2018 CIGRE–CANADA Calgary

CIGRÉ - W2.07 – ABS 12
INNOVATIVE & EFFECTIVE METHOD & SYSTEM FOR VOLTAGE IMPROVEMENT, POWER QUALITY & REDUCTION OF LOSSES IN ELECTRICAL POWER DISTRIBUTION

Name:	KRISTO LAKIKO, P.Eng., Canada
Education:	B-Tech.(Hons), HND-E.Eng.
Current areas of interest:	Power Systems & Controls [Oil & Gas, Utilities & Industrial]
Current role and responsibility:	Engineering Manager, EGC

Professional Engineering Status (License): APEGA Member # 71928

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INNOVATIVE & EFFECTIVE METHOD & SYSTEM FOR VOLTAGE IMPROVEMENT, POWER QUALITY & REDUCTION OF LOSSES IN ELECTRICAL POWER DISTRIBUTION

PATENT #: PCT/CA2016/051553 and US-2018-0115159-A1

REPRESENTED AS: MVROT METHOD AND SYSTEM

KRISTO LAKIKO, P Eng.

Engineering Manager

Energo Group Canada Inc.

Canada

DATE: October 17, 2018

INTRODUCTION

Utilities and Distribution Challenges - “Quality and Efficiency of Power Systems”

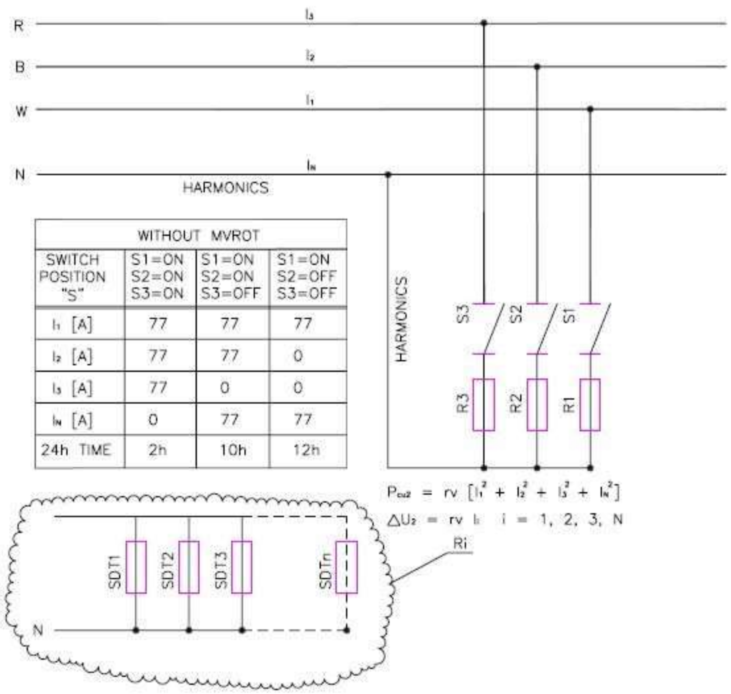
- Not necessarily new and are addressed in many ways
- Traditional methods can be quite expensive
- Requiring major reconstructions
- Long duration of construction
- Large capital investment
- Low investment returns and public hearings

CANADIAN ELECTRICITY SECTOR CHALLENGES

According to the Canadian Electricity Association and Infrastructure, the Canadian electricity sector is expected to spend approximately $294 billion between 2010 and 2030 :

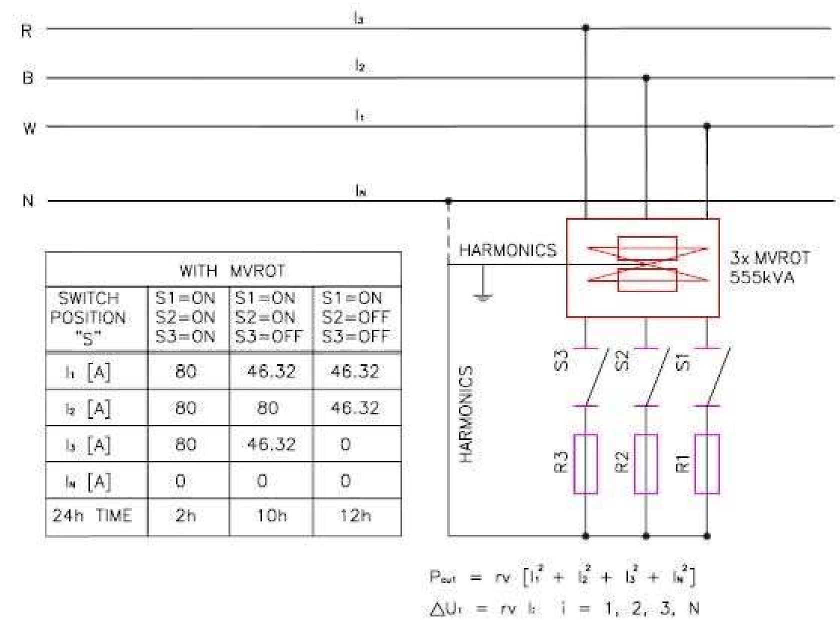
- Aging and deterioration of existing infrastructure
- Continuous demand and load growth
- Transmission and distribution efficiency
- Power quality
  - ✓ (DC to AC convertors or inverters, green power and renewable technologies are adding large harmonics into systems).

CLASSIC METHODS VERSUS MVROT METHOD AND SYSTEM



WITHOUT MVROT			
SWITCH POSITION "S"	S1=ON S2=ON S3=ON	S1=ON S2=ON S3=OFF	S1=ON S2=OFF S3=OFF
I_1 [A]	77	77	77
I_2 [A]	77	77	0
I_3 [A]	77	0	0
I_N [A]	0	77	77
24h TIME	2h	10h	12h

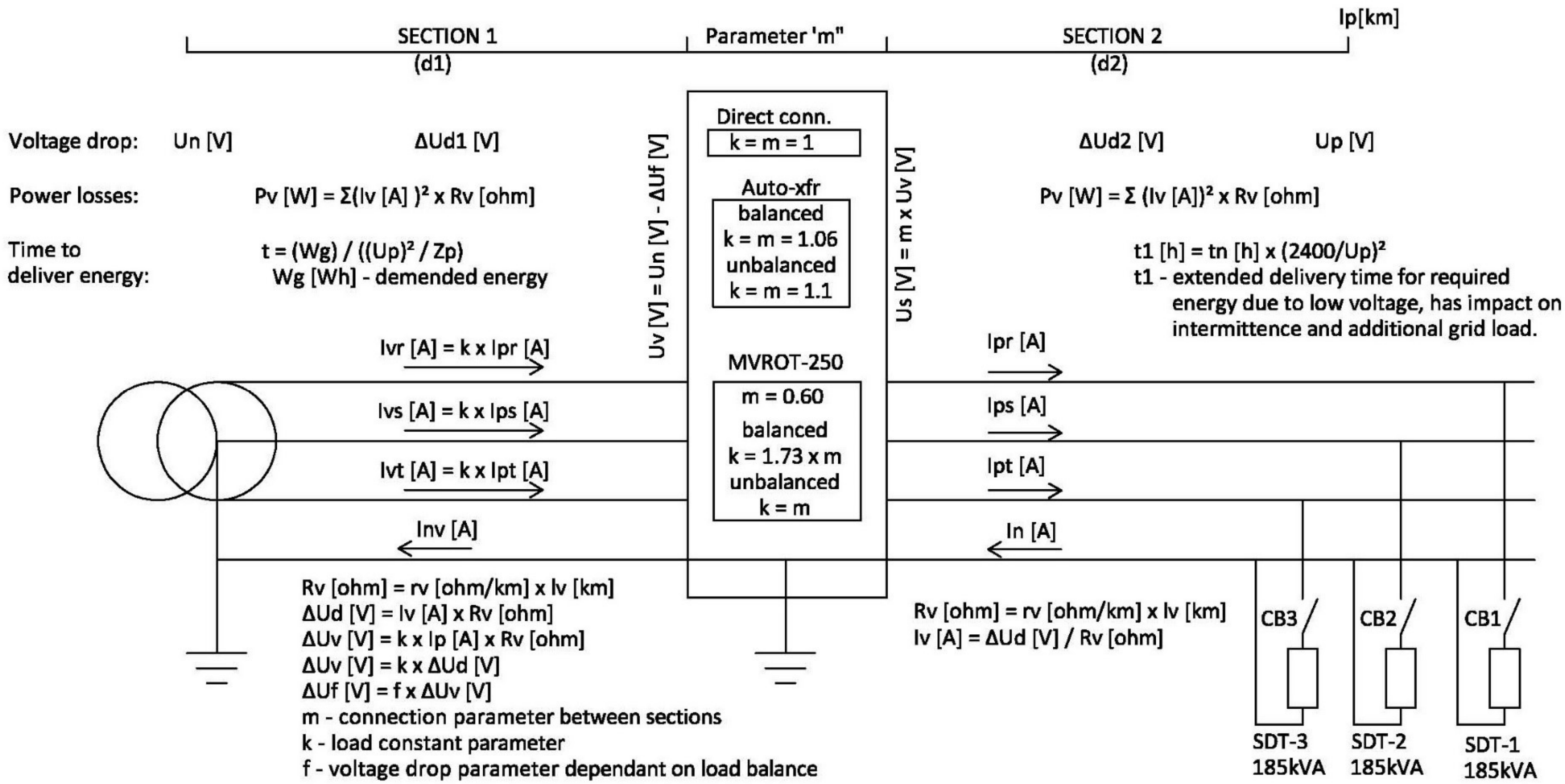
TYPICAL DISTRIBUTION SCHEMATIC GRID WITHOUT MVROT: Figure 1



WITH MVROT			
SWITCH POSITION "S"	S1=ON S2=ON S3=ON	S1=ON S2=ON S3=OFF	S1=ON S2=OFF S3=OFF
I_1 [A]	80	46.32	46.32
I_2 [A]	80	80	46.32
I_3 [A]	80	46.32	0
I_N [A]	0	0	0
24h TIME	2h	10h	12h

TYPICAL DISTRIBUTION SCHEMATIC GRID WITH MVROT: Figure 2

MVROT METHOD AND SYSTEM WORKING PRINCIPLE



POSSIBLE LINE CONNECTIONS and MVROT CONNECTION: Figure 3

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COMPARISON BETWEEN CLASSIC LINE CONNECTIONS AND MVROT

Table 1

voltage drop Δd1 [V] = 200	balanced, CB1,CB2,CB3 closed							voltage drop ΔUd2 [V] = 40
	m	k	f	Inv [A]	ΔUv [V]	Uv [V] = Un [V] - ΔUf [V]	Us [V] = m x Uv [V]	Up [V] = Us [V] - ΔUd2 [V]
direct connection	1	1	1	0.0	200	2400 [V] - 200 [V] = 2200	2200	2160.0
autotransformer	1.06	1.06	1	0.0	212	2400 [V] - 212 [V] = 2188	2319.28	2279.28
MVROT-250	0.6	1.04	2	0.0	208	4160 [V] - 416 [V] = 3744	2246.4	2206.41

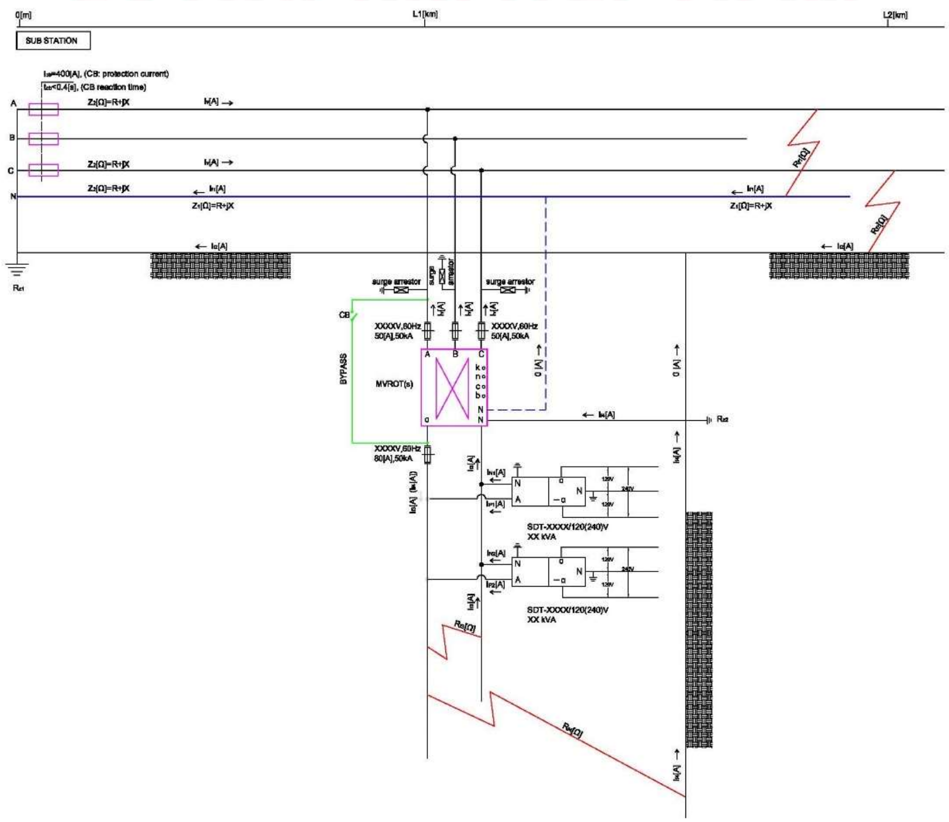
RESULTS WHEN LOADS ARE BALANCED IN GRID

Table 2

voltage drop ΔUd1 [V] = 200	unbalanced, CB1-closed, CB2 i CB3 open							voltage drop ΔUd2 [V] = 80
	m	k	f	Inv [A]	ΔUv [V]	Uv [V] = Un [V] - ΔUf [V]	Us [V] = m x Uv [V]	Up [V] = Us [V] - ΔUd2 [V]
direct connection	1	1	2	k x Ip[A]	200	2400 [V] - 400 [V] = 2000	2000	1920
autotransformer	1.1	1.1	2	k x Ip[A]	220	2400 [V] - 440 [V] = 1960	2156	2076
MVROT-250	0.6	0.6	2	0.0	120	4160 [V] - 240 [V] = 3920	2352.0	2272

RESULTS WHEN LOADS ARE UNBALANCED IN GRID

MVROT METHOD AND SYSTEM EXTRA PROTECTION



SECTIONING OF DISTRIBUTION GRIDS – LOCALIZE POTENTAL OUTAGES: Figure 3

TRADITIONAL METHODS AND SYSTEMS

1. **Upgrading grids to the higher voltage levels:**
   - Requires public hearings,
   - Big capital investment or taxpayer funding.
   - Increase in $/kWh to recover the cost.
   - It may not address harmonics, unbalanced loads or grid selectivity.

2. **Phase conductors and neutral wire replacement with bigger wire sizes:**
   - Additional loads to the existing poles
   - Poles might need to be replaced
   - Less investment needed than the first option
   - Still does not address all issues – power quality in rural areas.

3. **Replacement of conductors and addition of capacitors:**
   - Expensive solution with the possibility of overvoltage in long lines.

MVROT METHOD AND SYSTEM BENEFITS

SAFETY:

- No current in neutral
- No circulated currents
- Improved overall grid protection

ENVIRONMENTAL BENEFITS:

- Low dBA - urban friendly
- Dry technology - no oil, no leaks
- No chemical or harmful materials
- Consistent performance from -50 c° to +65 c° ambient temperature

RELIABILITY:

- Loads balanced most of the time
- Optimal working conditions
- Full automatization and controls
- Smart efficient grids
- Improved system performance
- Perfect combination with SCADA
- Selectivity of grid protection
- Improved protection sensitivity
- Blocks harmonics
- Eliminates / resolve "flickers"

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MVROT METHODS AND SYSTEMS ECONOMIC BENEFITS

To users:

- Significant voltage improvement
- Better overall power quality
- Significant intermittence improvement
- Increased reliability / less outages
- Reduces production time losses

To Utilities:

- Significant reduction of technical distribution losses
- Enhanced fault detection
- Faster restoration
- Small capital investment, fast return
- Fast and simple installation

To Utilities cont.:

- Minimum maintenance
- More energy available
- Redistribution to new customers
- Extend the life of the existing facilities
- Simple and effective engineering design completely satisfying EN 50160,
- Limit or eliminate the use of voltage regulators or harmonic filters in S/Stations.
- Smaller conductor sizes in new design
- No need for the neutral conductor in three phase- less copper

MVROT INNOVATIVE SOLUTION

Applying the MVROT unit to an entire distribution network will result in:

- Up to 60% reduction in the power distribution losses.
- Up to 40% reduction in voltage drop.

Partial implementation in an undergoing Pilot Project:

- Expected reduction of power losses in the range of 20%

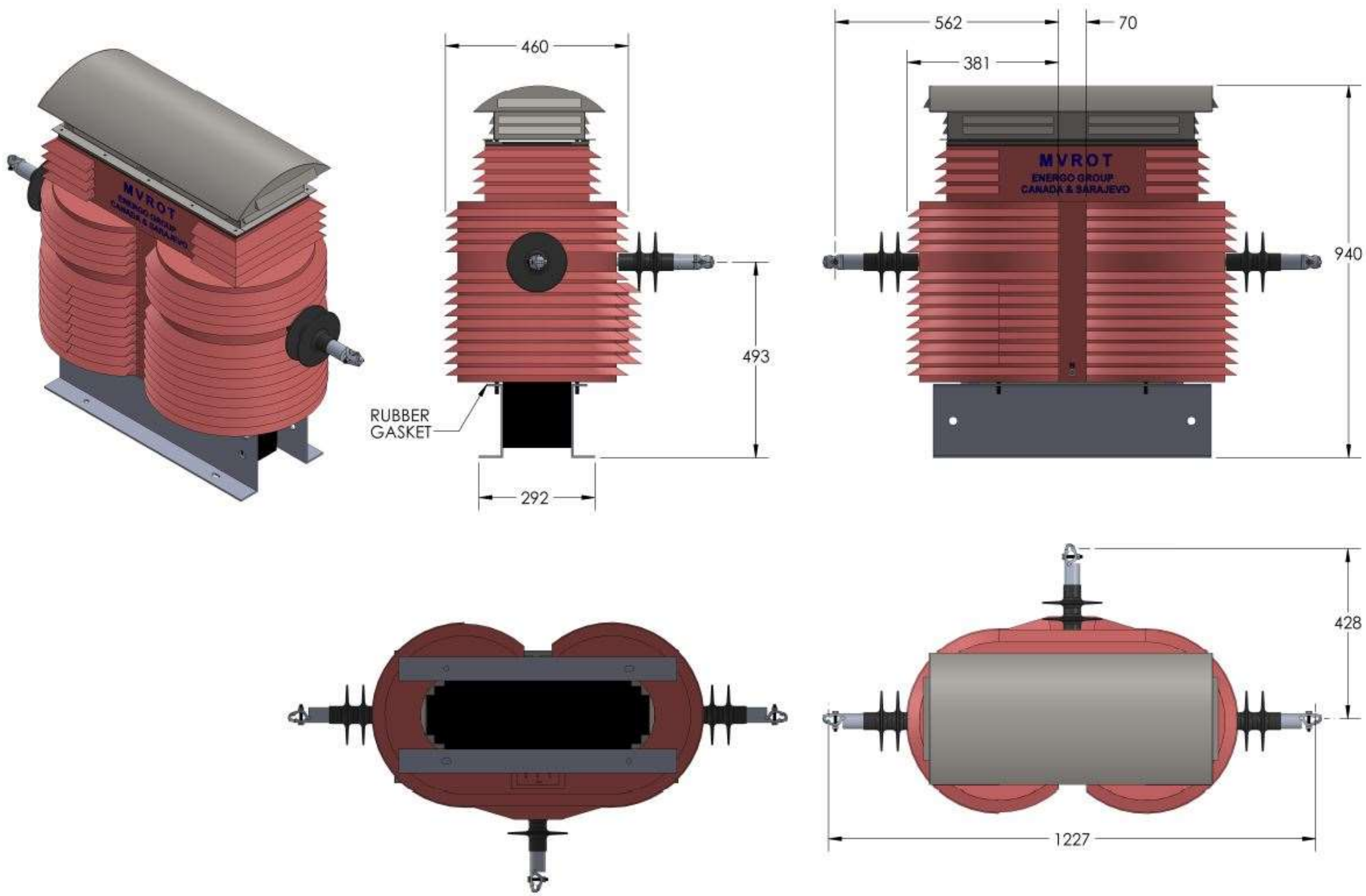
MVROT – 250 TECHNICAL DATA

CSA 264700

Height [mm]	940
Depth [mm]	460
Weight [kg]	870
Mechanical Protection	IP56/NEMA 3R
Ambient Temperature	-50 to +65
Primary Voltage [kV]	0.6 to 4.16
Secondary Voltage [kV]	0.11 to 2.5
Power: Sn [kVA]	up to 215
Power Factor: "COS"	0.97
Harmonics	N/A (Does not generate / pass through)
Nominal Power [kVA]	185
Frequency [Hz]	50 / 60
BIL [kV]	30
Insulation Degree [kV]	7.2/20
Power Losses [kW]	Total 1% of Pnom
Standards / Certified	IEC 60076-11 / 2004, EN 50160, NETA, C22.2 No. 47-13, IEEE C57.12.01 / 2015

	Metering PT	Control PT	Metering CT
Primary Voltage [kV]	4.16	4.16	4.16
Secondary Voltage [V]	120	120	-
Primary Current [A]	-	-	60
Secondary Current [A]	-	-	1 / 5
Class [%]	0.5%	3%	0.5%
Protection	3P	3P	-
Burden [VA]	100	300	10
BIL [kV]	30	30	30
Insulation Degree [kV]	7.2/20	7.2/20	7.2/20

MVROT – 250 DIMENSIONS



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CONCLUSION

The innovative technology shown in this paper will introduce power quality into existing grids with fast installation, small investment along with short term capital payback. Additionally, power providers will have more energy available to existing or new consumers. Distribution grids become “selective” as extra protection will localize potential outages within small areas preventing large area blackouts.

Making existing grids stable, providing power quality per EN 50160, with all extreme cases under balanced and unbalanced loads that could happen in the grids is easily achievable with this technology. Balancing loads eliminates all currents in neutral line (and ground current) making the grid safer, and having instrument transformers built in can make the entire grid SMART.

Q&A