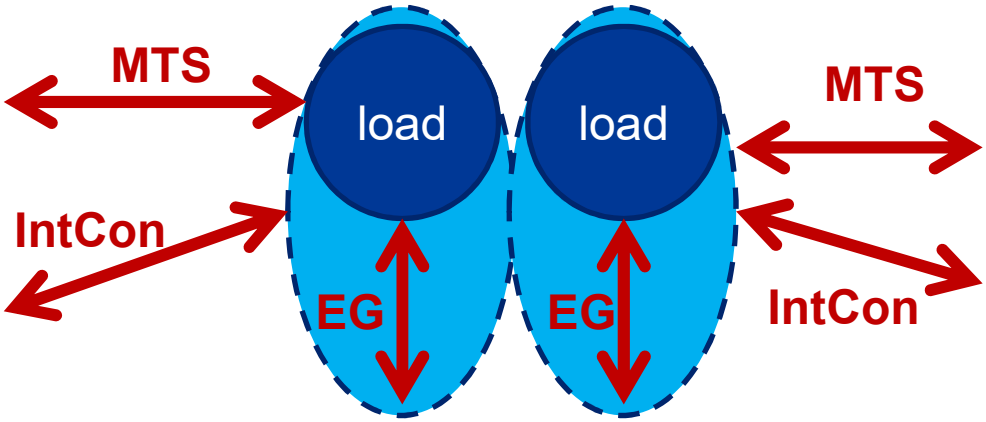
Key Concept

The both methodologies rely on the summation of currents to determine the load at the distribution node supplied by Transmission:

$$P_{atNode} = \sum P_{Entering} - \sum P_{Leaving}$$



At an MTS load zone:

$$P_{TX} = \left(\sum P_{MTS(+)} + \sum P_{IntCon(+)} \sum P_{IPP(+)}\right) - \left(\sum P_{MTS(-)} + \sum P_{IntCon(-)} \sum P_{IPP(-)}\right)$$

If P_{TX} is positive then then node is a load

If P_{TX} is negative then then node is a source (accounted for elsewhere)

The load seen from Transmission includes the distribution load and the losses.

$$P_{TX} = P_{DX} + P_{Loss}$$

Key Concept

The both methodologies rely on the summation of currents to determine the load at the distribution node supplied by Transmission:

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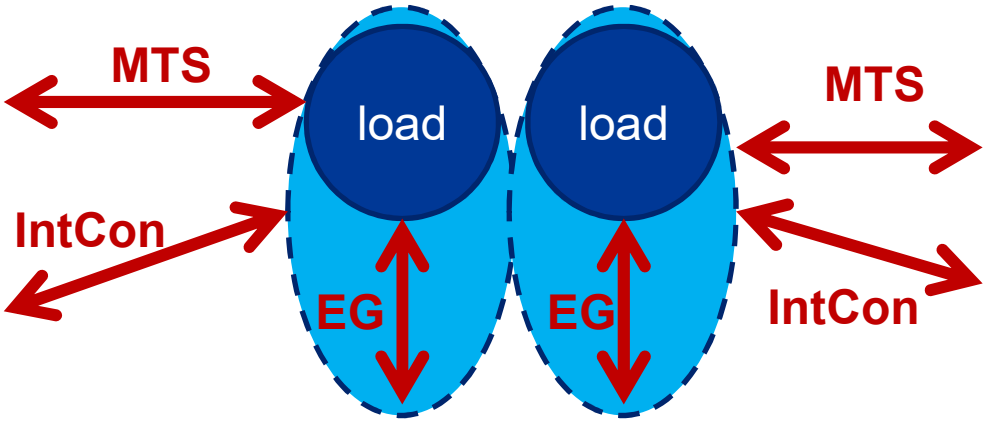

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If P_{TX} is positive then then node is a load

Make sure you get the sign convention (+/-) correct. A missing "+" in this picture?

If P_{TX} is negative then then node is a source (accounted for elsewhere)

The load seen from Transmission includes the distribution load and the losses.

$$P_{TX} = P_{DX} + P_{Loss}$$

If P_{Loss} is the technical losses, as we saw before, P_{DX} is not all accounted for (energy sales). Some will be a commercial loss

Methodology

Data gathering process

1. Get data
    I. Map Object IDs to Meter IDs (MV90 or Analogues) — Should already exist
    II. Create batchfiles or queries for automatic batch downloading **(MW and MVAR)** — Interaction with MV90/DAS

    Data required: **Loading, IPP Generation, Interconnection powerflow**

    intconnection powerflow only neccessary if you have external grids for complex meshed networks modelled as external grids.

2. Process data
    I. Investigate irregularities* — Not too important for loss
    II. Correct channel errors — IPP channels generally
    III. Normalize (hourly values) — helps with importing

3. Import data
    I. Import as hourly data into the PowerFactory Casefile (Loads, IPPs and Interconnections)

    DBA to help

4. Configure Power Factory
    I. Aligned MTS Zones according to Network Planning NDPs
    II. Model IPP as PQ External Grid at the connect busbar
    III. Ensure Constant Power Load types

Methodology

If you use customer meter data – you will also include the commercial loss (energy that is not measured). The result will not only show the technical losses.

Data gathering process

1. Get data
   I. Map Object IDs to Meter IDs (MV90 or Analogues)
   II. Create batchfiles or queries for automatic batch downloadin

   Data required: **Loading, IPP Generation, Interconnection powe**

   intconnection powerflow only neccessary if you have extern grids.

Should already exist

If you use customer meter data – you might also include the losses in the MV and LV reticulation. This could be a source of error if PF only gives the losses in Sub-transmission / Distribution?

2. Process data
   I. Investigate irregularities*
   II. Correct channel errors
   III. Normalize (hourly values)

Not too important for loss

IPP channels generally

helps with importing

3. Import data
   I. Import as hourly data into the PowerFactory Casefile (Loads, IPPs and Interconnections)

   DBA to help

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   I. Aligned MTS Zones according to Network Planning NDPs
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Methodology

The Iterative Loss Reporting Script (written in PF DPL, works with casefile **study Time**)

Algorithm:

1. **Input** study month and Export file location
2. **Set** StudyTime (initial: first hour of the month)
3. **Calculate** loadflow
4. **Record** information at MTS zone level
    I. X_new = X_old + X_new
5. **Check** if end of month
6. **Iterate** per hour until it's the end of the month
7. **Write** to Excel the results for each MTS Zone if end of month

Script Results: CopperLoss(**MWh**),NoLoadLoss(**MWh**),Load(**MWh**)

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Script Results: CopperLoss(**MWh**),NoLoadLoss(**MWh**),Load(**MWh**)

The script seems correct.

How time consuming is it to iterate for every hour of the month?

Loss calculation Template in Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Date Time**	**KWH_EXP**	**KVARH_EXP_LAG**	**KVARH_EXP_LEAD**	**KWH_IMP**	**KVARH_IMP_LAG**	**KVARH_IMP_LEAD**		MW	MVAr	MVA	MW^2	TimeInt			
2	2017-05-01 00:00	113464,9688	0	33197,46875	424	0	0		113,041	-33,1975	117,8148	12778,26	1	MW Maks	237,3583	
3	2017-05-01 01:00	111890,127	0	35516,93213	377	0	0		111,5131	-35,5169	117,0326	12435,18		MW Avg	164,3505	
4	2017-05-01 02:00	111615,3105	0	44178,22314	381	0	0		111,2343	-44,1782	119,6862	12373,07		LF	0,692415	
5	2017-05-01 03:00	112464,1406	0	43326,81641	381	0	0							MW^2Max	56338,96	
6	2017-05-01 04:00	120679,6777	0	43064,91992	333	0	0							MW^2Avg	27917,85	
7	2017-05-01 05:00	123515,875	0	43721,25586	381	0	0							LLF	0,495534	
8	2017-05-01 06:00	133757,418	0	40847,37891	383	0	0							E Purch	122276,8	
9	2017-05-01 07:00	134047,4473	1028,411865	24529,74951	347	0	208							MVA SysPeak	221,4238	
10	2017-05-01 08:00	150100,2031	17391,94751	0	0	10471	6333							MW SysPeak	221,059	
11	2017-05-01 09:00	150788,6504	30838,59814	0	0	10546	4150							LLF Scaled	0,571302	
12	2017-05-01 10:00	149674,3613	39456,15723	0	0	11915	3027							MVAr SysPeak	12,70498	
13	2017-05-01 11:00	160682,9287	40956,33691	0	0	14840	2927									
14	2017-05-01 12:00	179891,3203	40508,66504	0	0	15097	3638									
15	2017-05-01 13:00	173358,4512	39205,00781	0	0	13406	2828									
16	2017-05-01 14:00	167853,1445	35837,72559	0	0	15449	3316									
17	2017-05-01 15:00	177237,8633	32949,01807	0	0	13646	4374									
18	2017-05-01 16:00	176044,998	26088,68848	0	0	12455	3467		176,045	17,10069	176,8736	30991,84				
19	2017-05-01 17:00	213041,8789	15753,42041	0	0	11632	4619		213,0419	8,74042	213,2211	45386,84				
20	2017-05-01 18:00	190791,1094	10258,66809	8341	265	0	1789		190,5261	3,706668	190,5622	36300,2				
21	2017-05-01 19:00	184578,9258	2187,898926	15915,25755	427	0	0		184,1519	-13,7274	184,6629	33911,93				
22	2017-05-01 20:00	174995,3359	0	26750,21997	429	0	0		174,5663	-26,7502	176,604	30473,41				
23	2017-05-01 21:00	159113,418	0	34564,68701	333	0	0		158,7804	-34,5647	162,499	25211,22				
24	2017-05-01 22:00	142493,3398	0	43601,59229	376	0	0		142,1173	-43,6016	148,6554	20197,34				
25	2017-05-01 23:00	132480,0234	0	45034,15869	377	0	0		132,103	-45,0342	139,5682	17451,21				

Calculation fields seem correct

Be sure to check convention of LAG and LEAD for column J

Loss calculation Template in Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Date Time	KWH_EXP	KVARH_EXP_LAG	KVARH_EXP_LEAD	KWH_IMP	KVARH_IMP_LAG	KVARH_IMP_LEAD		MW	MVAr	MVA	MW^2	TimeInt			
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Calculation fields seem correct

Individual MTS loading at System Peak – correct approach!

	A	B	C	D	E	F
1	MVA	Date & Time				
2	244,2637317	2017-05-01		System Peak	563,8370085	
3	242,1086113	2017-05-01 01:00		System Peak Time	2017-05-29 18:00	
4	247,8112018	2017-05-01 02:00		Total Hours	743	
5	253,0541169	2017-05-01 03:00				
6	262,1872255	2017-05-01 04:00				
7	254,0440746	2017-05-01 05:00				
8	286,7876865	2017-05-01 06:00				
9	304,8497129	2017-05-01 07:00				

Loss calculation Template in Excel

Total System Purchases	**147,1**	GWh	
Total System Loss Energy	**61,5**	GWh	
% Loss	**41,815**	%	

Import MTS | Import PF Results

MTS Sheet Name	Sheet Index	Total Purchases (MWh)	Active Load at System Peak (MW)	Reactive Load at System Peak (MVAr)	Load at System Peak (MVA)	LLF Scaled	Copper Power Loss from PF (MW)	Iron Power Loss from PF (MW)	Loss Energy (MWh)	% Loss
Boundary	4	94866	221,1	12,7	221,4	0,5713021	8,377624594	0,860685659	4195,60205	33023,3
Ferrum	5	-15869	42,8	36,8	56,4	1,0943485	0,939408392	0,147560406	873,4712184	2376
Hydra	6	582	47,8	-18,9	51,4	4,5626448	15,37985554	0,482279655	52496,73733	278049,8
Lewensaar	7	3269	4,2	-1,4	4,4	2,3256269	0	0	0	0
Olien	8	39208	78,7	12,7	79,7	1,3819569	2,108832599	0,211648686	2322,591647	18350
Roodekuil	9	3928	41,7	-16,1	44,7	0,1092507	5,471361151	0,037376221	471,8989478	2939,3
Ruigtevallei	10	21140	101,8	-14,3	102,8	0,1153079	13,27237329	0,030408904	1159,688365	8094,4

How are the importing functions working? All OUs manage to import their data?

Form earlier in the training: “The ELF is multiplied with the peak power losses together with the number of hours studied and the period’s energy losses are received.”

In your case ELF is the LLF Scaled

But the peak power losses are not the starting point – instead the power losses at the System Peak are used in PF – how does this affect the formula?

LLF seems correct as LLF ~ LF^2

You are not considering the A-factor in the loss factor relation to the load factor

Loss calculation Template in Excel

Total System Purchases	**147,1**	GWh	
Total System Loss Energy	**61,5**	GWh	
% Loss	**41,815**	%	

Import MTS | Import PF Results

MTS Sheet Name	Sheet Index	Total Purchases (MWh)	Active Load at System Peak (MW)	Reactive Load at System Peak (MVAr)	Load at System Peak (MVA)	LLF Scaled	Copper Power Loss from PF (MW)	Iron Power Loss from PF (MW)	Loss Energy (MWh)	% Loss
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Does Hydra MTS have high losses in general?

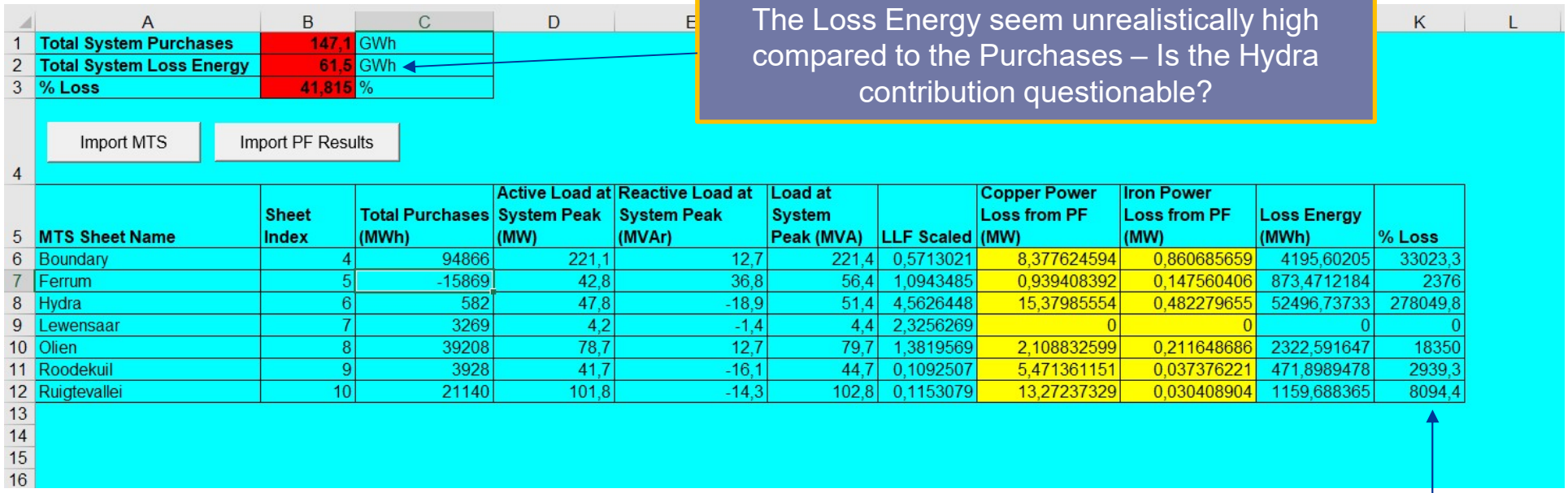
MW Maks	285,9006
MW Avg	83,76746
LF	0,292995
MW^2Max	81739,16
MW^2Avg	10433,68
LLF	0,127646
E Purch	62322,99
MVA SysPeak	51,41233
MW SysPeak	47,82009
LLF Scaled	4,562645
MVAr SysPeak	-18,8803

MW Maks	285,9006
MW Avg	83,76746
LF	0,292995
MW^2Max	81739,16
MW^2Avg	10433,68
LLF	0,127646
E Purch	62322,99
MVA SysPeak	51,41233
MW SysPeak	47,82009
LLF Scaled	=O7*(O2/O10)^2
MVAr SysPeak	-18,8803

The use of “LLF Scaled” to compensate for MTS that have a lower load (than their usual average and max) at the System Peak is a detour.

Rather skip the scaling to Load at System Peak and do the PF calculation at the MTS individual max using the LLF only.

Loss calculation Template in Excel



	A	B	C
1	**Total System Purchases**	**147,1**	GWh
2	**Total System Loss Energy**	**61,5**	GWh
3	**% Loss**	**41,815**	%

Import MTS | Import PF Results

MTS Sheet Name	Sheet Index	Total Purchases (MWh)	Active Load at System Peak (MW)	Reactive Load at System Peak (MVAr)	Load at System Peak (MVA)	LLF Scaled	Copper Power Loss from PF (MW)	Iron Power Loss from PF (MW)	Loss Energy (MWh)	% Loss
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The Loss Energy seem unrealistically high compared to the Purchases – Is the Hydra contribution questionable?

Not sure what this column is for and why it is based on the reactive load?