

Variable Frequency Drive Testing

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Context

- *No standard for VFD*
- *Difference between system efficiencies*
- *If efficiency is mentioned, normally only at motor full speed and load*
- *Need to have data at different motor speeds and torques*

....Context

- *Need to know influence of VFD operating conditions on system efficiency (supply voltage)*
- *Need to know influence of VFD configurations on system efficiency (switching frequency, energy saving mode)*
- *Need to know influence of "add-ons" on system efficiency (input reactor, DC reactor, output filter)*

CEATI program



- *CEATI currently operates an extensive program covering:*
 - *Power Generation (5 interest groups)*
 - *Transmission (6 interest groups)*
 - *Distribution & Utilization (3 interest groups)*

Project Sponsors

A



Participating Manufacturers

- *Manufacturer A*
- *Manufacturer B*
- *Manufacturer C*
- *Manufacturer D*
- *Manufacturer E*

Proposed Procedure

- *Benchmark test*
- *10, 50, 100 hp*
- *5 VFD manufacturers*
- *Same motor for each VFD size*
- *Different motor manufacturer*
- *15 complete efficiency tests*
- *Specific tests*

Test Points

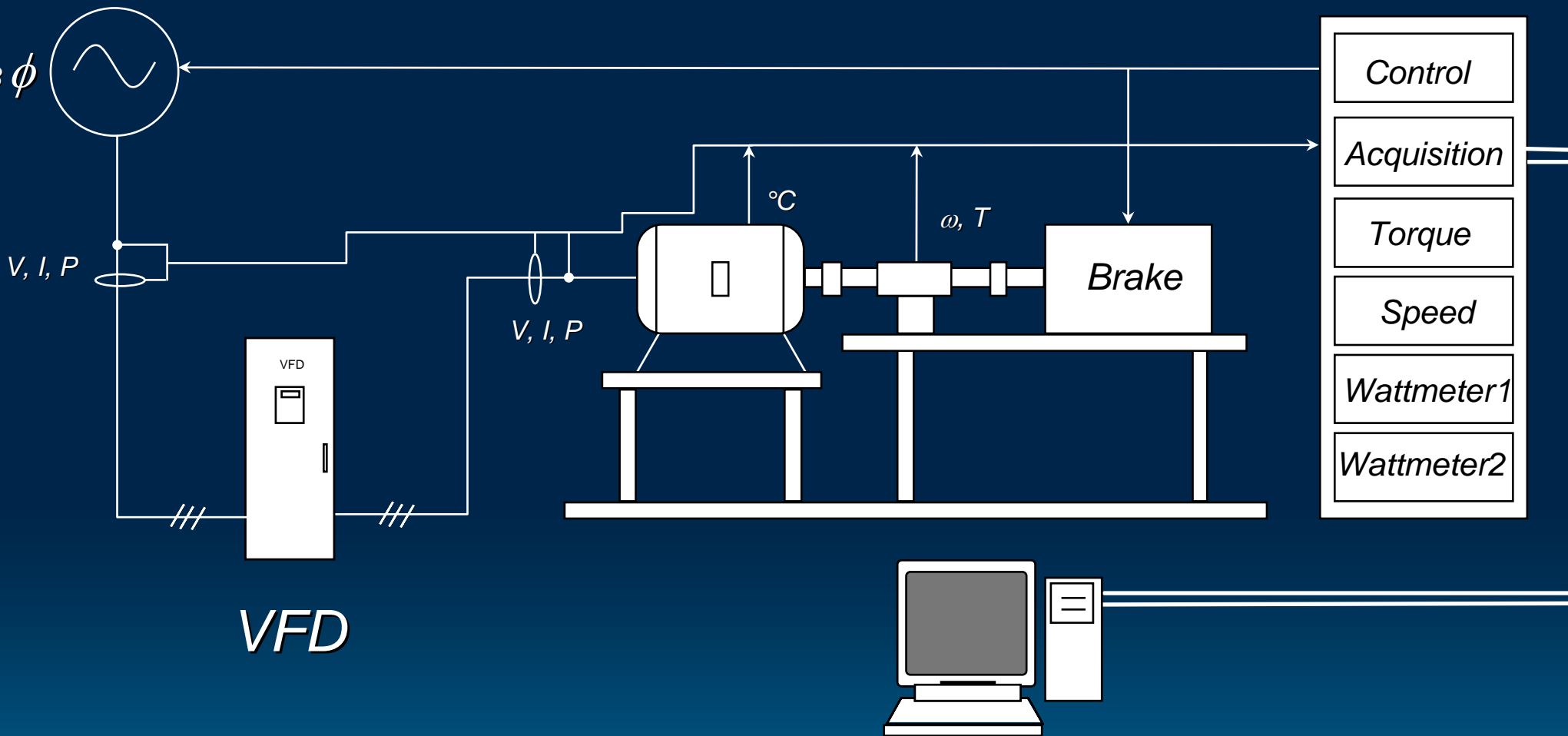
Points	1	2	3	4	5
Speed (%)	100	100	100	100	100
Torque (%)	100	75	50	25	10

Points	6	7	8	9	10
Speed (%)	75	75	75	75	75
Torque (%)	100	75	50	25	10

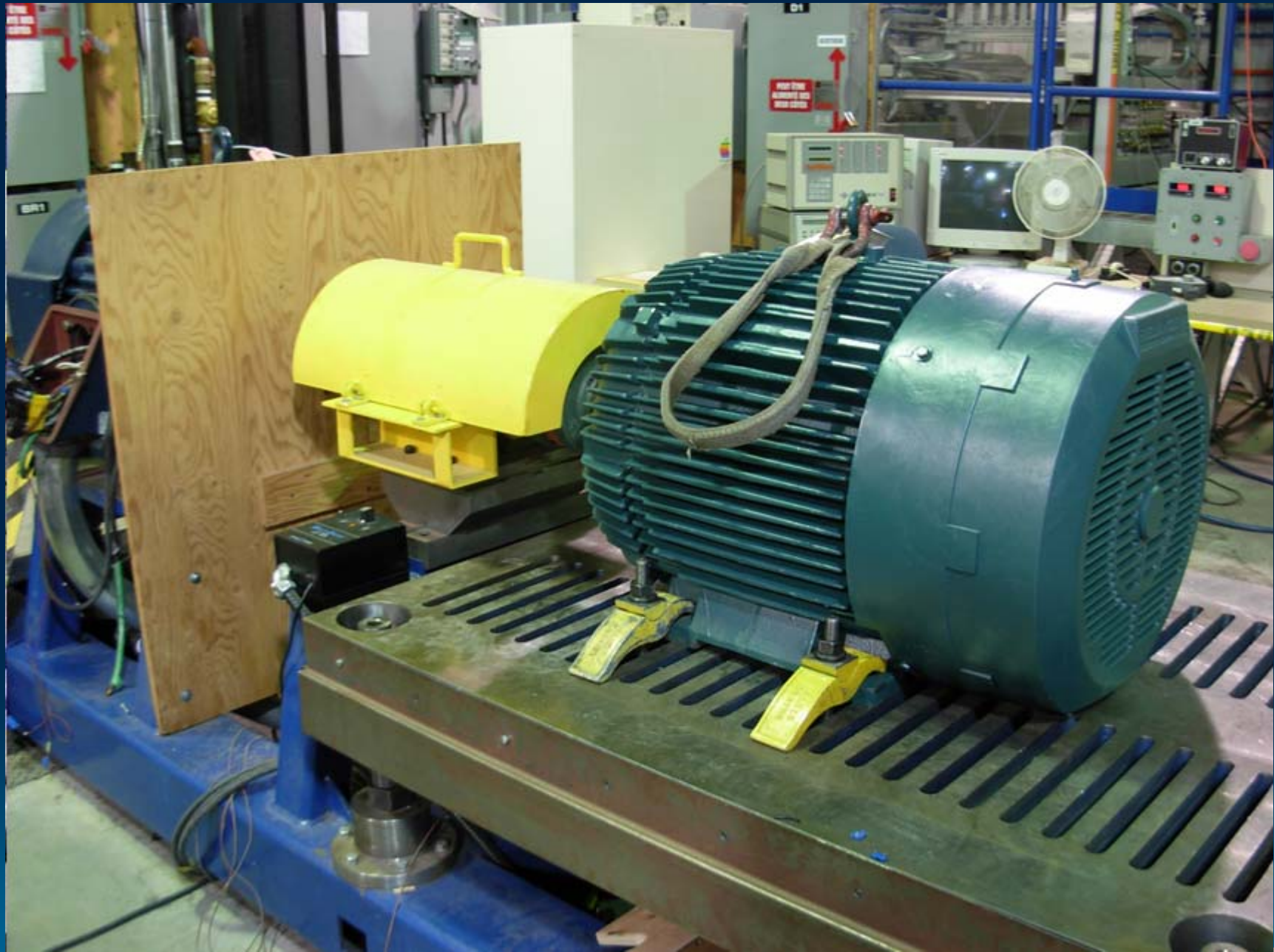
Points	11	12	13	14	15
Speed (%)	50	50	50	50	50
Torque (%)	100	75	50	25	10

Points	16	17	18	19	20
Speed (%)	25	25	25	25	25
Torque (%)	100	75	50	25	10

Test Set-up



Test Set-up



Efficiency Comparison

4-pole, 60 Hz

<i>Size</i>	<i>EPACT</i>	<i>Premium</i>	<i>IE1</i>	<i>IE2</i>	<i>IE3</i>
<i>1 hp 0.75 kW</i>	<i>82.5</i>	<i>85.5</i>	<i>78.0</i>	<i>82.5</i>	<i>85.5</i>
<i>10 hp 7.5 kW</i>	<i>89.5</i>	<i>91.7</i>	<i>87.5</i>	<i>89.5</i>	<i>91.7</i>
<i>100 hp 75 kW</i>	<i>94.5</i>	<i>95.4</i>	<i>93.2</i>	<i>94.5</i>	<i>95.4</i>

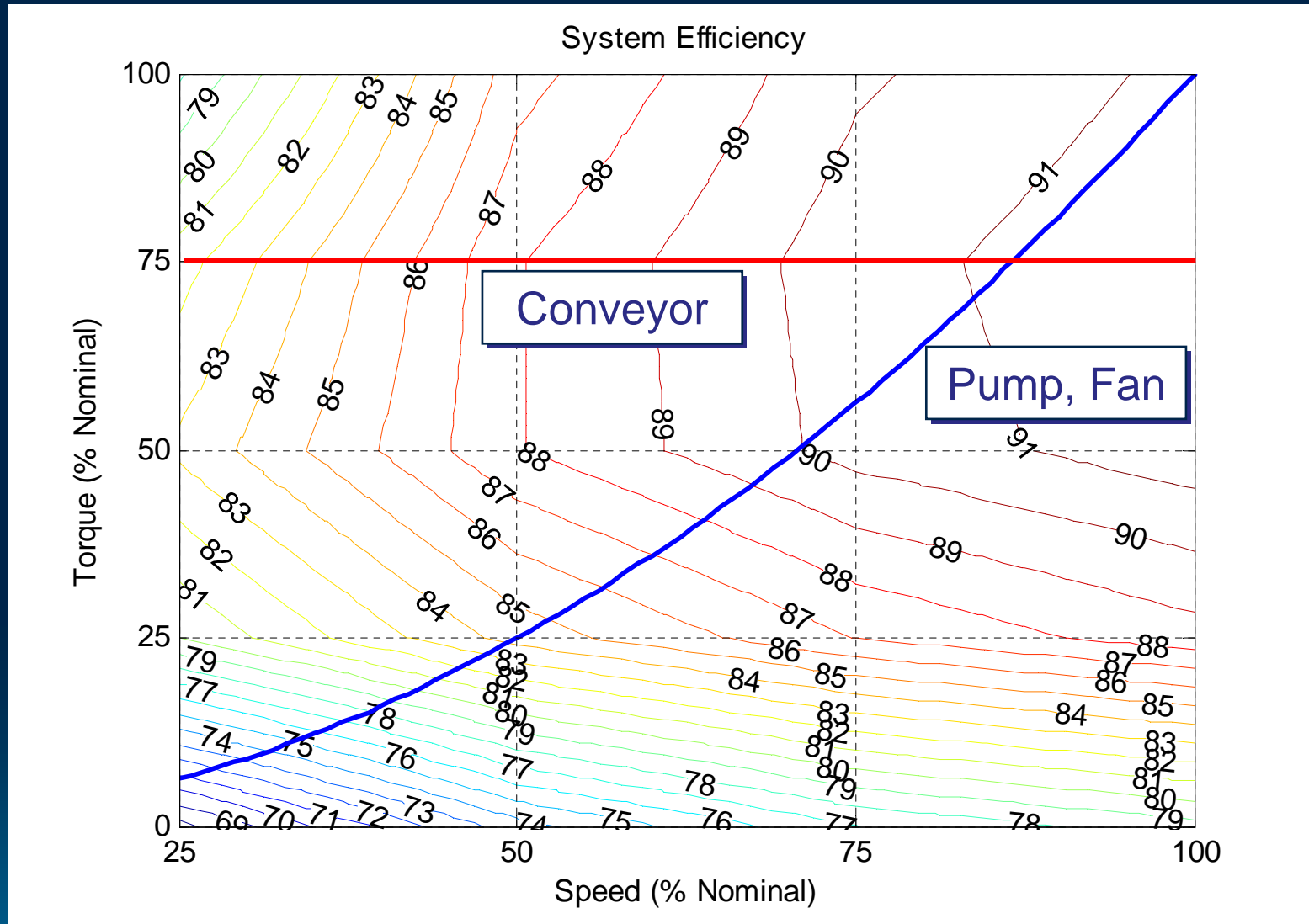
Reference: NEMA MG1-2006, IEC 60034-30 Ed. 1 - 2008

Impacts on Efficiency

- *Impact of VFD and Motor Temperature*
- *Impact of Switching Frequency*
- *Impact of Voltage Level and Voltage Unbalance*
- *Impact of Flux Control*

*New Approach to Present
the Results*

New Approach to Present the Results



Developing a Standard

- *Canadian Standard Association (CSA)*
 - *CSA838 Committee*
 - *Utilities*
 - *Manufacturers*
 - *End Users*
 - *3 meetings*
 - *Working Draft*

...Developing a Standard

- *International Electrotechnical Commission (IEC)*
 - *TC2: Rotating Machinery*
 - *WG 28: Performance as determined by tests*
 - *IEC60034-2-3: Specific test methods for determining losses and efficiency of converter-fed AC machines*
 - *Stage of Working Draft*

Questions ?