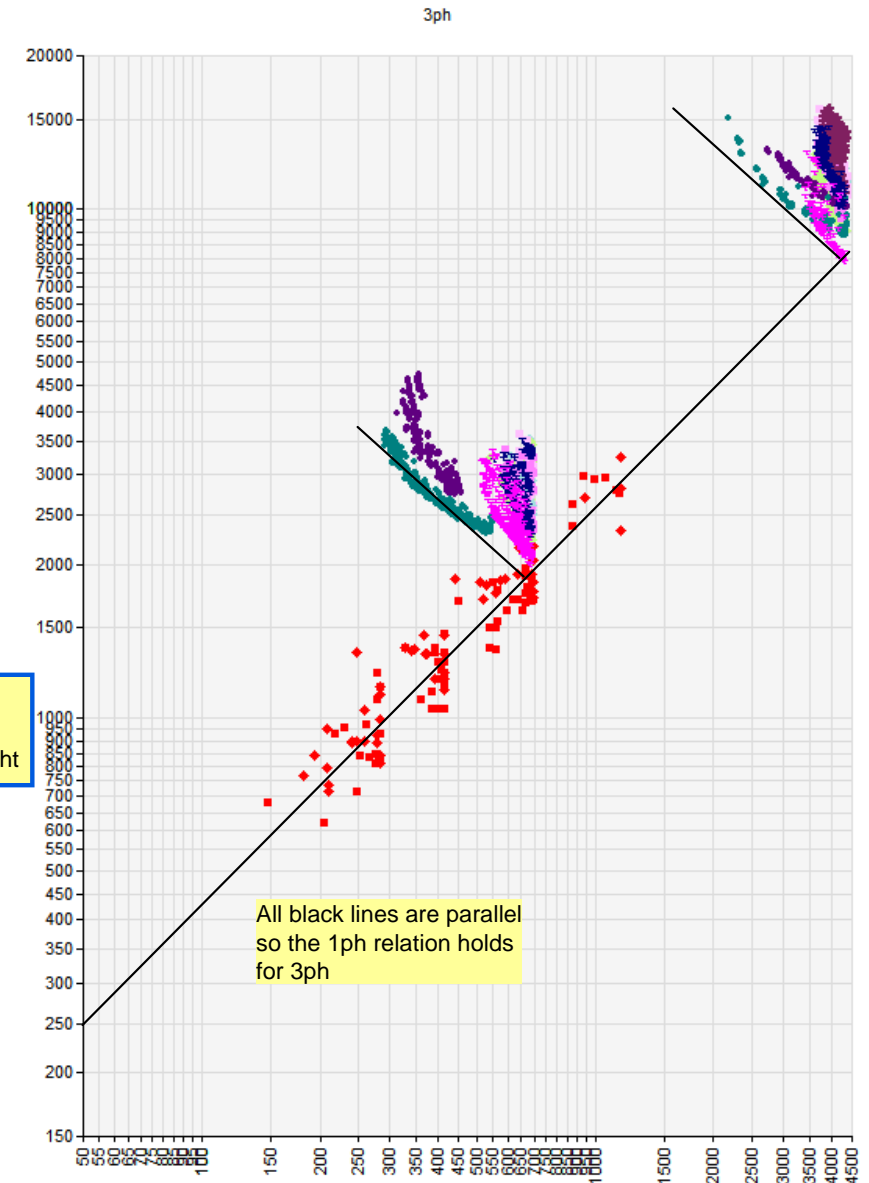
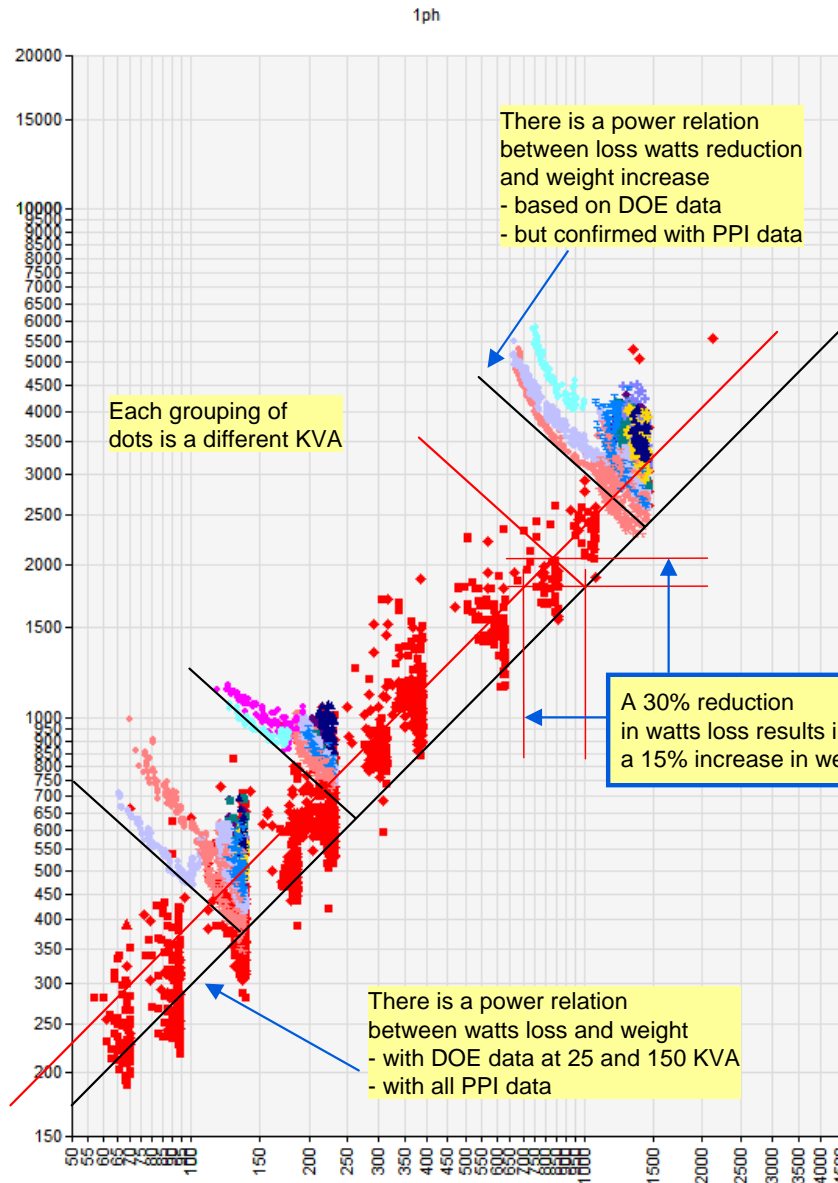
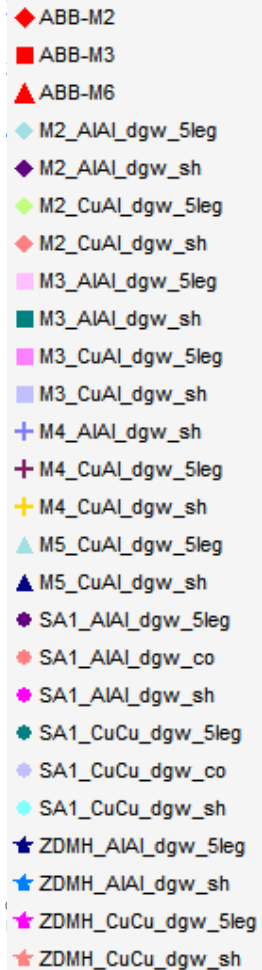


Wes Patterson, DOE Negotiating Committee, 17 Oct 2011

# Pole Mounted Transformers Weight

# MVLF – in-scope PPI Poles and all DOE designs (by Phase) 50% Load Total Loss (x-axis) vs Weight (y-axis)

- 1 A power relation exists between weight and losses in two dimensions
- change in KVA
  - change in technology with a KVA



# MVLF – 1ph – 10,15,25,37.5,50,75 KVA

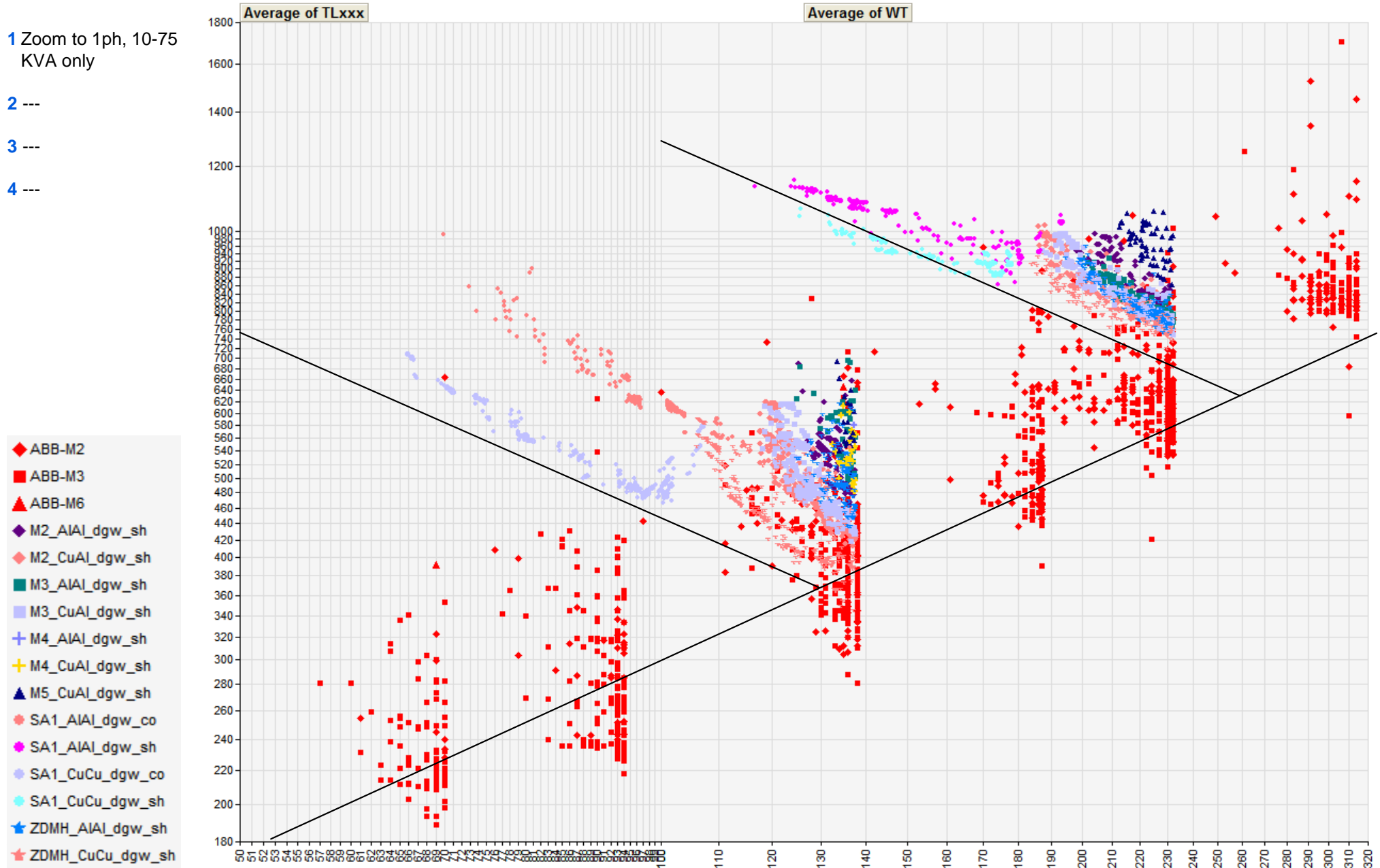
## 50% Load Total Loss (x-axis) vs Weight (y-axis)

1 Zoom to 1ph, 10-75 KVA only

2 ---

3 ---

4 ---



# MVLF – 1ph – 10,15,25,37.5,50,75 KVA – M3 only

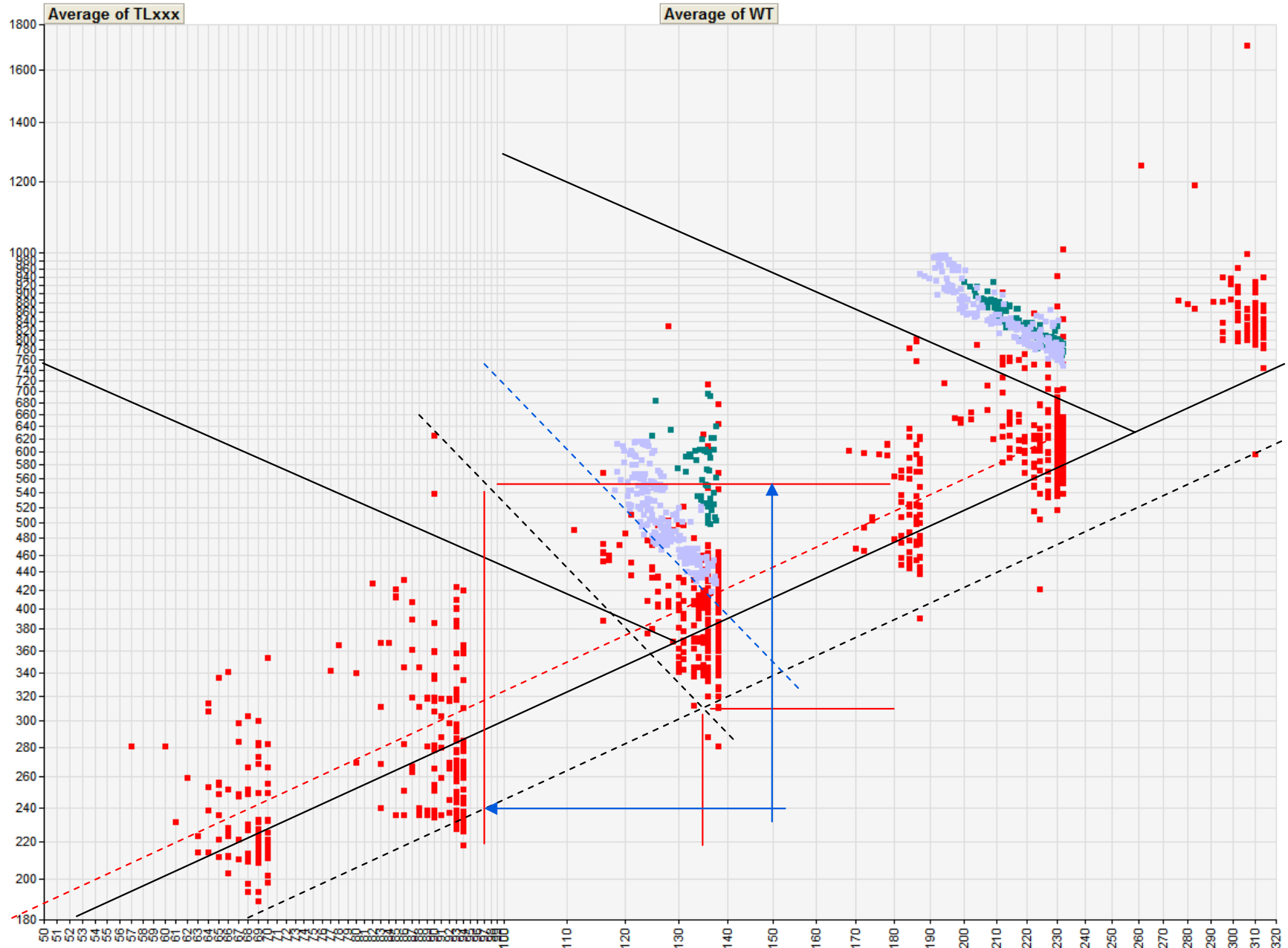
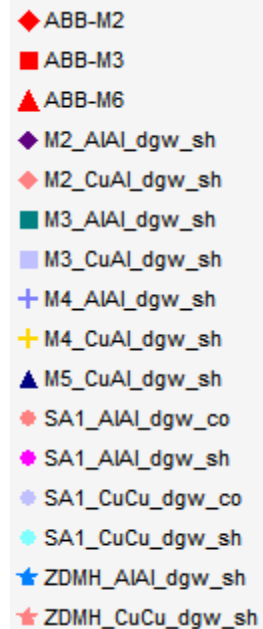
## 50% Load Total Loss (x-axis) vs Weight (y-axis)

1 Zoom to  
1ph, 10-75 KVA  
M3 only

2 For M3 only – a  
30% reduction in  
loss results in an  
83% increase in  
mass

3 ---

4 ---



# MVLF – Poles

## Average Weight variation by KVA / BIL

DOE Scope

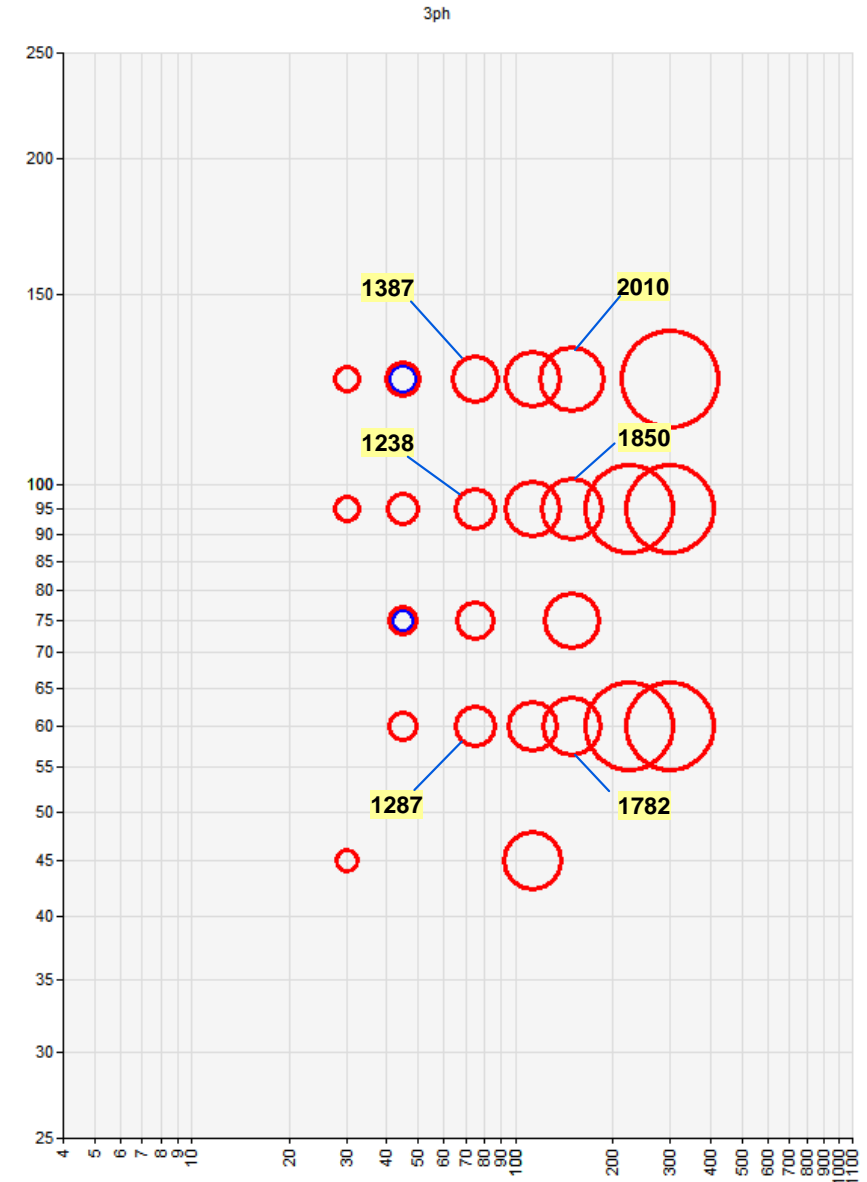
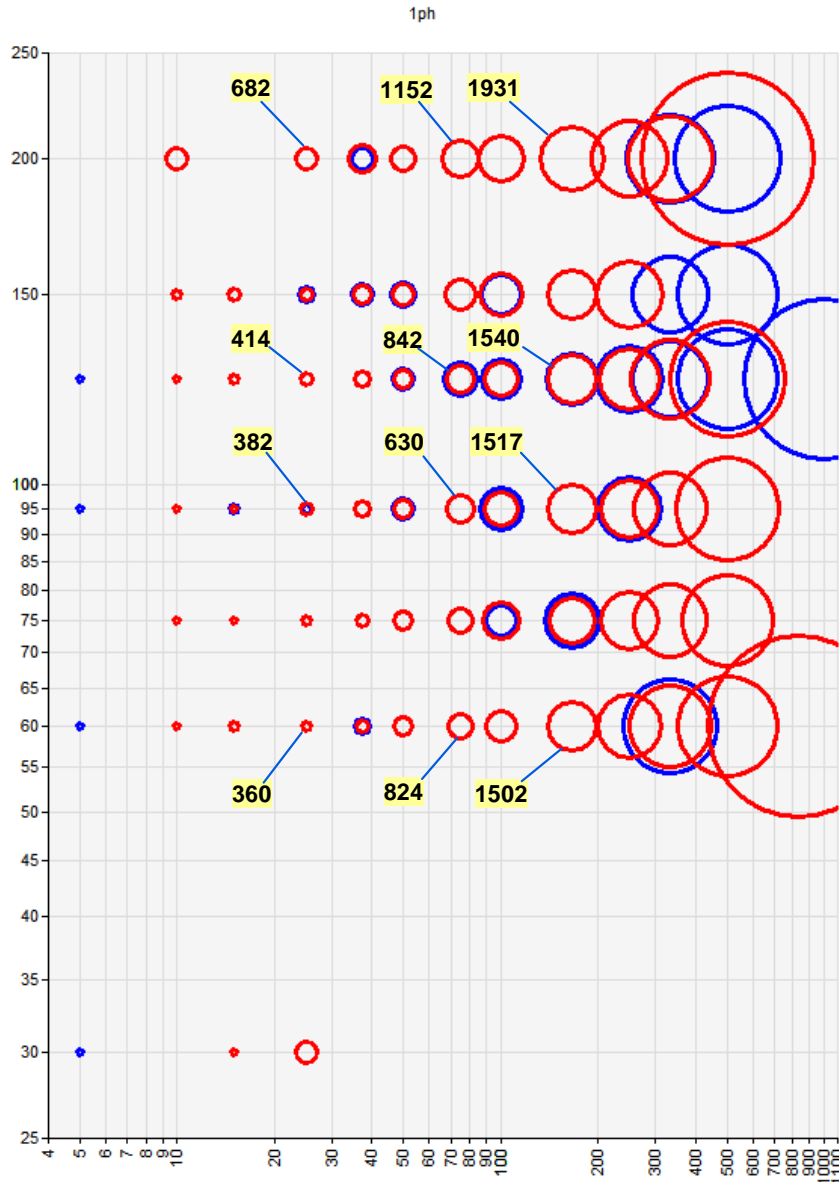
- NO
- YES

1 Weight increase with a) increase in KVA and b) increase in BIL

2 within a given BIL rating the weight change roughly follows the  $\frac{3}{4}$  scaling rule

3 ---

4 ---



# MVLF – Poles

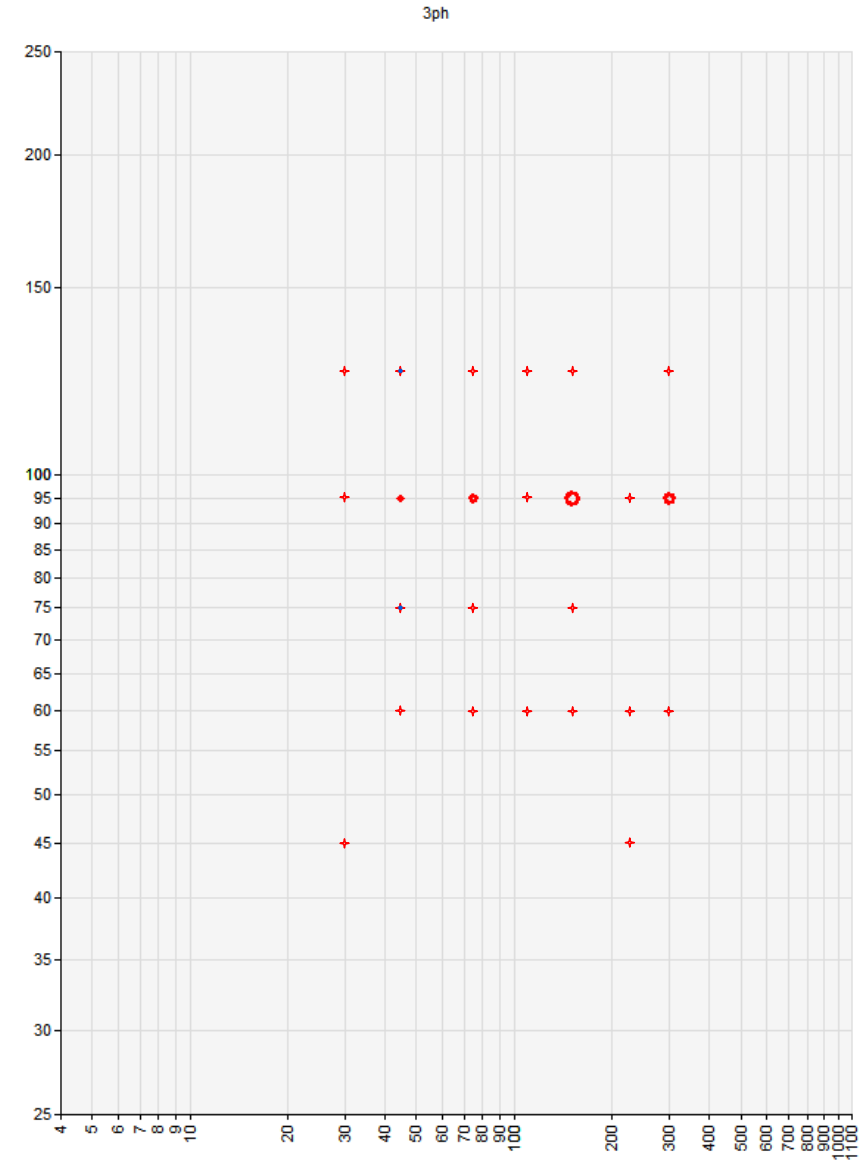
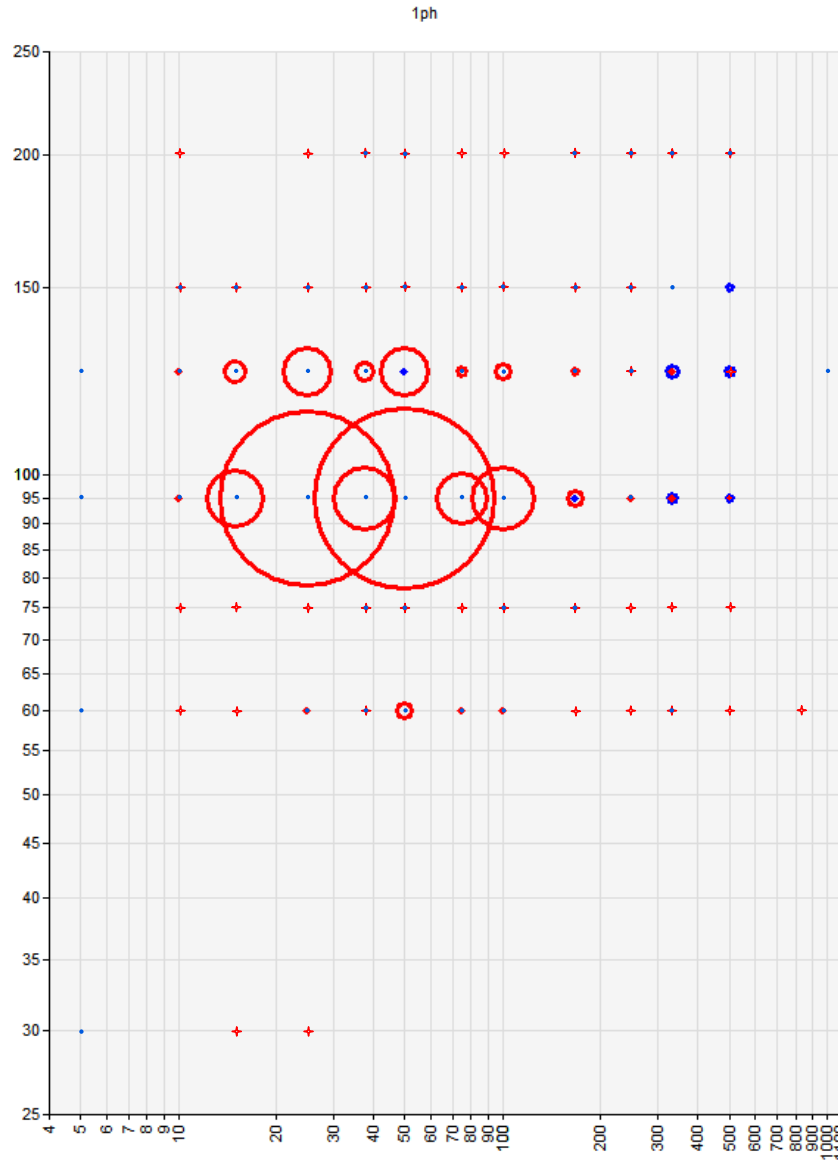
## MVA distribution (KVA x-axis, BIL y-axis, MVA bubble)

DOE Scope

NO

YES

- 1 The market is dominated by 95 BIL at 25 KVA and 75 KVA
- 2 but the regulation must cover thru 200 BIL and
- 3 ---
- 4 Note: out-of-scope are mainly exports and are included to illustrate the situation with no regulation



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# MVLF – 1ph only

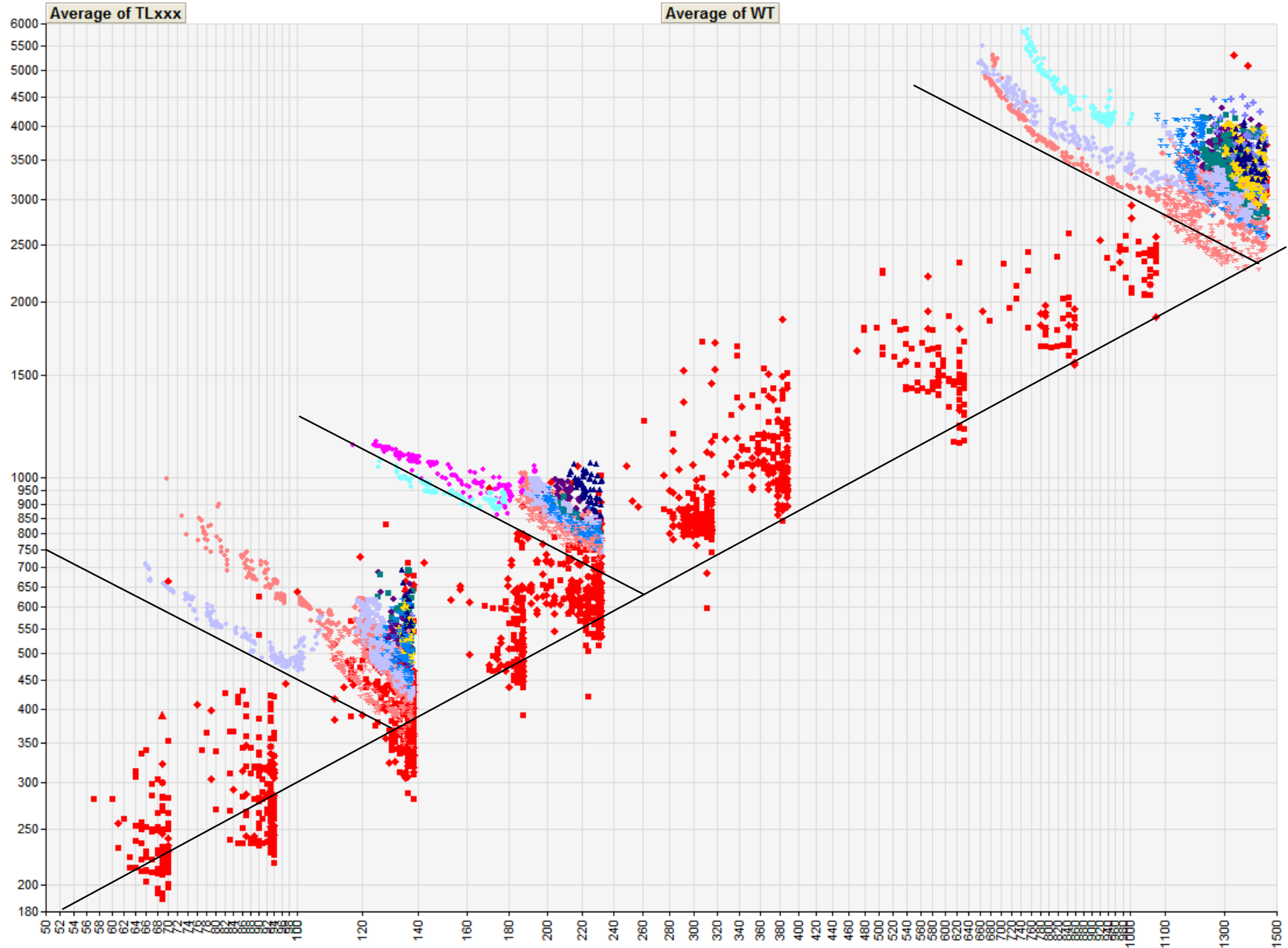
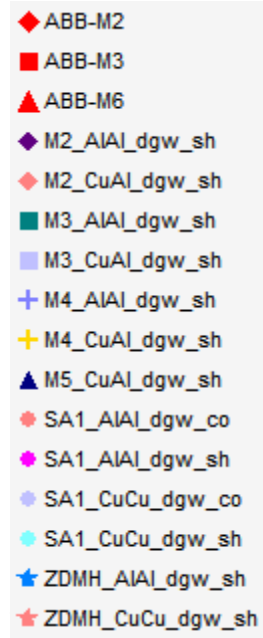
## 50% Load Total Loss (x-axis) vs Weight (y-axis)

1 Zoom to 1ph only

2 ---

3 ---

4 ---





# MVLF – 1ph – M3 only

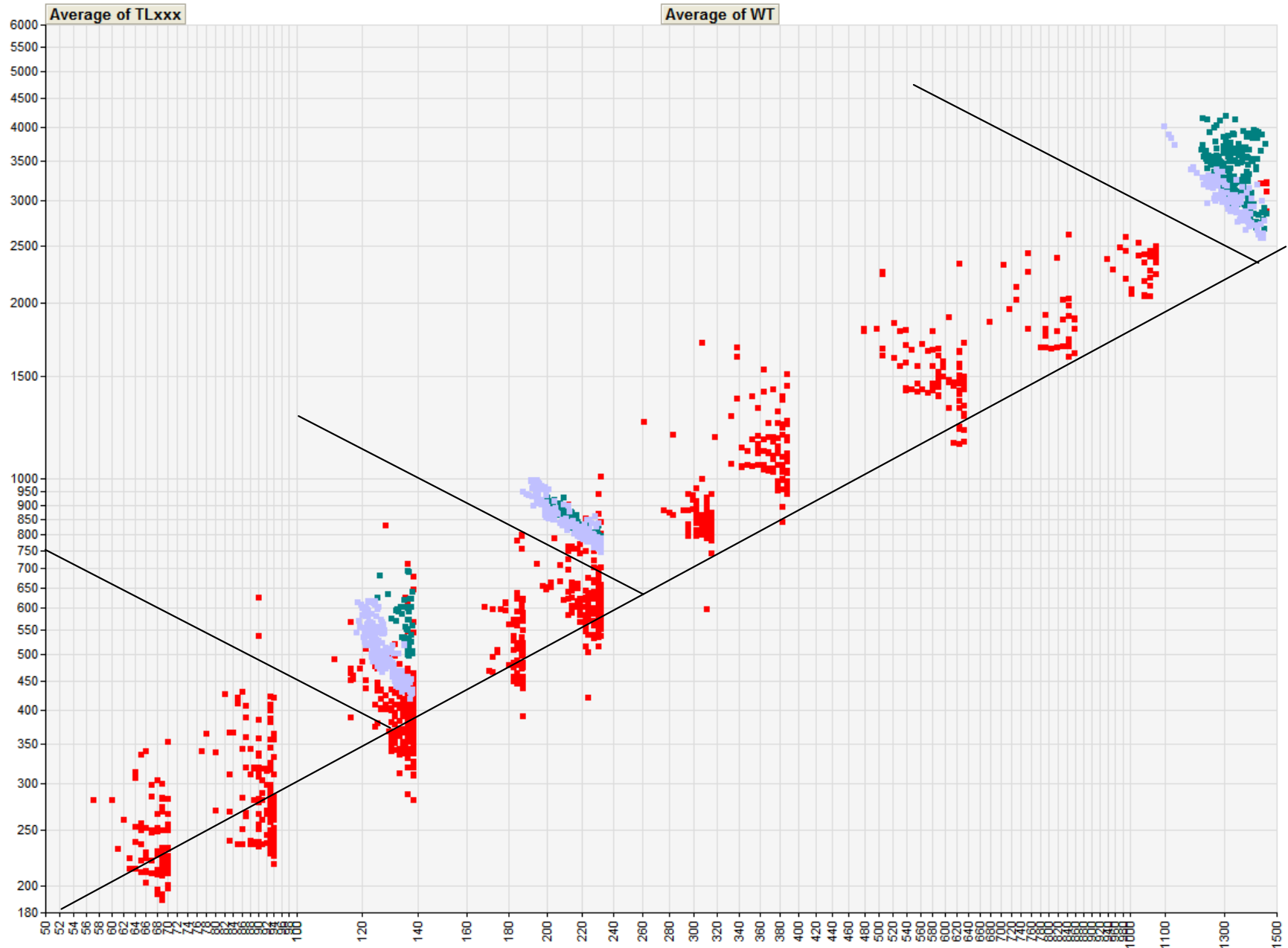
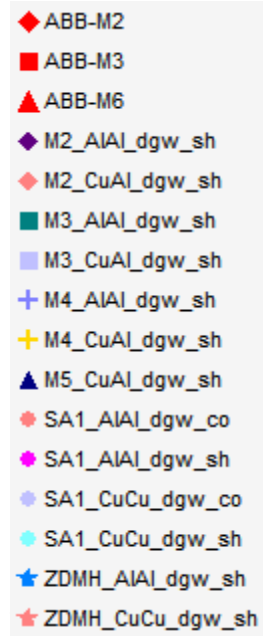
## 50% Load Total Loss (x-axis) vs Weight (y-axis)

1 Zoom to  
1ph – M3 only

2 ---

3 ---

4 ---



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# MVLF – **all** PPI Poles and all DOE designs

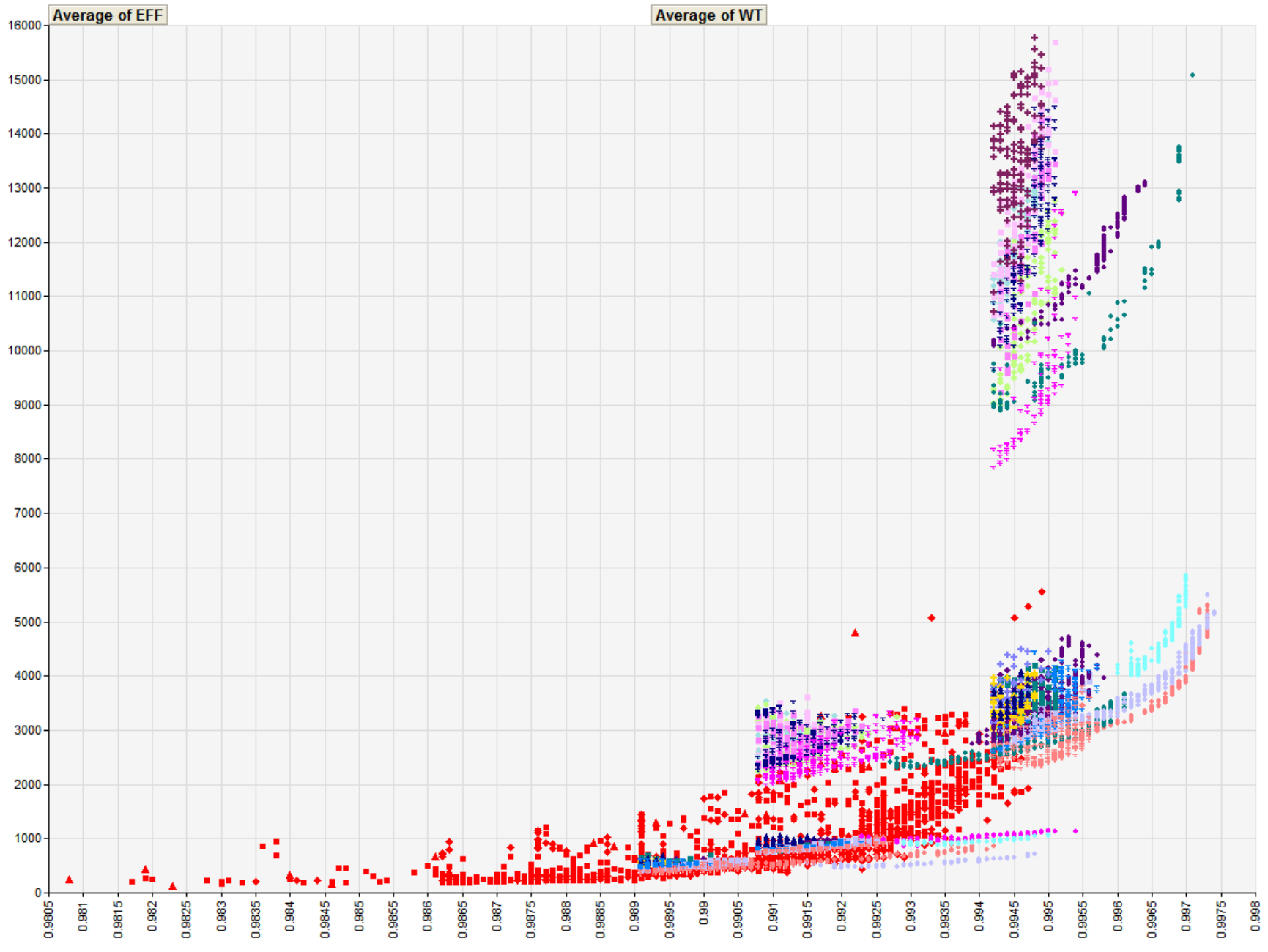
## Efficiency (x-axis) vs Weight (y-axis)

1 NOTE: includes exports

2 ---

3 ---

4 ---

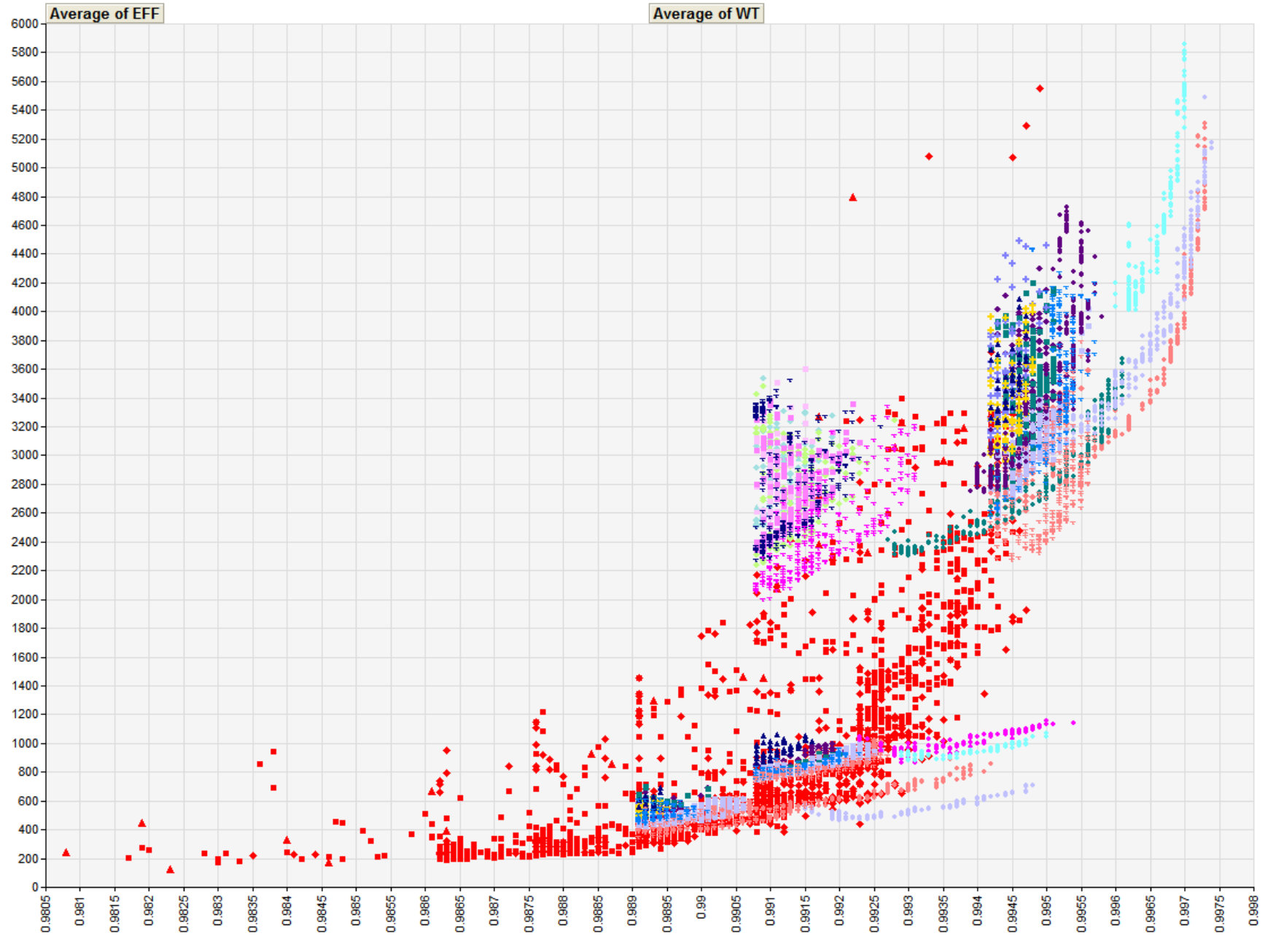


# MVLF – **all** PPI Poles and DOE designs (excl 1500 KVA)

## Efficiency (x-axis) vs Weight (y-axis)

- NOTE: includes exports
- Eliminated the 1500 KVA 3ph for better clarity of the pole market

3 ---



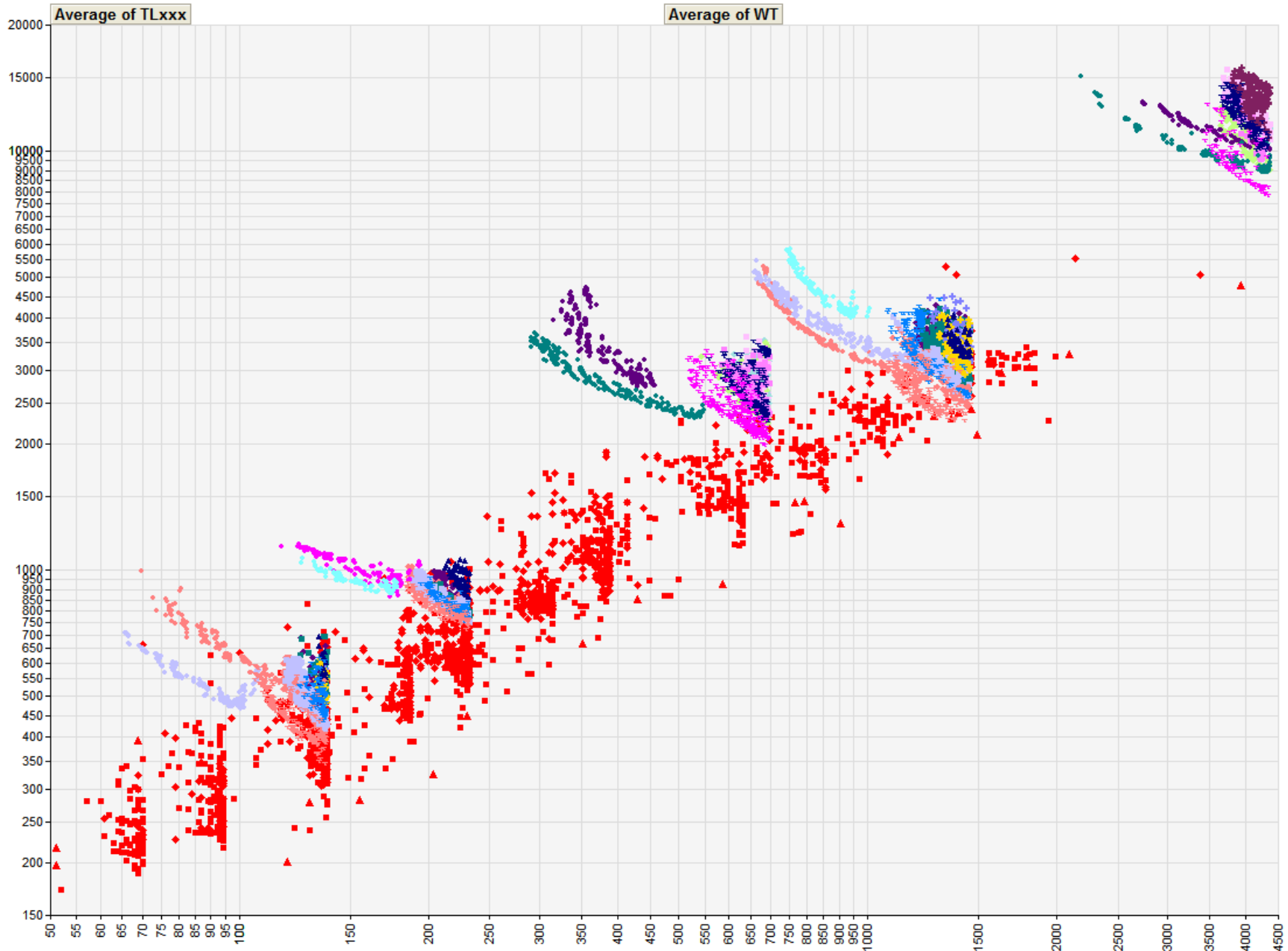
# MVLF – **all** PPI Poles and all DOE designs

## 50% Load Total Loss (x-axis) vs Weight (y-axis)

1 NOTE: includes exports and both 1ph and 3ph

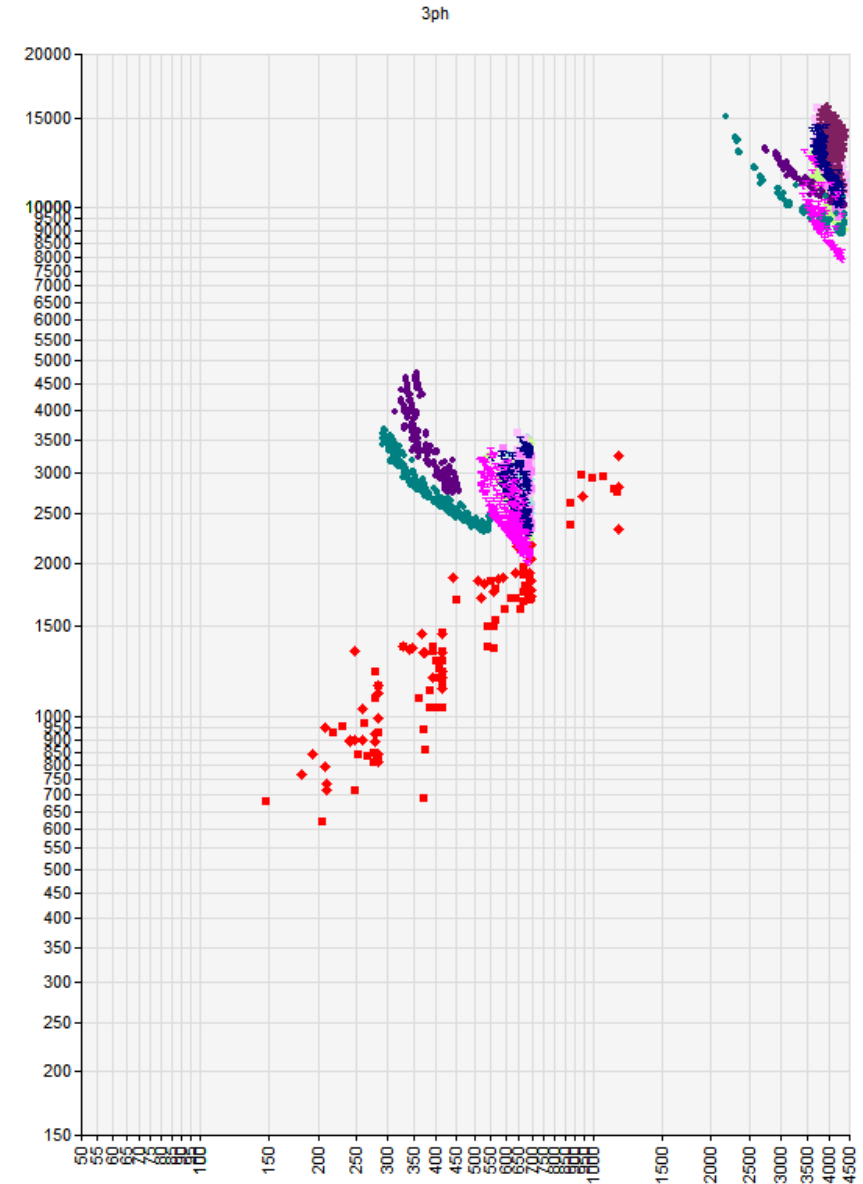
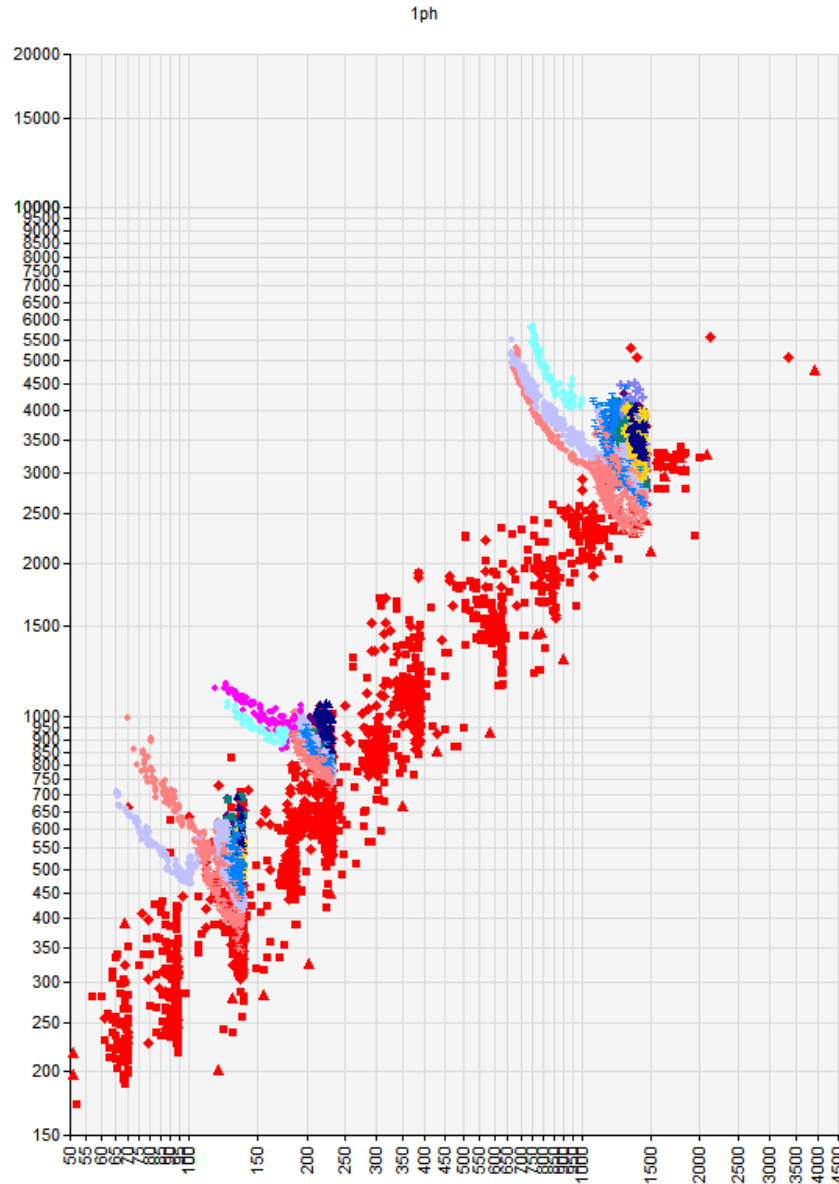
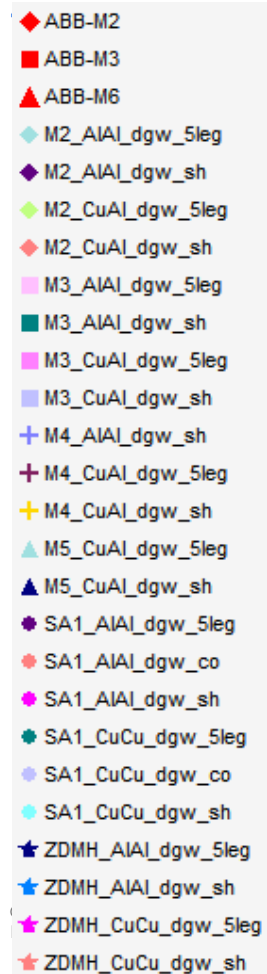
2 Note the power relation between losses and weights

3 ---



# MVLF – **all** PPI Poles and all DOE designs (by Phase) 50% Load Total Loss (x-axis) vs Weight (y-axis)

- 1 NOTE: includes exports
- 2 Note the power relation between losses and weights
- 3 ---



# MVLF – in-scope PPI Poles and all DOE designs (by Phase) KVA (x-axis) vs Weight (y-axis) – the $\frac{3}{4}$ Rule

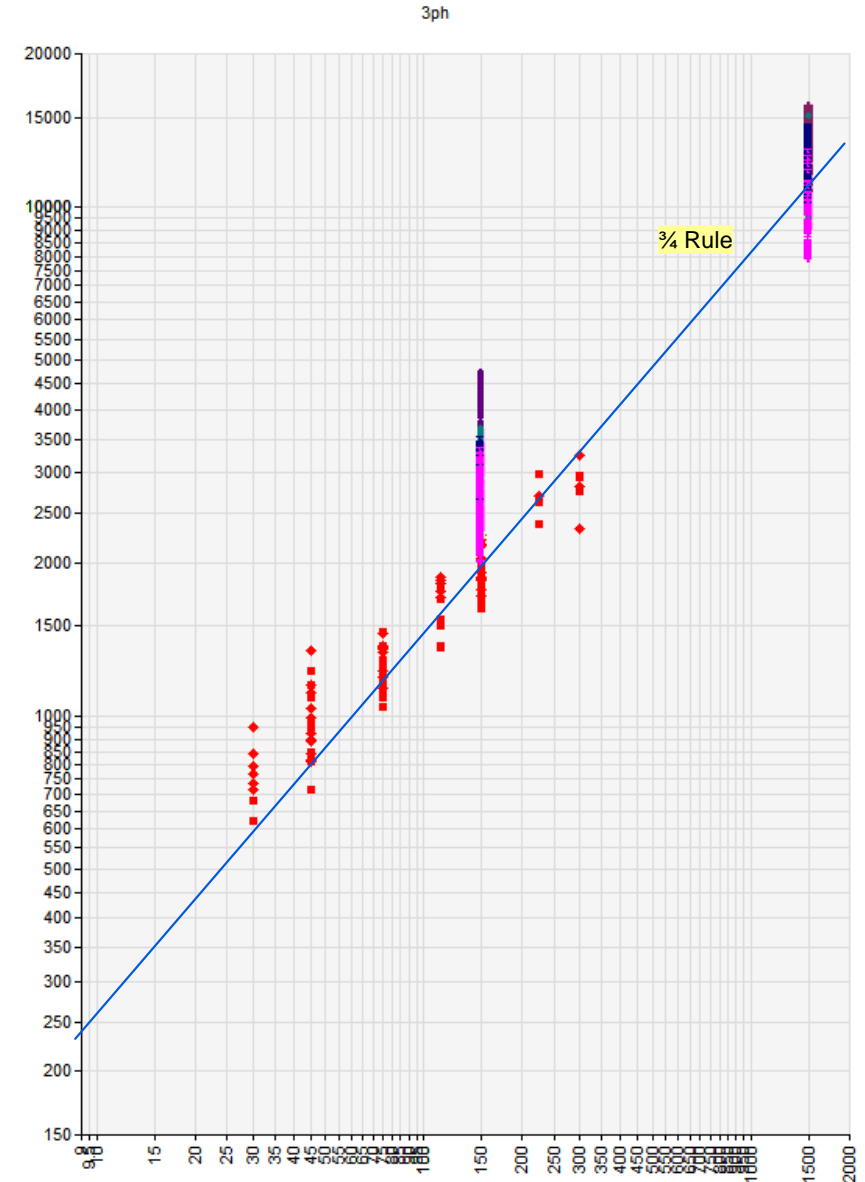
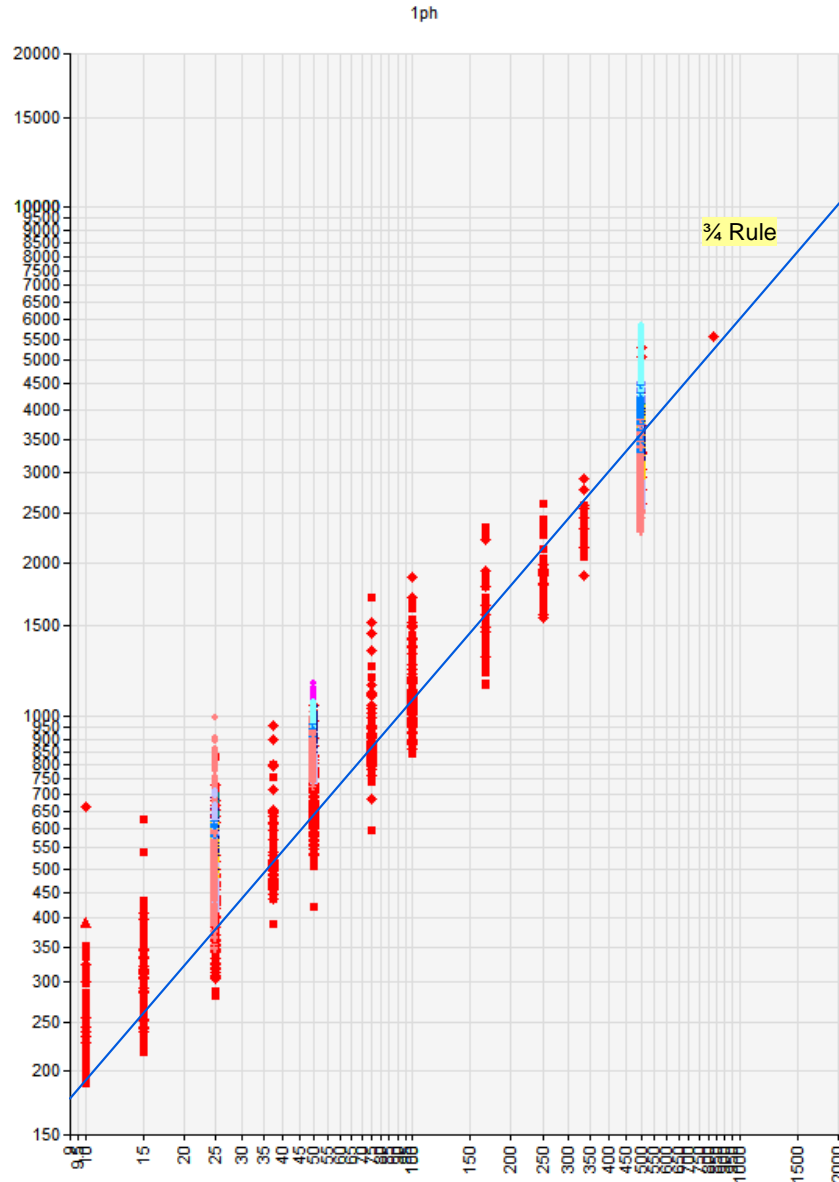
1 Check the fit to the  $\frac{3}{4}$  rule

2 ---

3 ---

4 ---

- ◆ ABB-M2
- ABB-M3
- ▲ ABB-M6
- ◆ M2\_AIAI\_dgw\_5leg
- ◆ M2\_AIAI\_dgw\_sh
- ◆ M2\_CuAl\_dgw\_5leg
- ◆ M2\_CuAl\_dgw\_sh
- ◆ M3\_AIAI\_dgw\_5leg
- M3\_AIAI\_dgw\_sh
- ◆ M3\_CuAl\_dgw\_5leg
- M3\_CuAl\_dgw\_sh
- + M4\_AIAI\_dgw\_sh
- + M4\_CuAl\_dgw\_5leg
- + M4\_CuAl\_dgw\_sh
- ▲ M5\_CuAl\_dgw\_5leg
- ▲ M5\_CuAl\_dgw\_sh
- ◆ SA1\_AIAI\_dgw\_5leg
- ◆ SA1\_AIAI\_dgw\_co
- ◆ SA1\_AIAI\_dgw\_sh
- ◆ SA1\_CuCu\_dgw\_5leg
- ◆ SA1\_CuCu\_dgw\_co
- ◆ SA1\_CuCu\_dgw\_sh
- ★ ZDMH\_AIAI\_dgw\_5leg
- ★ ZDMH\_AIAI\_dgw\_sh
- ★ ZDMH\_CuCu\_dgw\_5leg
- ★ ZDMH\_CuCu\_dgw\_sh



# MVLF – **all** PPI Poles and all DOE designs (by Phase) KVA (x-axis) vs Weight (y-axis) – the $\frac{3}{4}$ Rule

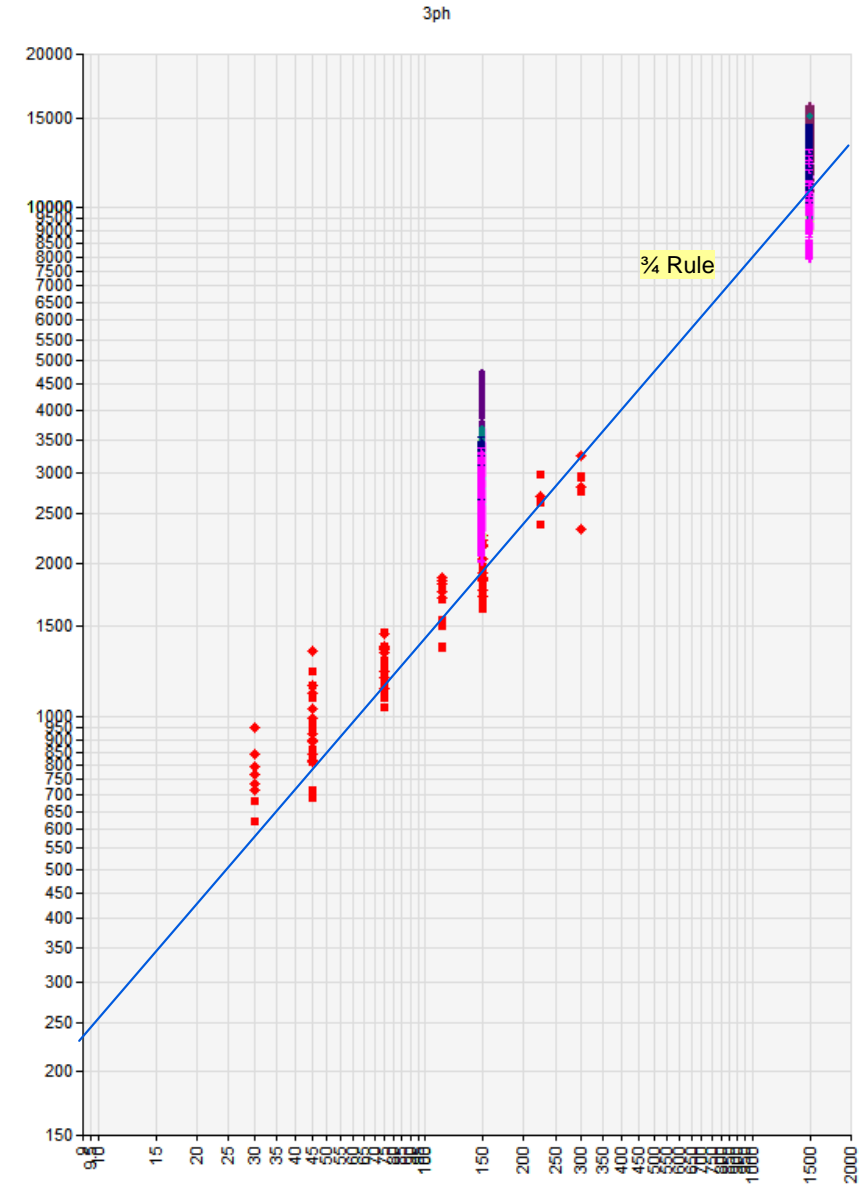
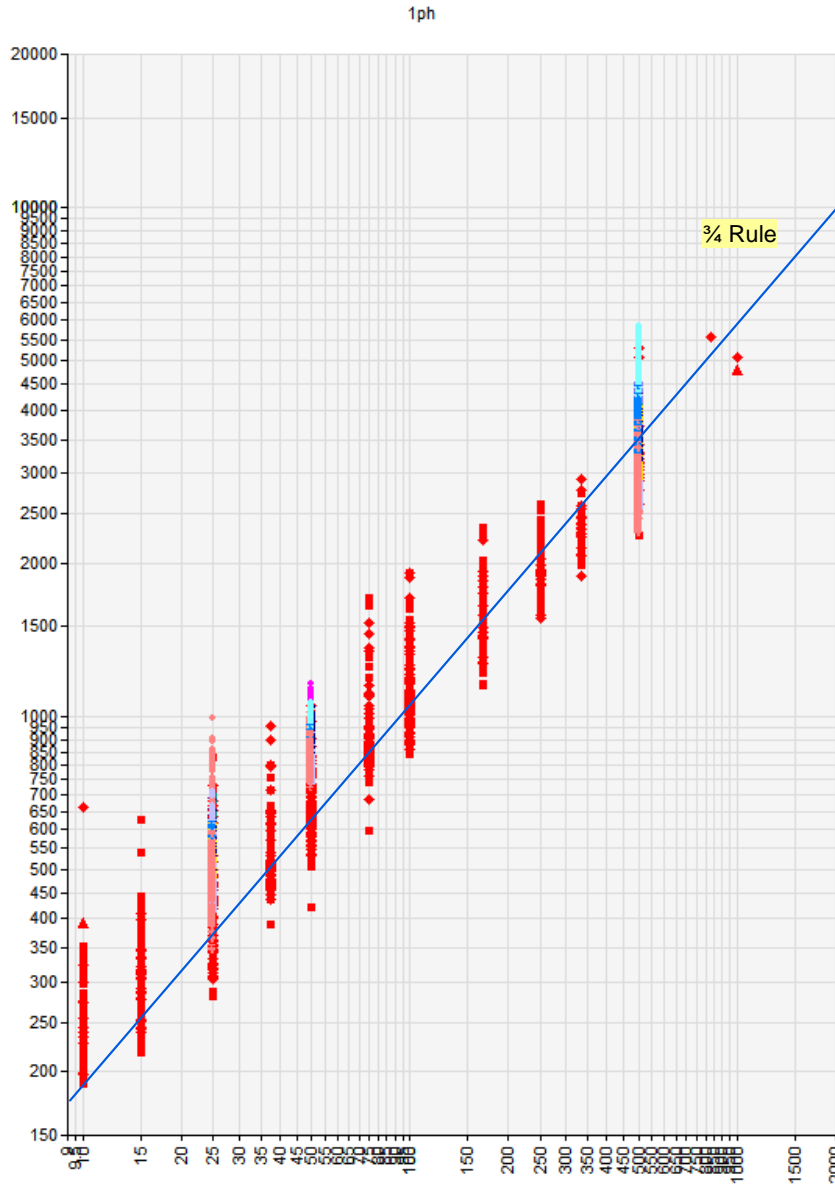
1 Check the fit to the  $\frac{3}{4}$  rule

2 ---

3 ---

4 ---

- ◆ ABB-M2
- ABB-M3
- ▲ ABB-M6
- ◆ M2\_AIAI\_dgw\_5leg
- ◆ M2\_CuAl\_dgw\_5leg
- ◆ M2\_CuAl\_dgw\_sh
- ◆ M3\_AIAI\_dgw\_5leg
- M3\_AIAI\_dgw\_sh
- ◆ M3\_CuAl\_dgw\_5leg
- M3\_CuAl\_dgw\_sh
- ◆ M4\_AIAI\_dgw\_sh
- ◆ M4\_CuAl\_dgw\_5leg
- ◆ M4\_CuAl\_dgw\_sh
- ◆ M5\_CuAl\_dgw\_5leg
- ▲ M5\_CuAl\_dgw\_sh
- ◆ SA1\_AIAI\_dgw\_5leg
- ◆ SA1\_AIAI\_dgw\_co
- ◆ SA1\_AIAI\_dgw\_sh
- ◆ SA1\_CuCu\_dgw\_5leg
- ◆ SA1\_CuCu\_dgw\_co
- ◆ SA1\_CuCu\_dgw\_sh
- ◆ ZDMH\_AIAI\_dgw\_5leg
- ◆ ZDMH\_AIAI\_dgw\_sh
- ◆ ZDMH\_CuCu\_dgw\_5leg
- ◆ ZDMH\_CuCu\_dgw\_sh





# MVLF – in-scope PPI Poles and all DOE designs (by Phase) KVA (x-axis) vs 50% Load Total Loss (y-axis) – the $\frac{3}{4}$ Rule

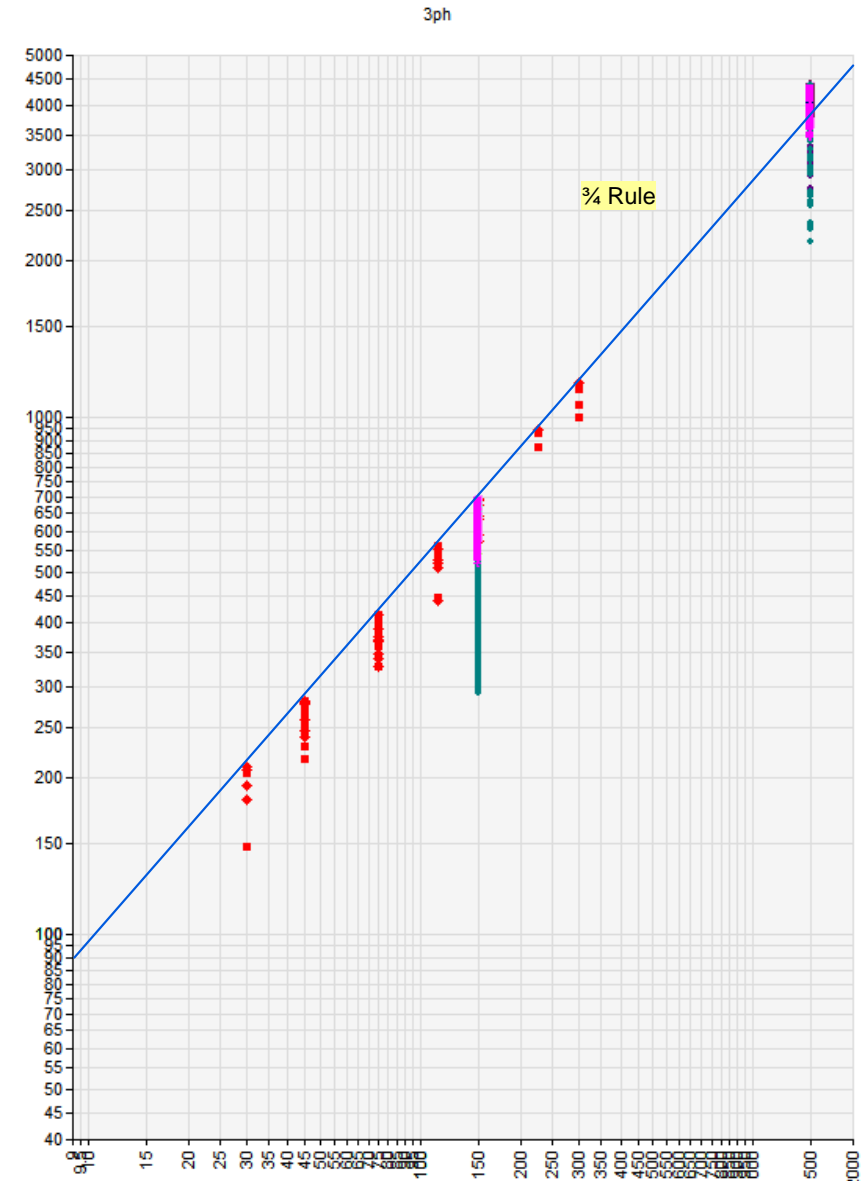
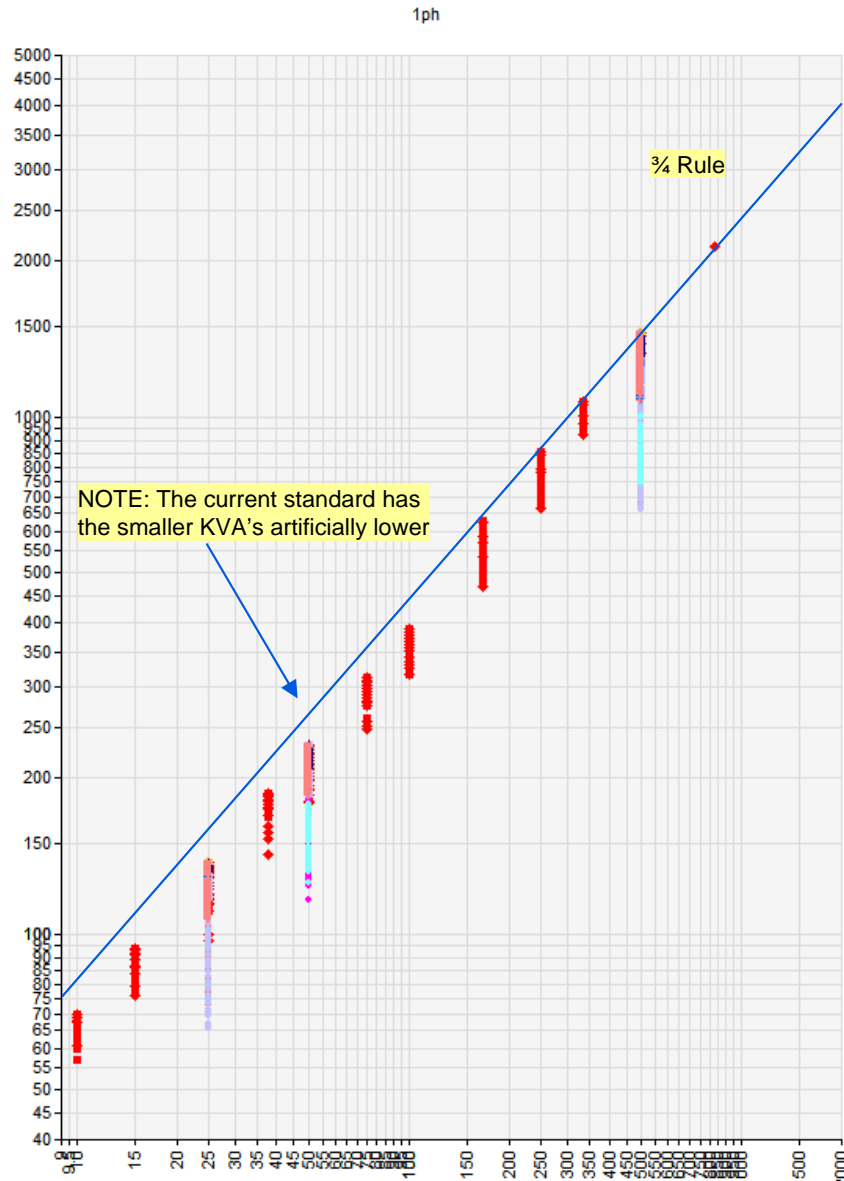
1 Check the fit to the  $\frac{3}{4}$  rule

2 ---

3 ---

4 ---

- ◆ ABB-M2
- ABB-M3
- ▲ ABB-M6
- ◆ M2\_AIAI\_dgw\_5leg
- ◆ M2\_AIAI\_dgw\_sh
- ◆ M2\_CuAl\_dgw\_5leg
- ◆ M2\_CuAl\_dgw\_sh
- ◆ M3\_AIAI\_dgw\_5leg
- M3\_AIAI\_dgw\_sh
- ◆ M3\_CuAl\_dgw\_5leg
- M3\_CuAl\_dgw\_sh
- + M4\_AIAI\_dgw\_sh
- + M4\_CuAl\_dgw\_5leg
- + M4\_CuAl\_dgw\_sh
- ▲ M5\_CuAl\_dgw\_5leg
- ▲ M5\_CuAl\_dgw\_sh
- ◆ SA1\_AIAI\_dgw\_5leg
- ◆ SA1\_AIAI\_dgw\_co
- ◆ SA1\_AIAI\_dgw\_sh
- ◆ SA1\_CuCu\_dgw\_5leg
- ◆ SA1\_CuCu\_dgw\_co
- ◆ SA1\_CuCu\_dgw\_sh
- ★ ZDMH\_AIAI\_dgw\_5leg
- ★ ZDMH\_AIAI\_dgw\_sh
- ★ ZDMH\_CuCu\_dgw\_5leg
- ★ ZDMH\_CuCu\_dgw\_sh



# MVLF – **all** PPI Poles and all DOE designs (by Phase) KVA (x-axis) vs 50% Load Total Loss (y-axis) – the $\frac{3}{4}$ Rule

1 Check the fit to the  $\frac{3}{4}$  rule – it's a better fit with the exports included !!!

2 ---

3 ---

