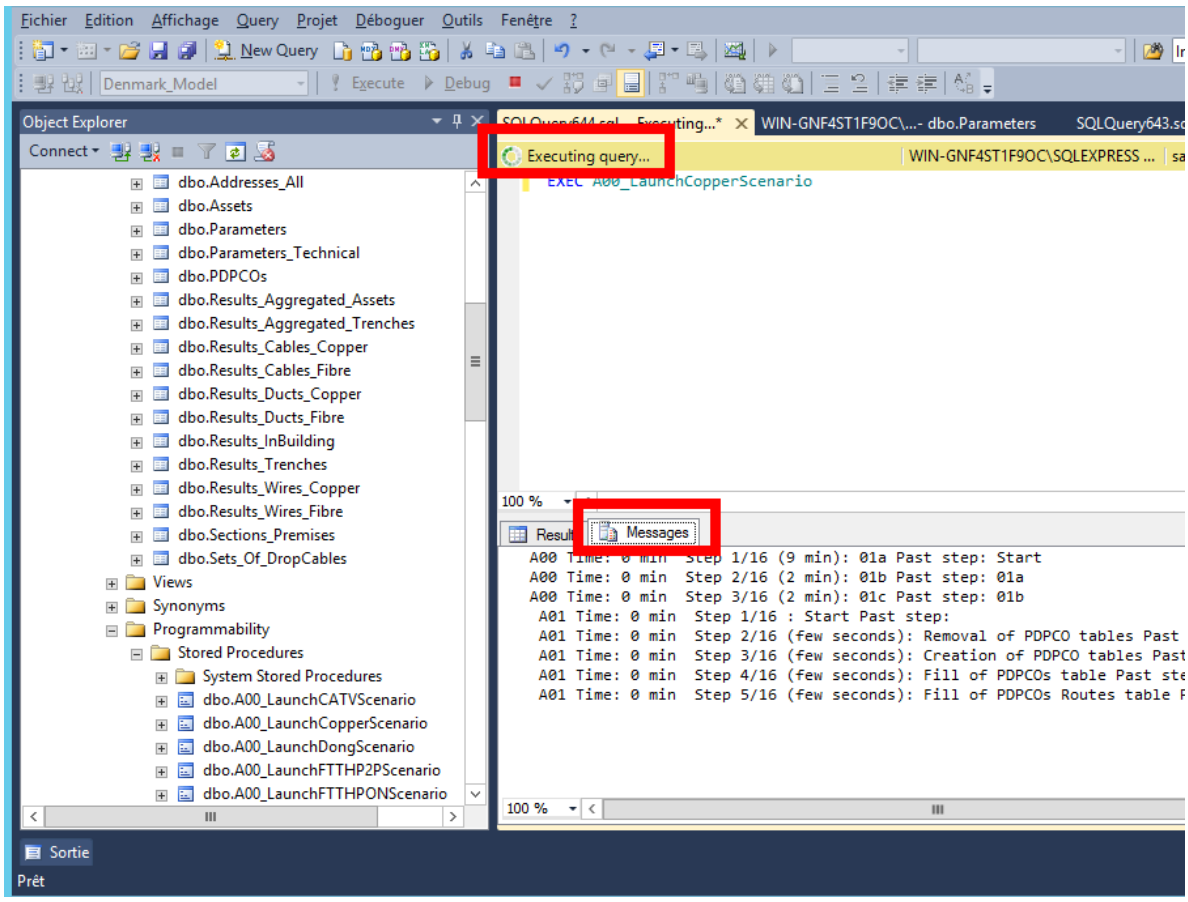
Figure 11 – Expand the 'Programmability' and 'Procedures' trees and write in the right panel 'EXEC A00_LaunchCopperScenario' (or one of the others, cf. the figure below)



Source: DBA

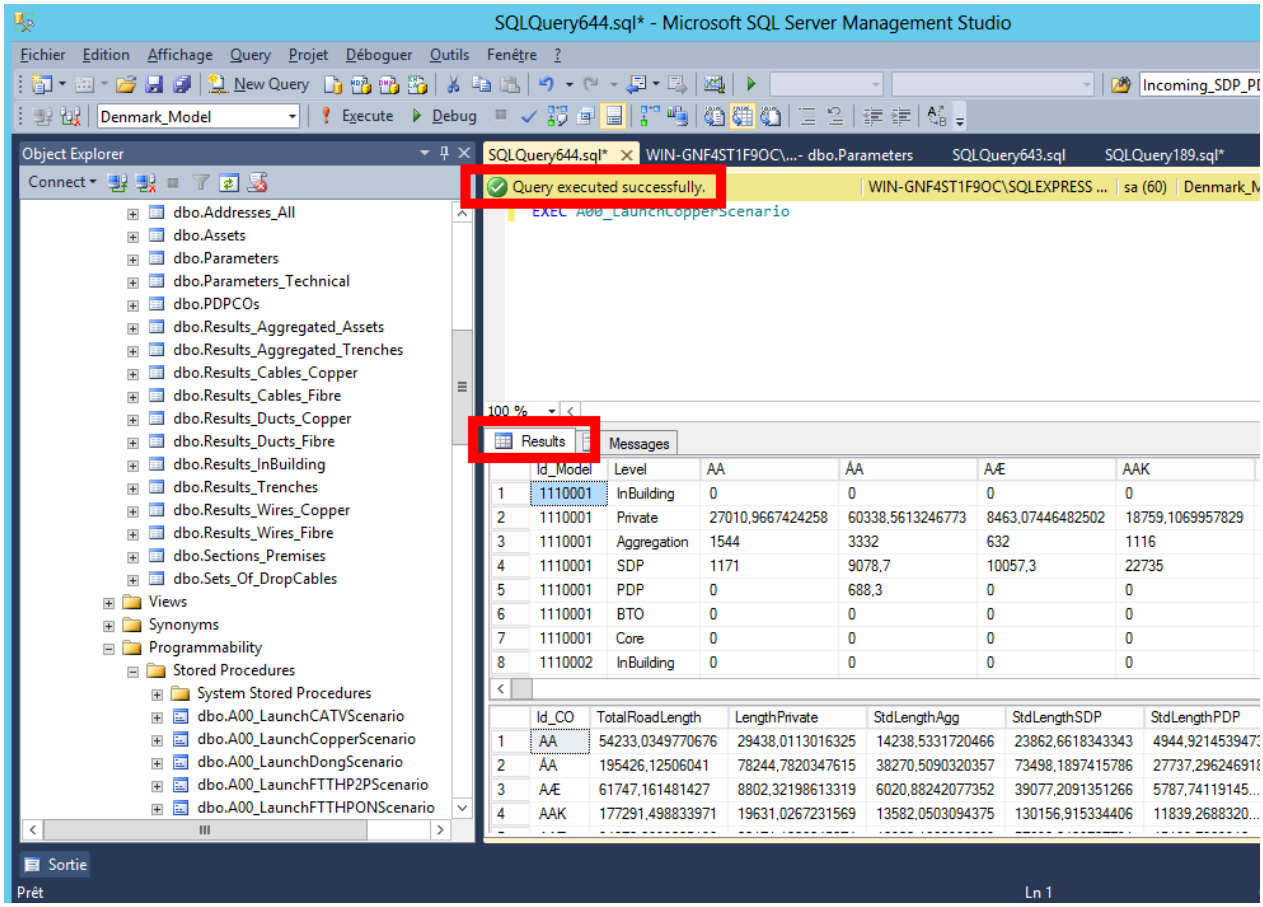
As long as the model is running the message "Executing query…" will be displayed at the top of the screen as shown in Figure 12. The other highlighted box concerns the result tab 'Messages'. Clicking on this tab will show the calculation progress, step by step.

Figure 12 – Press F5 key that launches the query and launches the model. Click on 'Messages' tab to show the calculation progress, step by step



Source: DBA

Figure 13 – Calculation completed, two result tables are displayed

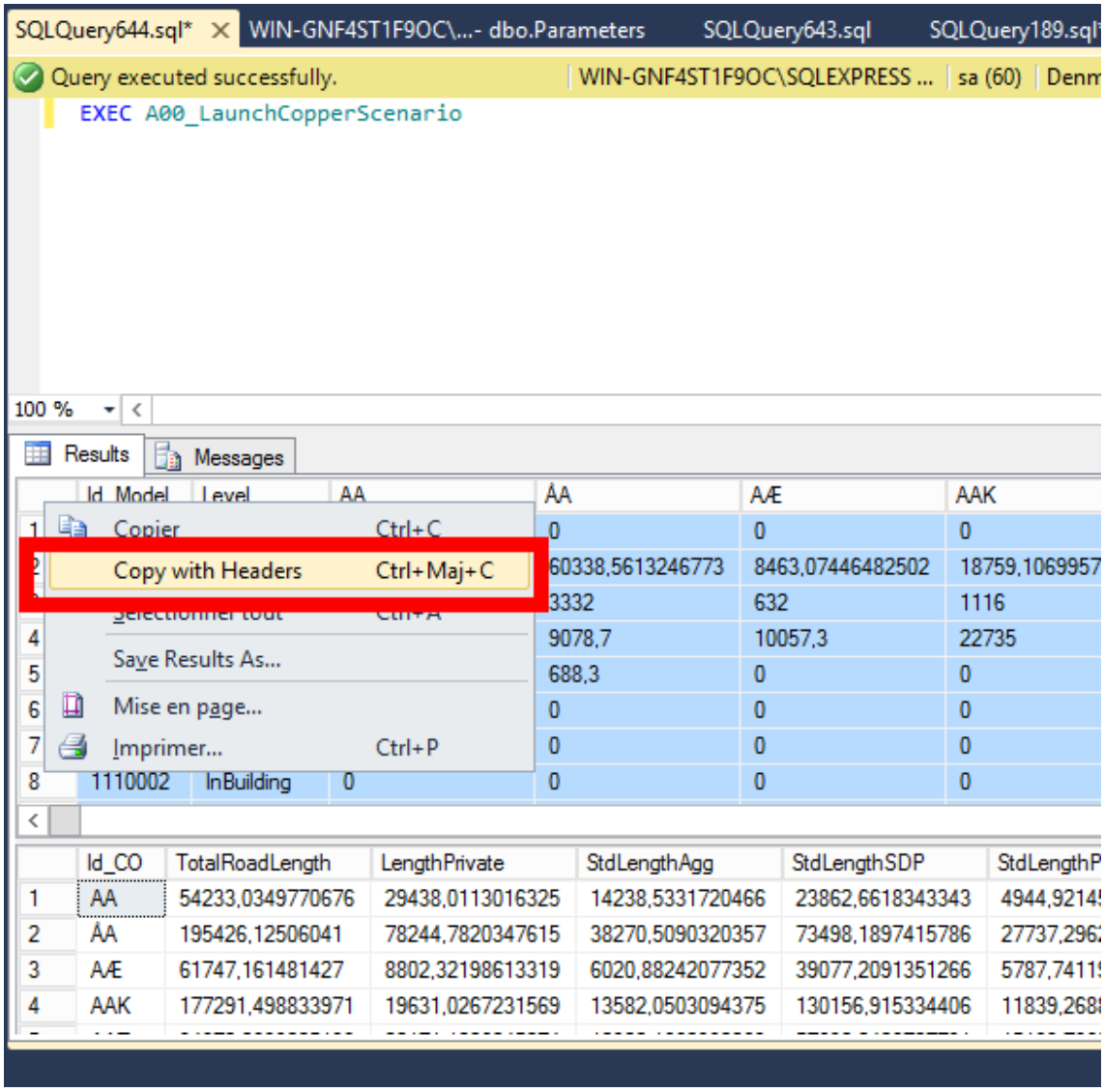


Source: DBA

1.6 Select and copy the results

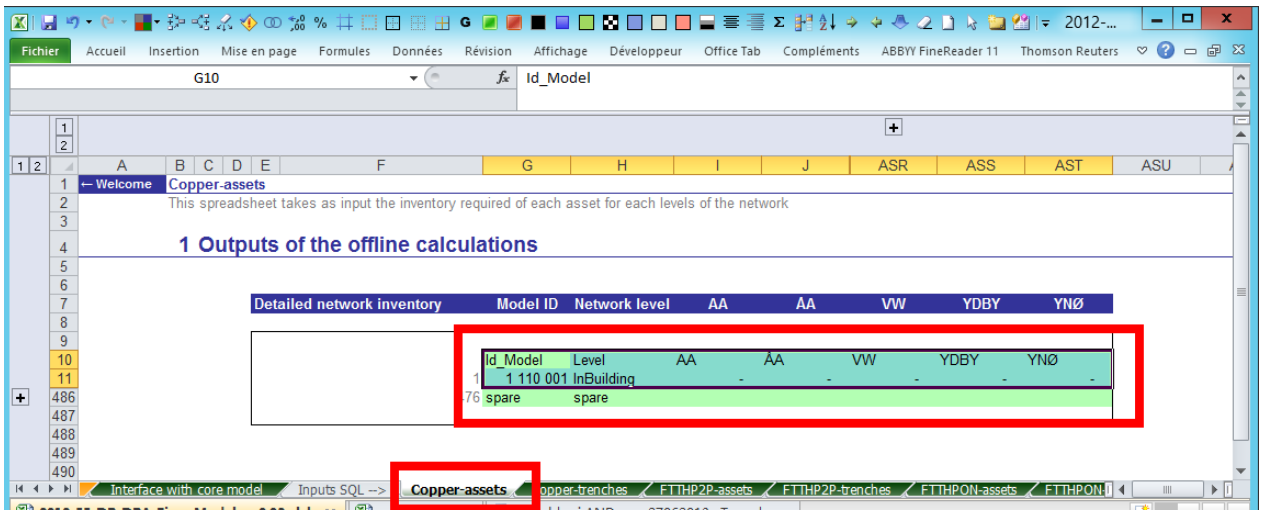
When the results have been returned, they can be copy-pasted into the Microsoft Excel file (the Access model). The first table in Figure 13 constitutes the assets table, the second one the table regarding trenches.

Figure 14 – Select the whole content of the first table, then copy with headers



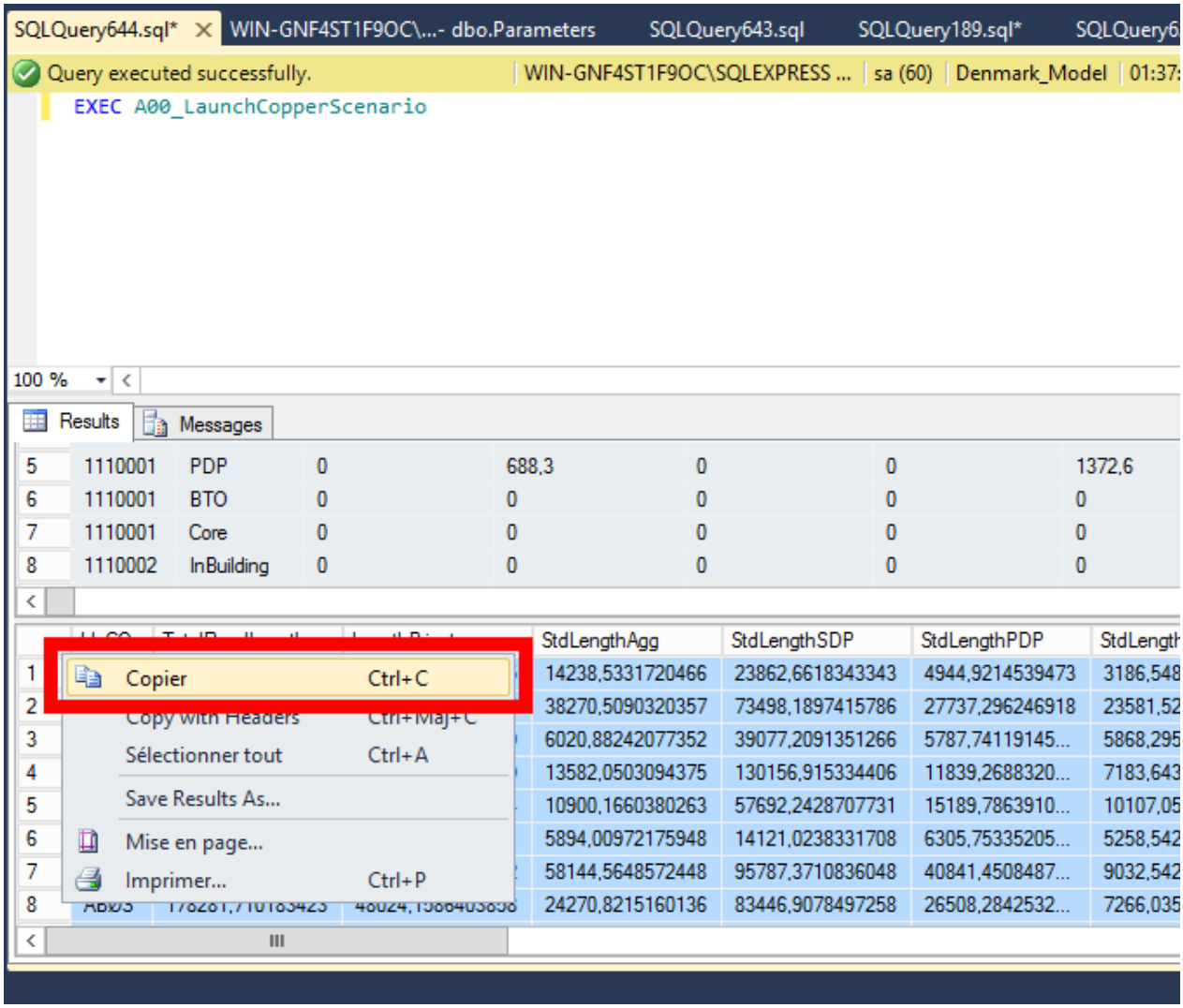
Source: DBA

Figure 15 – Paste the values into the "asset" input table in Excel, in the green area. This can either be the copper, FTTH-P2P, FTTH-PON or cable-TV asset sheet.



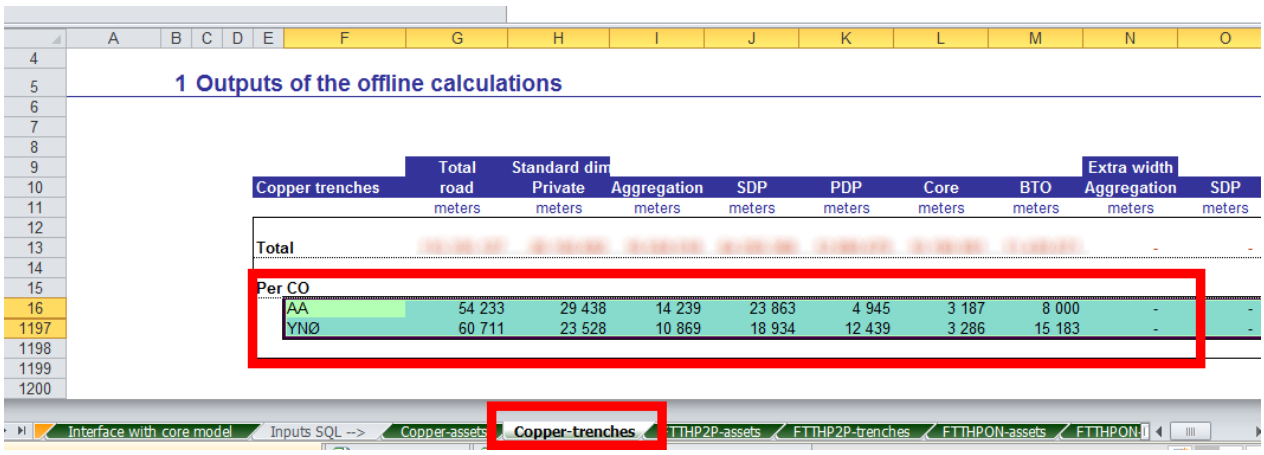
Source: DBA

Figure 16 – Select the results of the second table, again copy the table



Source: DBA

Figure 17 – Paste this into the "trench" input spreadsheet, in the green area. This can either be the copper, FTTH-P2P, FTTH-PON or cable-TV trenches sheet.



1 Outputs of the offline calculations

Copper trenches	Total road	Standard dim Private	Aggregation	SDP	PDP	Core	BTO	Extra width Aggregation	SDP
	meters	meters	meters	meters	meters	meters	meters	meters	meters
Total								-	-
Per CO									
AA	54 233	29 438	14 239	23 863	4 945	3 187	8 000	-	-
YNØ	60 711	23 528	10 869	18 934	12 439	3 286	15 183	-	-

Interface with core model | Inputs SQL --> | Copper-assets | Copper-trenches | FTTHP2P-assets | FTTHP2P-trenches | FTTHPON-assets | FTTHPON-

Source: DBA

2 Calculation flow

2.1 Introduction – procedures of the SQL model

When generating the results used in the Excel access model a number of SQL-procedures has to be run. In order to keep a logical ordering of the procedures, the SQL procedures used to dimension the modelled networks are named in the following way:

- *There are five model procedures, one for each scenario modelled. The names of the model procedures start with "A00_Launch", e.g. "A00_LaunchCATVScenario".*
- *The names of the main procedures start with "AXX_", where XX indicates the number the order of execution, e.g. "A01a_ChangeScenario"*
- *Some procedures start with "BXX". These are subsidiary procedures, in order to reduce the size and complexity of the main procedures.*
- *Other procedures are prefixed with "Tech_" or "Tools_". These are routines used in the main procedures.*
- *The remaining procedures prefixed with "Test_" are procedure aiming at providing statistics about the results of the model.*

The full list of procedures is shown in table 1:

Table 1 - List of procedures in the SQL model

A00_LaunchCATVScenario
A00_LaunchCopperScenario
A00_LaunchDongScenario
A00_LaunchFTTHP2PScenario
A00_LaunchFTTHPONScenario
A01a_ChangeScenario
A01b_FillAssetsTable
A01c_Sources_Import
A01d_Sources_Structuration
A01e_Results_Reset
A02_CoreAndBTO_Calculation
A03_PDP_To_CO_Localisation
A04_FDP_And_SDP_Locations
A05_TrenchesStrategy_Calculation
A06_Premises_To_PDP_Calculation
A06_Premises_To_PDP_Calculation_CATV
A07_PDP_To_CO_Calculation
A08a_SDP_Wires
A08b_Trenches_Lenghts

A08c_Cables_Ducts_Trenches_Calculation
A09a_Assets_Dimensioning
A09b_InsideCabling
A10_Aggregation_Per_CO
A99_Results_To_Spreadsheet
B00_Launcher
B06_Calculate_SectionDetails
B060_Calculate_SectionDetails
B061_Calculate_SectionDetails
B991_AssetsResults
Tech_DispError
Tech_DispFunctionError
Tech_DispProgress
Tech_ListTableColumns
Tech_SearchTextInObjects
Tech_StorageUsage
Tests_AverageLineLength
Tests_PremisesPerCO
Tools_DeleteTableIfExists
Tools_GenerateSerie

Source:DBA

There are five model procedures, one for each scenario modelled in the LRAIC-model. These are:

- *A00_LaunchCATVScenario*
- *A00_LaunchCopperScenario*
- *A00_LaunchDongScenario*
- *A00_LaunchFTTHP2PScenario*
- *A00_LaunchFTTHPONScenario*

Besides these model choice procedures, there are 19 main procedures in the model database. The calculation process is done by executing successively 18 out of the 19 procedures. Below a description of each of the main procedures is given.

- *A01a_ChangeScenario* - This procedure sets the parameters related to the required scenario, i.e. the procedure reflects the network of choice to be modelled (Copper, CATV, FONG, FTTHP2P or FTTHPON).
- *A01b_FillAssetsTable* - This procedure fills the asset table with the relevant assets based on the chosen network,
- *A01c_Sources_Import* - This procedure imports the modelling input data from one of the 3 input databases

- *A01d_Sources_Structuration* - This procedure structures and prepares some inputs
- *A01e_Results_Reset* - This procedure empties and refills the results tables
- *A02_CoreAndBTO_Calculation* - This procedure calculates the wires required by core and BTO networks
- *A03_PDP_To_CO_Localisation* - This procedure localises the paths impacted by the PDP to CO routes on the section network
- *A04_FDP_And_SDP_Locations* - This procedure calculates the number of wires required at the edge of each private property and checks for each section whether there will be a SDP or not.
- *A05_TrenchesStrategy_Calculation* - This procedure determinates the way trenches will be dug for both sides of each road section
- *A06_Premises_To_PDP_Calculation* - This procedure calculates, for copper and fibre scenarios, for each section, the size of aggregation cables and at each edge of private property whether there is a SDP or not
- *A06_Premises_To_PDP_Calculation_CATV* - This procedure calculates for the CATV scenario, for each section, the size of aggregation cables and at each edge of private property whether there is a SDP or not. This procedure is only run if the CATV-scenario has been chosen as the modelled network.
- *A07_PDP_To_CO_Calculation* - This procedure calculates the wires required by the PDP to CO routes
- *A08a_SDP_Wires* - This procedure calculates the wires required by the SDP to PDP routes
- *A08b_Trenches_Lenghts* - This procedure determines the final length required to be dogged on the road section
- *A08c_Cables_Ducts_Trenches_Calculation* - This procedure dimensions the right size for cables, joints, ducts and trenches for each section
- *A09a_Assets_Dimensioning* - This procedure determines the assets (mainly distribution points) selected in line with the minimal size required
- *A09b_InsideCabling* - This procedure determines the dimensioning of inside cabling (MDU)
- *A10_Aggregation_Per_CO* - This procedure aggregates on a per-CO basis and per network level, the quantity required for each asset
- *A99_Results_To_Spreadsheet* - This procedure displays the results in a format that can be pasted in the Excel file

Besides the brief descriptions given above, we give a more thorough walk-trough of some of the important main procedures in the sections below.

2.2 Main procedures used in SQL

2.2.1 A04_FDP_And_SDP_Locations

This procedure calculates the following inputs:

- Calculation of the size of the final drop cable by multiplying the number of premises by the parameter “CablesRatio_FDP_Cables_Per_Premises”
    - For each building, the size of the final drop is equal to the number of premises multiplied by the parameter “CablesRatio_FDP_Cables_Per_Premises”.
- Calculation for each section if a SDP will be installed on the considered section by using the parameter @SDP_TriggerPerSection_Premises (see section 3.4.4 of the main documentation).
    - Buildings on a section are considered one by one, from the furthest to the CO to the closest.
        - If the first building has more premises than the parameter value, a SDP is installed;
        - otherwise the next building is considered, if the sum of both premises is above the parameter, a SDP is installed;
        - Once a SDP is installed, the count starts again from 0 for the next building.
- Calculation at a section level the number of premises and wires aggregated on the way to the PDP/CO
    - For each section, starting from the furthest, for each level (aggregation, SDP, PDP):
        - The number of wires aggregated from other sections is counted based on wires exiting sections aggregated on this section;
        - The number of wires generated by the section is calculated;
        - The total number of wires exiting the section is calculated.

2.2.2 A05_TrenchesStrategy_Calculation

This procedure aims at determining the best way to dig trenches, either on one side of the road or on both sides. Two scenarios are considered: a road cross for each drop cable, or trench on the road border followed by a unique road cross at the end of the section (see section 3.4.8.1 of the main documentation).

Four values are calculated for the length required for the second side: Left_OneCrossLength, Left_ManyCrossLength, Right_OneCrossLength and Right_ManyCrossLength.

- The value Left_OneCrossLength corresponds to the length required to link all buildings on the left side (the length between the first and the last building), plus crossing the road once.
- The value Left_ManyCrossLength corresponds to the length required to cross the road once for each building of the left side.
- The value Right_OneCrossLength corresponds to the length required to link all buildings on the right side (the length between the first and the last building), plus crossing the road once.
- The value Right_ManyCrossLength corresponds to the length required to cross the road once for each building of the right side.

Then these values allow determining for each section Identifying the main side, by identifying smallest combination left length + right length using the value described above for one side and a whole section length for the second side (assuming that cables are aggregated from other sections, and therefore will have to cross the whole section).

Selecting the right value allows identifying the trench strategy (one cross or many crosses) by selecting the one minimizing the length.

2.2.3 A06_Premises_To_PDP_Calculation

This procedure is the most time consuming of the procedures. It calculates for each section the wires required on each side of the road (length and number of pairs) for the final drops and for the SDP to the end of the section. The calculation is performed per section from the edge of the network to the PDP.

For each section is calculed:

- The number of fibres and copper pairs aggregated incoming from other sections for SDP and potentially drop wires;
    - The number of fibres and copper pairs outgoing from all sections connected to the considered section, that use the considered section as a path to the PDP is considered as incoming and summed.
- The number of premises aggregated at the end of the section;
    - The number of premises aggregated by all sections connected to the considered section, that use the considered section as a path to the PDP is considered and summed with the considered section number of premises.
- The number of wires leaving the section;

  - The number of wires that will leave the section and be considered as "outgoing" is determined. The number of wires for SDPs is the sum of incoming wires plus the number of wires outgoing from the section's SDPs.

- The exact trench length used on both side, for the aggregation and SDP levels;
  - In order to allocate the right length of trenches per section at each level, a precise length of trench used by each level is determined, depending on the installation of SDPs and the trench strategy determined (see section 2.2.2).
- The length of cables used for SDP.
  - The length required is determined depending on the position of SDPs on the section.

The calculation on a per-section basis is performed by two sub-procedures:

- B060_Calculate_SectionDetails: this procedure is used to perform calculations in case the trenching strategy of "one cross per drop cable" has been chosen;
- B061_Calculate_SectionDetails: this procedure is used to perform calculations in case the trenching strategy of "road-side digging + one cross road" has been chosen.

The main parameters used in these procedures are the following:

- CablesRatio_FDP_Cables_Per_Premises: determines the number of copper pairs per premises;
- SDP_TriggerPerSection_Premises: determines which sections will have a SDP;
- SDP_TriggerPerAddress_NbPremises: determines at each address whether if a SDP has to be installed or not.

2.2.4 A07_PDP_To_CO_Calculation

This procedure aims at dimensioning the PDPs and the paths from PDP's to CO's. The first step is to dimension the incoming and outgoing cables from the PDPs, for both fibre and copper. The second step is to deploy cables on the path from PDP to CO on the whole route.

The parameters used in the calculation are:

- CablesRatio_FDP_Cables_Per_Premises to calculate the number of incoming copper pairs to the PDP;
- CablesRatio_PDP_CopperOut_To_TotalCopperIn to calculate the number of copper pairs going out of the PDP;
- CablesRatio_PDP_FibreOut_To_TotalCopperIn to calculate the number of fibres going out of the PDP (in case of national DSL at the cabinet)

- CablesRatio_PDP_FibreOut_To_FibreIn is used for the fibre scenarios.

2.2.5 A08a_SDP_Wires

This procedure calculates the wires required from the SDP to the PDP, in terms of number of pairs and length.

2.2.6 A08b_Trenches_Lenghts

This procedure determines for each section the total length of trenches, taking into account all layers of the network deployed (Aggregation, SDP, PDP, Core and BTO).

2.2.7 A08c_Cables_Ducts_Trenches_Calculation

This procedure dimensions cables, ducts and trenches sizes (see section 3.4.6 of the main documentation).

The first step dimensions the cables depending on the number of wires required and the number of joints.

The second step consists of calculating the number of ducts, which is deducted from the surface used by cables. The total surface of ducts must be at least equal to the total surface of cables multiplied by the “Ducts_MaxFill” factor.

The third step is to dimension the cables and ducts for the final drop.

The fourth step is to dimension the size of trenches, based on the surface used by ducts as explained in the main documentation section 3.4.8.2.

2.2.8 A09a_Assets_Dimensioning

This procedure aims at dimensioning all distribution points. For copper distribution points, incoming and outgoing pairs are summed, and choosing the smallest distribution point providing more pairs than this sum.

2.2.9 A09b_InsideCabling

This procedure aims at dimensioning all cabling from the edge of the trench leading to the premises and the NTP in each apartment, as explained in the main documentation section 3.4.8.3.

2.2.10 Last procedures

The last two procedures, A10_Aggregation_Per_CO and A99_Results_To_Spreadsheet, are used to gather all information in two tables. These two tables and the ones which are copy-pased into the Excel access model.

3 Additional functions used in the SQL

Few additional functions are used during the calculation process. There are three types of table-functions, prefixed by “AXX_SelectParameters”, “A99_” and “Assets_”

- The functions prefixed by SelectParameters allow each procedure to search in the table “Parameters” for the right parameters.
- The functions “A99_” prepare the results to be displayed for the export to the Excel model.
- The functions “Assets_” select the right assets in the asset inventory, based on dimensioning requirement passed as parameters.

4 Table structure

As described in the main documentation, there is a list of tables in the model database, c.f. table 2 below. The list both consist of input tables (corresponding to offline calculations) and tables which are fed into the main result table used for the Excel access model.

Table 2 - Tables of the SQL model

_Source_Routes
_Source_Routes_BTO
_Source_Routes_Core
_Source_Routes_PDP_CO
_Source_Routes_Sections
_Source_Routes_Sections_BTO
_Source_Routes_Sections_Core
_Source_Routes_Sections_PDP_CO
_Source_Sections
_Source_Sections_All
Addresses_All
Assets
Parameters
Parameters_Technical
PDPCOs
Results_Aggregated_Assets

Results_Aggregated_Trenches
Results_Cables_Copper
Results_Cables_Fibre
Results_Ducts_Copper
Results_Ducts_Fibre
Results_InBuilding
Results_Trenches
Results_Wires_Copper
Results_Wires_Fibre
Sections_Premises
Sets_Of_DropCables

Source: DBA

All tables prefixed by "_Source" are taken from an input database by the SQL-model. It corresponds to offline calculations.

"Addresses_All" corresponds to all addresses passed in the network of choice; "Sets_Of_DropCable" groups the addresses by property, it means that each line of this table correspond to a trench for a drop cable.

"PDPCOs" is the list of PDPs and COs considered for the network, it describes the position of PDPs, but also allows to dimension them.

"Assets" is the list of assets taken from the Excel model, from which some elements are dedicated to specific scenarios are removed for performance reasons.

The "Results_Wires_" tables provide for each section the number of wires and the length required for each level, for both the main side and the second side of the section

The "Results_Cables_" tables provide for each section the dimensioning of cables corresponding to the wires calculated in the "Results_Wires_" tables, and the dimensioning of joints corresponding to the cables dimensioned.

The "Results_Ducts_" tables provide for each section the dimensioning of ducts corresponding to the cables calculated in the "Results_Cables_" tables.

The "Results_Trenches" table provide for each section the dimensioning of trenches corresponding to the ducts calculated in the "Results_Ducts_" tables.

The "Results_InBuilding" table provide for each building the dimensioning of MDUs.

The "Results_Aggregated" tables are built in order to prepare the results to be displayed for the Excel model.

The table "Parameters_Technical" provides parameters that are scenario-independent, mainly regarding trenches and MDU dimensioning.

The last table is the "Parameters" table. It gathers all parameters that are scenario-dependent. This table can be found in the excel model, spreadsheet "SQL Parameters":

- The parameters starting with “Cables_Ratio” are used to dimension all cables at the different levels based on the number of premises aggregated at the considered point.
- The parameters starting with “SDP_Trigger_” are used to determine when to install a SDP while rolling out the network.
- The parameters starting with “Technology_ ” are used to set the technology used for each level of the network.
- The parameter “Source_Database” is used to determine which set of inputs will be used for the modelling.
- The parameters starting with “MinSectionLengthForJoint” are used to determine whether a joint has to be considered for the section or not.

5 Parameter values

The parameter values are described in the section 10.2.2.1. in the model documentation. The following values are used in the modelling of the networks:

Table 3 - SQL parameter values

Parameter name	Copper	FTTH PTP	FTTH PON	CATV	Dong
CablesRatio_FDP_Cables_Per_Premises	2.00	2.00	2.00	1.00	2.00
CablesRatio_PDP_CopperOut_To_TotalCopperIn	0.70	-	-	-	-
CablesRatio_PDP_FibreOut_To_FibreIn	1.00	1.00	0.03	1.00	0.70
CablesRatio_PDP_FibreOut_To_TotalCopperIn	-	-	-	-	-
CablesRatio_SDP_To_PDP	0.75	0.60	0.03	1.00	0.75
MinSectionLengthForJoint_CoreBTO	420	420	420	420	420
MinSectionLengthForJoint_PDP	70	100	100	300	70
MinSectionLengthForJoint_SDP	15	15	15	15	15
Scenario	Copper	ftthp2p	ftthpon	Catv	Dong
SDP_TriggerPerAddress_NbPremises	20	12	32	80	12
SDP_TriggerPerSection_Premises	0	0	16	50	0
Source_Database	[Denmark_Input_CopperFTTH]	[Denmark_Input_CopperFTTH]	[Denmark_Input_CopperFTTH]	[Denmark_Input_CATV]	[Denmark_Input_Dong]
Technology_Aggregation	copper	Fibre	Fibre	Coax	Fibre
Technology_PDP_CO	copper	Fibre	Fibre	Fibre	Fibre
Technology_SDP_PDP	copper	Fibre	Fibre	fibre	Fibre

Source: DBA