



# Skúšobné systémy Omicron

## pre skúšanie rozvodných sietí s reclosermi

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# Juraj Kachnič

- |   |            |
|---|------------|
| <b>1969 – 1977 – EF SVŠT</b>            | Bratislava |
| <b>1977 – 1993 – Elektrovod</b>         | Bratislava |
| <b>1994 – 2002 – Siemens s.r.o.</b>     | Bratislava |
| <b>2002 – 2002 – LIV Elektra s.r.o.</b> | Bratislava |
| <b>od 2003 - AP Consulting s.r.o.</b>   | Bratislava |

# AP Consulting, s.r.o. Bratislava



## Skúšobné zariadenia

Primárne a sekundárne skúšobné zariadenia  
Podpora pri výbere s praktickým predvedením  
Zaškolenie a konzultácie pre užívateľov  
Servis a kalibrácia zariadení Omicron  
Prenájom zariadení



## Digitálne ochrany

Dodávky a inžiniering ochrán:  
- Sprecon  
- Siprotec  
- Multilin  
- MiCOM  
Parametrizácia a skúšky ochrán  
Výpočty nastavenia ochrán



## Diagnostika

Merania v energetických systémoch  
Merania na výkonových zariadeniach  
Analýza prevádzkových javov



## Školenia

Odborné školenia pre užívateľov skúšobných zariadení a ochrán  
Manažérske rozvoj v oblasti vedenia ľudí  
Školenia a tréningy pre predajcov, operátorov

# www.apcon.sk



CMC353 + CMControl



Votano 100



CT Analyzer



CMC256



CMC850



MPD 600



CIBANO 500



CPC100



# Antolská 4 Bratislava

[www.apcon.sk](http://www.apcon.sk)

# Skúšobné systémy Omicron

pre skúšanie rozvodných sietí s reclosermi

## Požiadavky na skúšobný systém:

- Skúšanie 3-fázovým zdrojom U/I
- Simulácia komplexných prev. stavov
- Jednoduché pripojenie na skúš.objekt
- Práca v obvykle zlých podmienkach
- Skúšanie ochranných a ovládacích funkcií
- Skúšanie spolupráce distrib. Systémov
- Protokolovanie individ. a komplex. Skúšok
- Vyhodnotenie spoľahlivosti napájania pre jednotlivé uzly siete

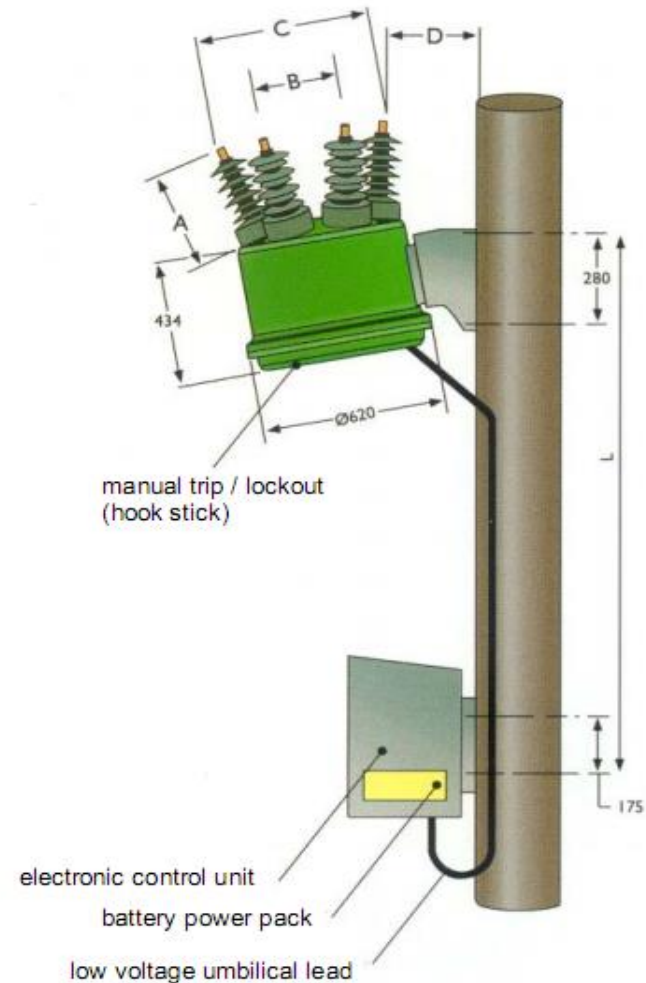


# Recloser

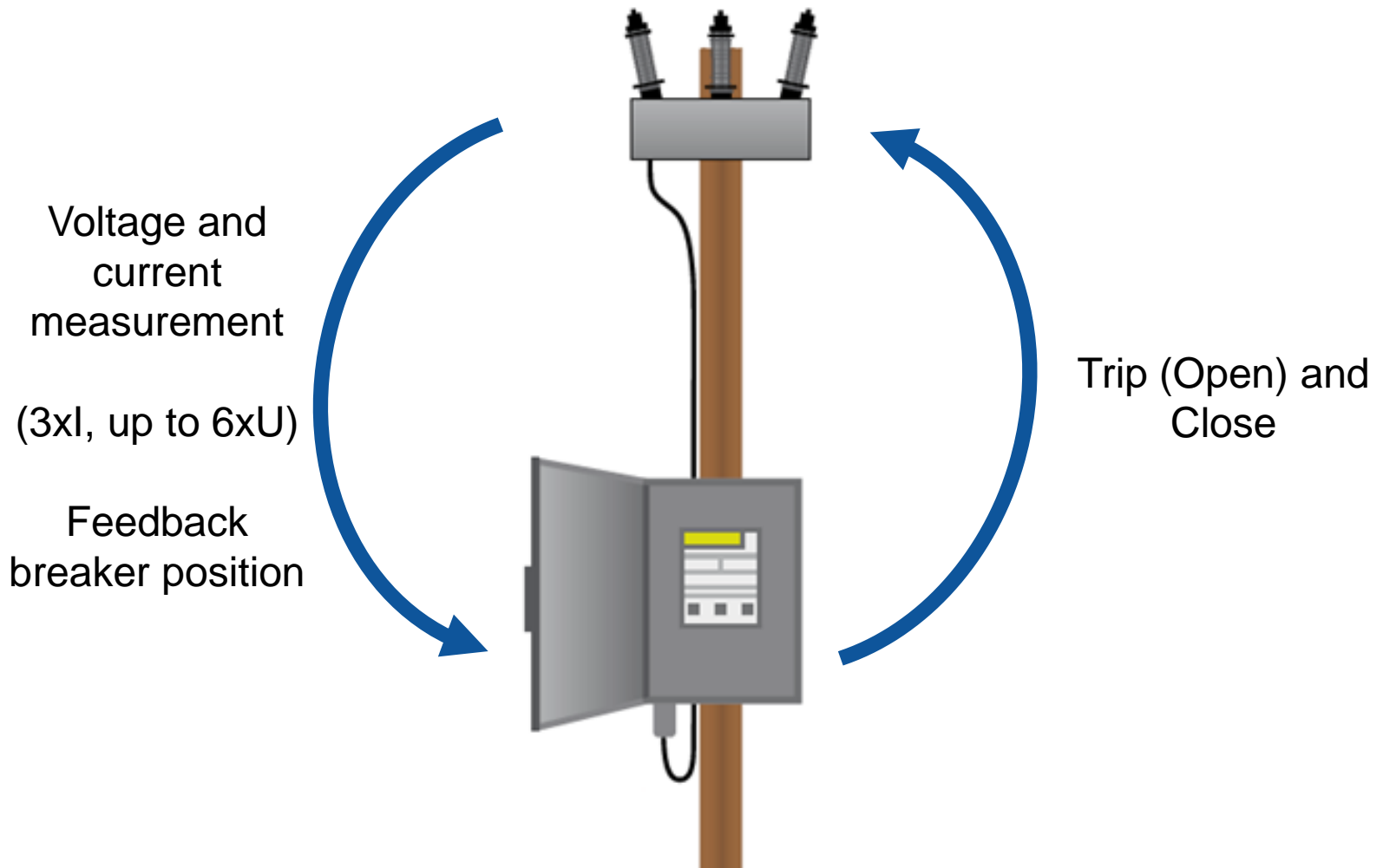
A recloser includes all elements of a fault clearing system (protection system):

- > Circuit Breaker (single or 3-pole)
- > Protection (Recloser Controller)
- > Sensors (CT, VT)
- > Power supply / Battery
- > Communication (opt.)

Used in distribution grids of countries with wide overhead distribution power lines



## Typické usporiadanie Reclosera



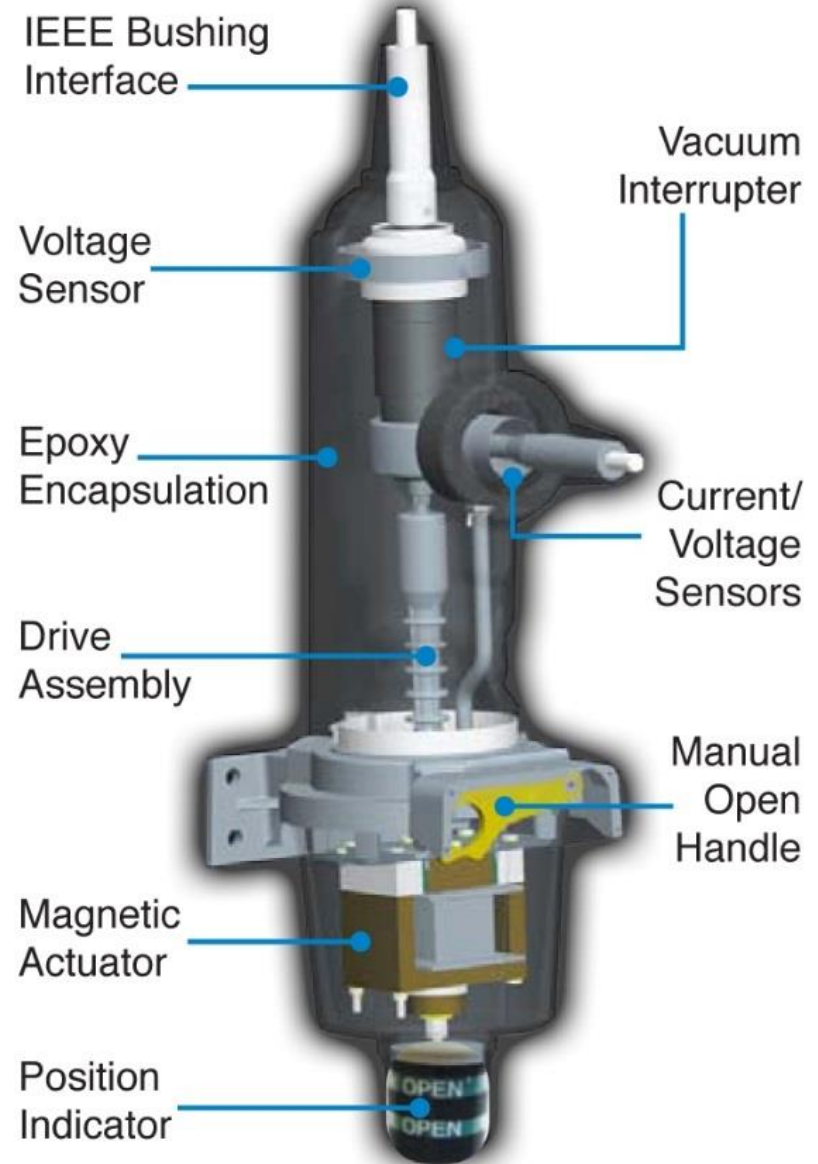
# Meranie prúdu a napätia

## Meranie prúdu :

- > Rogowski Coils
- > Current Transformers (e.g. 1000/1A ratio)

## Meranie napätia (opciona) :

- > Conventional VTs (120V sec) often externally attached to recloser
- > Capacitive or resistive voltage dividers often built into bushing
  - > compact,
  - > low weight
  - > typical ratio 10,000/1V or 2,200/1V

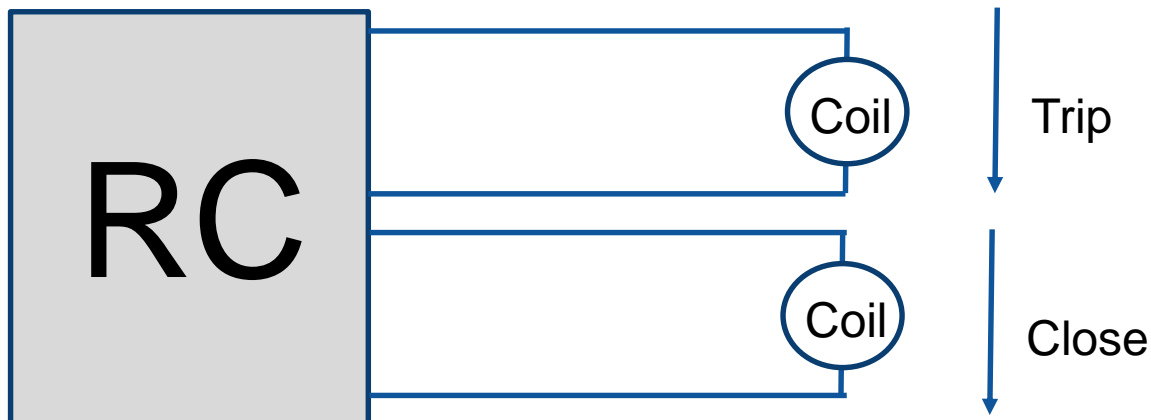
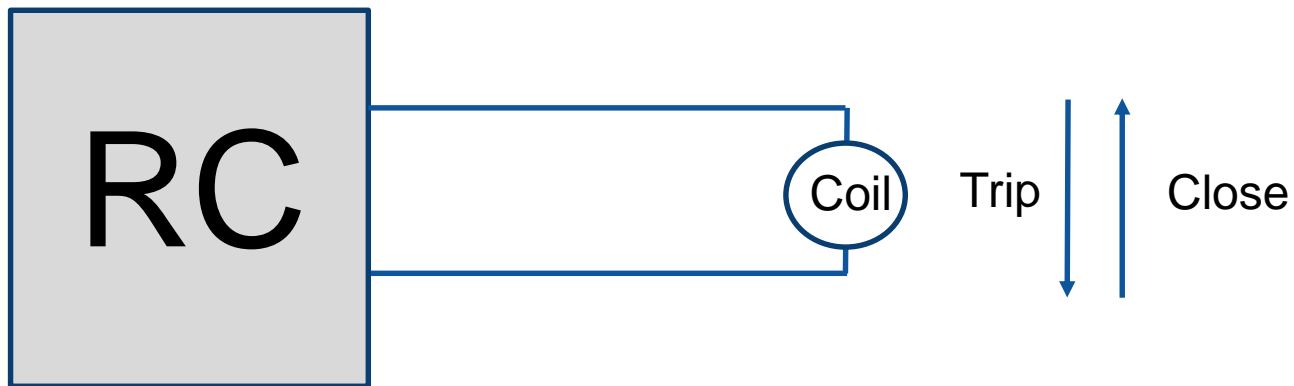


Picture source: G&W



## Ovládacie prvky Reclosera - Zap - Vyp

- > New types of reclosers are in most cases equipped with vacuum breakers and magnetic actuators



## Recloser a Odpínač ( úsečník )

- > Reclosery a odpínače sa používajú na zvýšenie spoľahlivosti napájania
  - > Redukcia dĺžky výpadku pri trvalých poruchách
  - > SAIFI / SAIDI / CAIDI ( ukazovatele spoľahlivosti )
- > Odpínače ( úsečníky ) :
  - > Nemôžu vypínať poruchové prúdy
  - > Pôsobia počas beznapätvej pauzy pri OZ napájacieho reclosera / vypínača

## Príklad Reclosera na stípe



Recloser  
Total System



Pole Mounted Vacuum Switch –  
with communication antenna  
and power supply VT



Controller

# Príklad odpínača (úsečníka ) na stípe



S&C Scada Mate Switch A1

SCADA Mate Sectionalizer System



S&C Scada Mate Switch A1 Switch Side

SCADA Mate Switch



S&C Scada Mate Switch A1 Controller

Sectionalizer Controller

# Príklad Reclosera v skrini



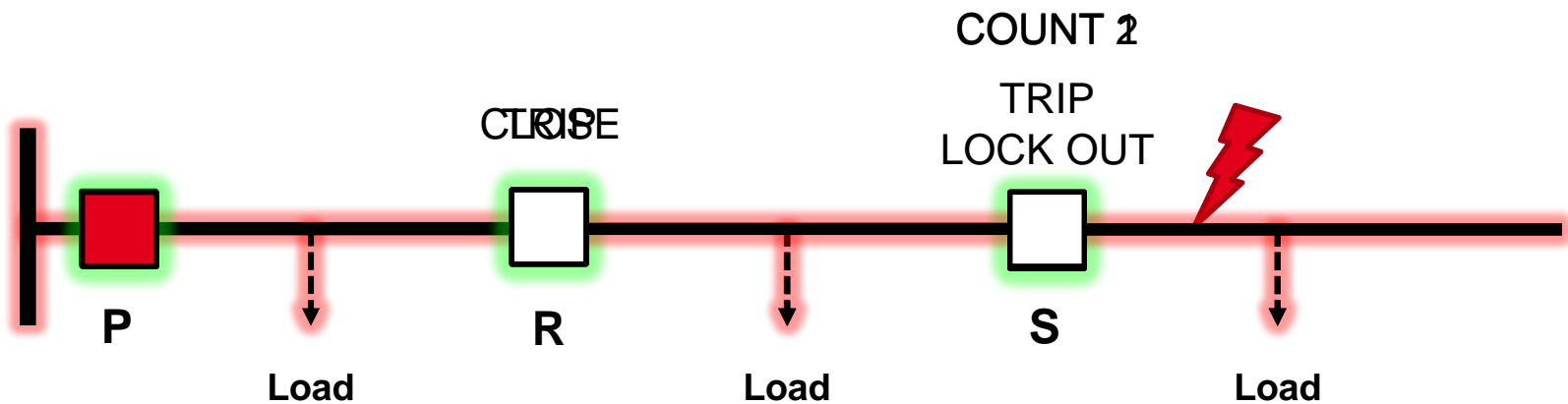
Cooper Form 4C Recloser B1 Pad mount

Pad Mounted Recloser System  
Pad Mounted Vacuum Switch & Form 4C Controller

# Recloser – obvyklé ( ochranné ) funkcie

- > **Nadprúdová funkcia :**
  - > Inverse time / definite time
  - > Partly different O/C characteristics (Cooper curves)
  - > Sensitive earth fault
  - > Negative sequence
  - > Cold load pick-up
  - > Inrush restraint
- > **Automatika OZ (AR)**
  - > Lockout
  - > Directional blocking (directional element for O/C)
  - > Live load blocking
- > **Koordinácia spínania**
- > **Výkonové funkcie** (frequency/voltage protection)
- > **Meracie funkcie**
  - > Power quality

# Obvyklá konfigurácia systému (jednoduchá schéma)



Example:

- > Permanent fault at the end of the line
- > **Protection relay**: higher trip time than the downstream **recloser**

**Recloser**: 3 shots (2 recloses)

1. Detects fault and opens
2. First reclose
3. Second opening (trip)
4. Second reclose

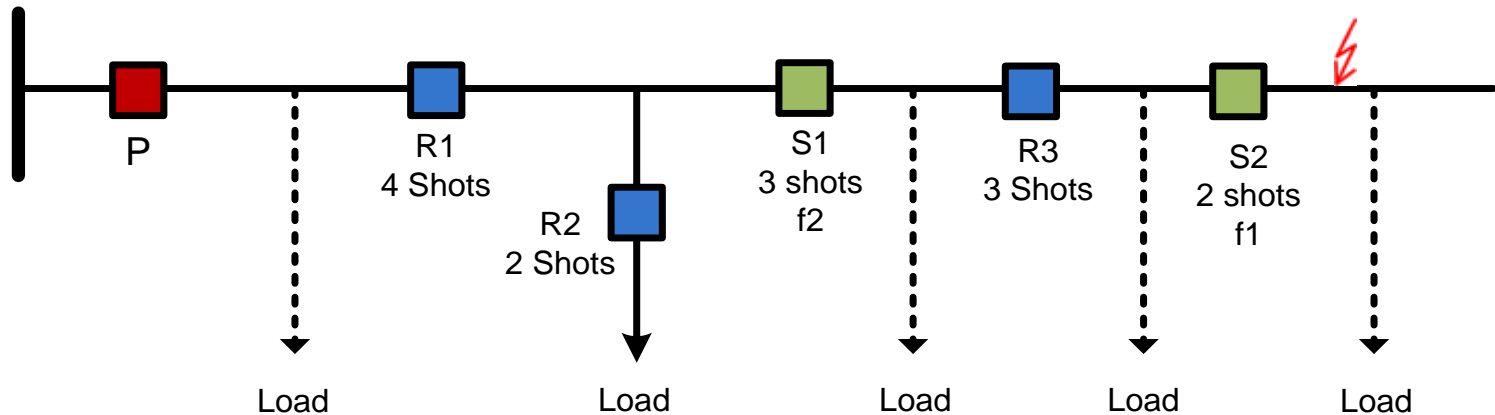
**Sectionalizer** (open during second interruption)

Detects fault interruption → Counter to 1

Detects fault interruption → Counter to 2

Opens **before** R recloses again

## Obvyklá konfigurácia systému ( Zložitá schéma)



Legend:

**R1:** 3 attempts to reclose, then lock-out

**R2:** 1 attempt to reclose, then lock-out

**S1:** Must open during the 3<sup>rd</sup> AR dead time of R1, if fault was seen; load shedding with threshold f2

**R3:** 2 attempts to reclose, then lock-out (must lock-out earlier than R1)

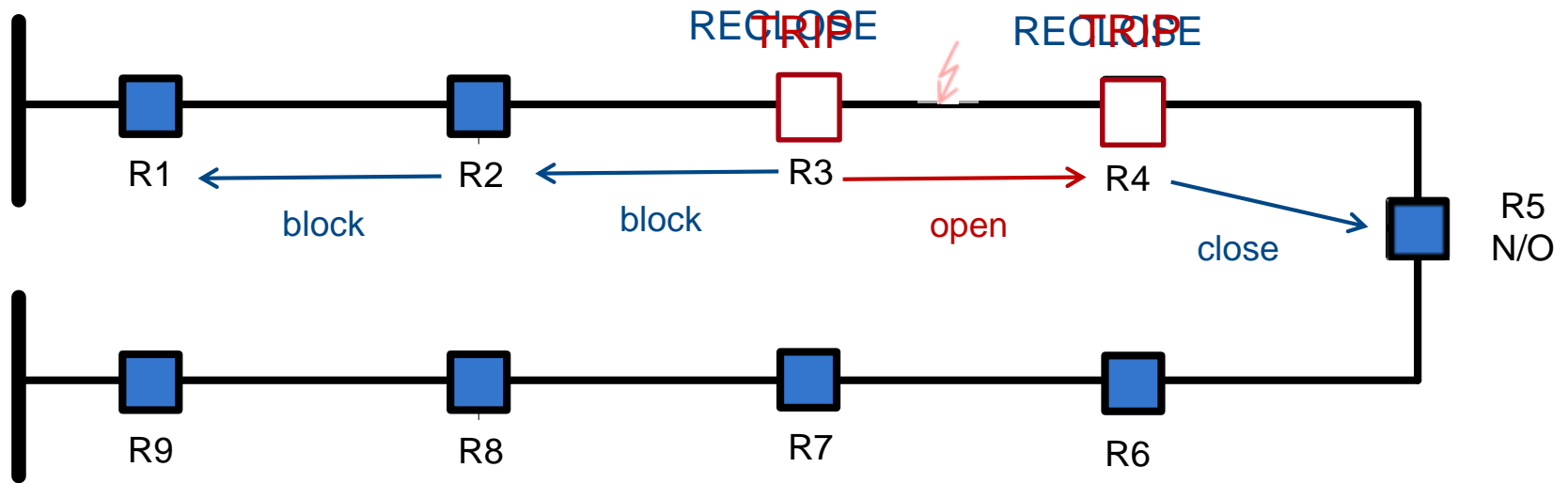
**S2:** Must open during the 2<sup>nd</sup> AR dead time of R3, if fault was seen; load shedding with threshold f1

No communication, different handling for 1-pole, 3-pole faults, subsequent faults etc.

Testing for various fault conditions with simulated reaction of other devices required.



## Príklad: Systém automatického obnovenia napájania



Successful AR: R3 and R4 stay closed  
after delay time: R5 opens → initial state

Unsuccessful AR: R3 and R4 go to lock-out

In addition R4/R5 are sending confirmation messages for switching

Source: Orange & Rockland / IPTS 2010

# Skúšobné systémy fy Omicron

## pre skúšanie rozvodných sietí s reclosermi

# Skúš. zariad. CMC s ovládaním CMControl R

- > A CMC test set combined with the CMControl R - an easy-to-use front panel control for CMC test sets specifically designed for testing recloser and sectionalizer controls – is the perfect tool for quick manual recloser testing in the field

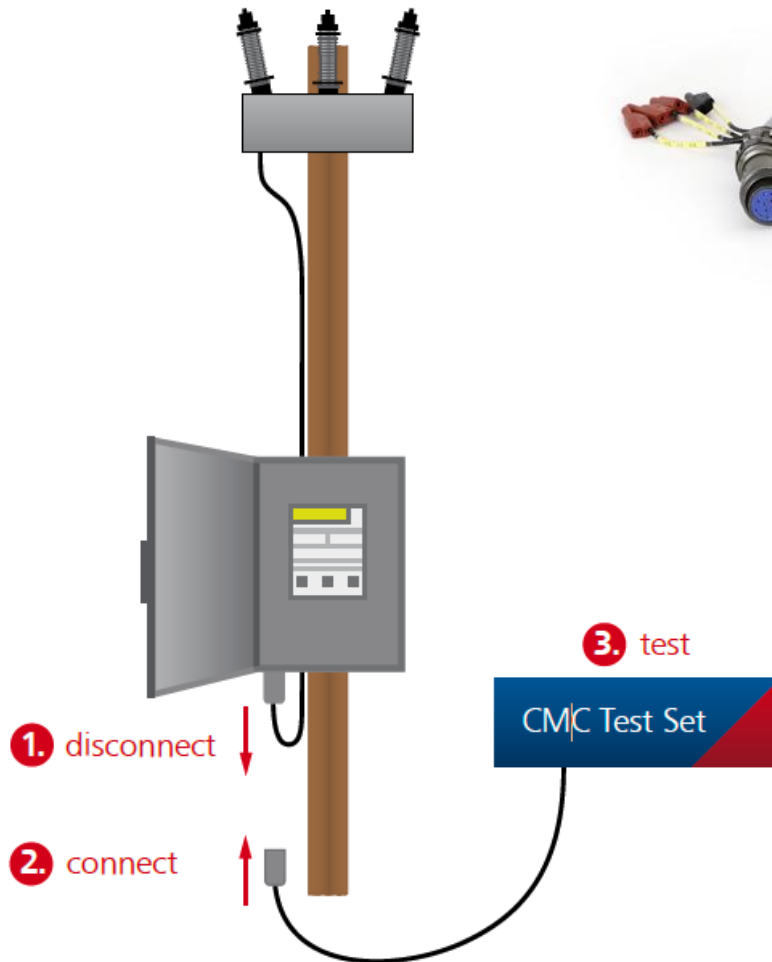
**CMC353 + CMControl**



**CMC256 + CMControl**



# Testing Connections



Cable usually contains:

- Currents
- (Voltages)
- 52a and/or 52b CB contacts
- Trip signal
- Close signal
- (69 contact (yellow handle))

## Controller Test Cables available



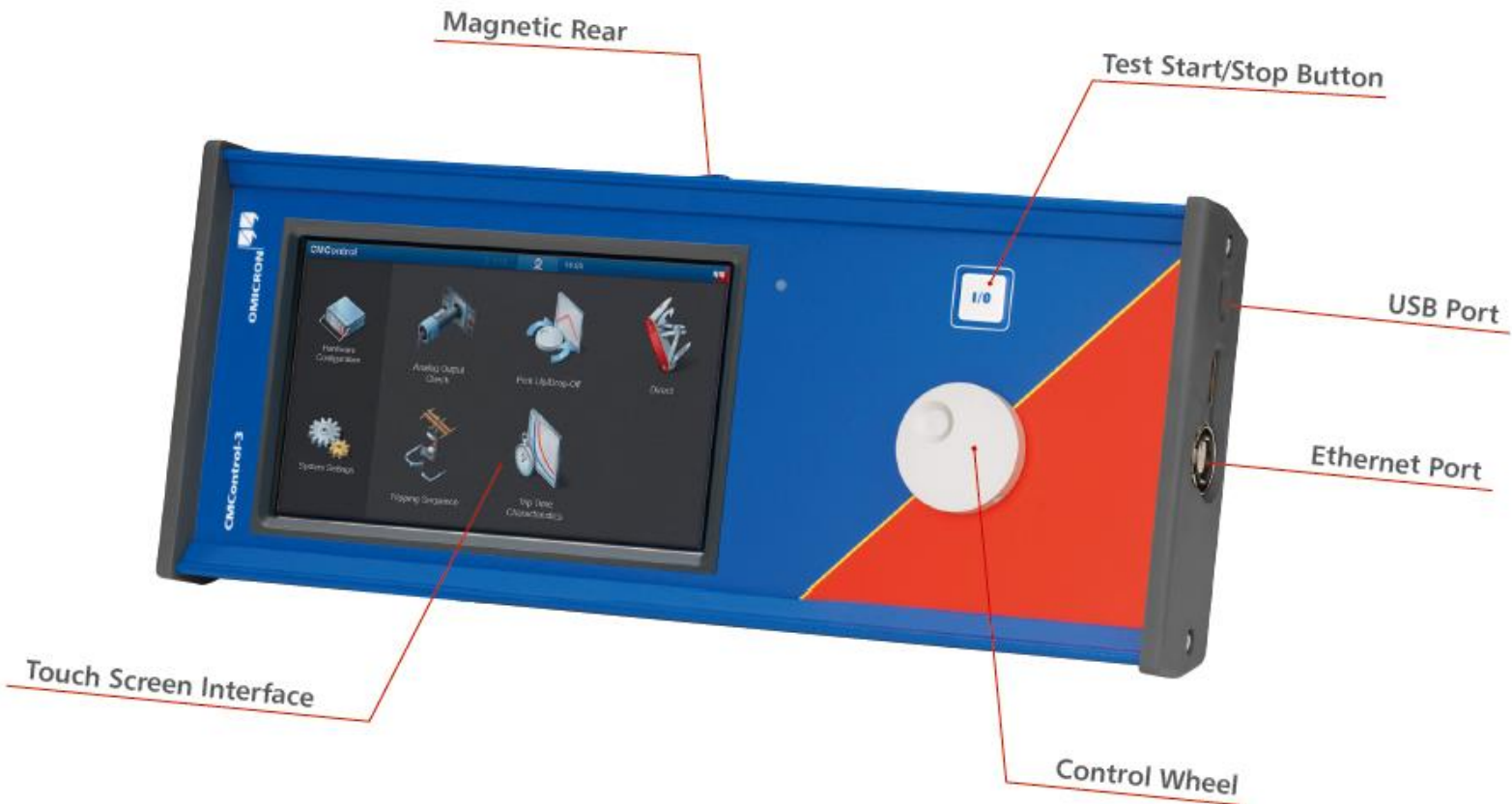
Type	Pins	Controller	Recloser/Sectionalizer
RST1	14	Cooper Form 4, 5, 6, SEL 351R, SEL 651R, GE URC, ICMU URC II, ...	Cooper NOVA G&W Viper S Elastimold MVR (3-Phase)
RCP1	19	Cooper Form 4, 5, 6, SEL 651R	Cooper NOVA G&W Viper S
RCS1	26	Cooper Form 5, 6 T/S SEL 651R	Cooper NOVA STS Cooper NOVA-TS
RGS1	24	ABB RER620	ABB GridShield
ROV1	24	ABB PCD, ABB RER620	ABB OVR-3 ABB OVR-3S
RNU1	24	Schneider ADVC, Nu-lec PTCC	Schneider/Nu-lec N-/U-/W-Series

## Controller Test Cables available



Type	Pins	Controller	Recloser/Sectionalizer
RVT1	32	SEL 651R	G&W Viper ST G&W Viper LT Elastimold MVR (Triple/Single)
RVP1	10	SEL 351RS Kestrel	G&W Viper SP Elastimold MVR (1-Phase)
RSM1	24	S&C 5801, S&C 6801	S&C Scada-Mate
RSI1	40	SEL 651R Siemens 7SR422	Siemens SDR Triple/Single
RTO1	32	SEL 651R	Tavrida OSM AI 2
RIR1	-	S&C IntelliRupter	S&C IntelliRupter
RMI1	42	SEL651R	G&W Viper St/LT, Tavrida OSM, T&B Elastimold MVR

# CMControl R

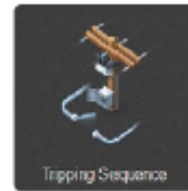


# CMControl R

> The test tools of the CMControl R provide diverse functionality:



The **Analog Output Check** allows controlling of analog test quantities and operational measuring values.



The **Tripping Sequence** tool tests the controller main functions: permanent fault, autoreclosure logic.



The **Pick-Up/Drop-Off** tool is used to test the thresholds of recloser and sectionalizer controls.



The **Trip Time Characteristics** tool checks the operating characteristics and the switch logic between the fast and the slow curve.



The **Direct** tool enables individual configuration of all CMC outputs for special test tasks.



The **Restoration** tool allows testing of voltage controlled functions – e.g. automated distribution restoration schemes.



## CMControl R Key Features

- > Portable testing solution without PC
- > Simple and fast testing with innovative user guidance
- > Specially developed for testing of recloser and sectionalizer controls
- > Reduced testing efforts, increased productivity
- > No special training required

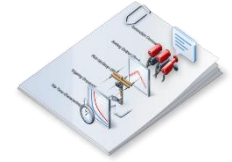


# CMControl R App

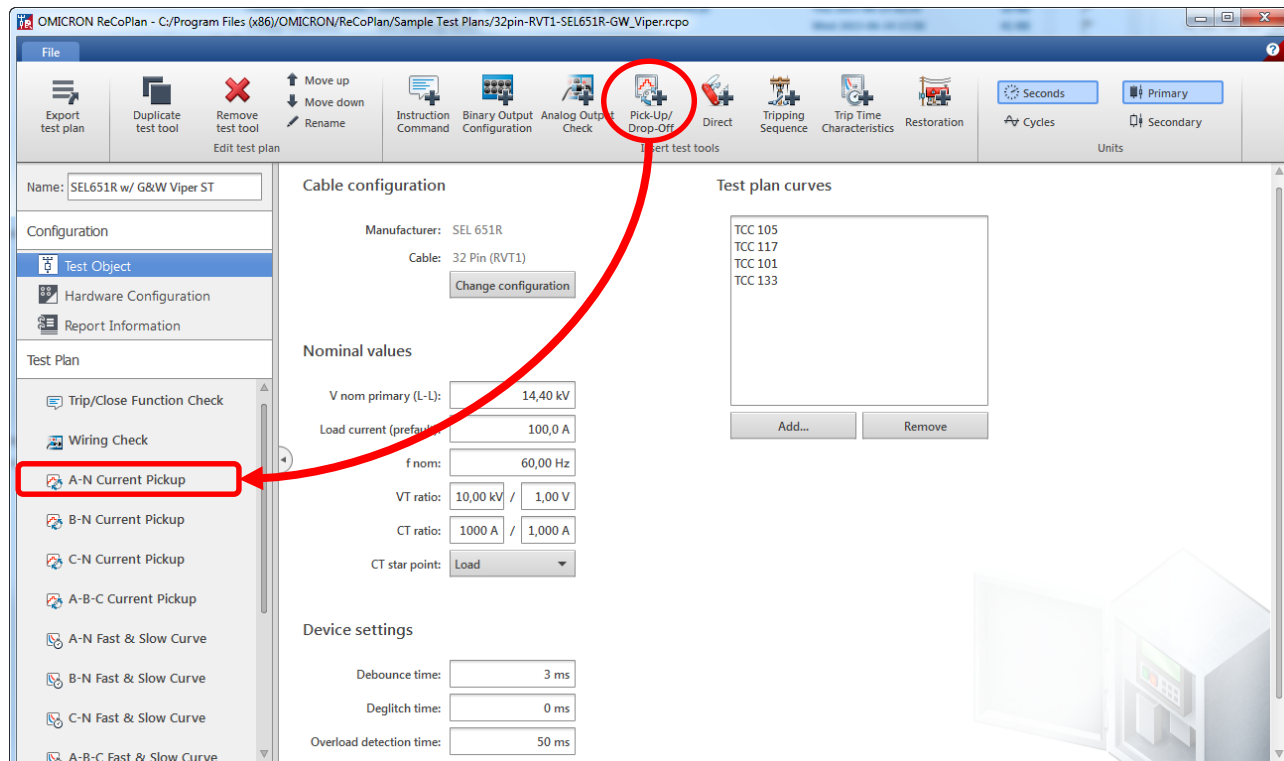
- > Available for Windows and Android tablets
- > Offers all functionalities of the CMControl R device
- > All physical operation elements (control wheel, push button) emulated
- > No cables required when using Wifi connection
- > Store and display test results on same device



# Create Test Plans for CMControl R

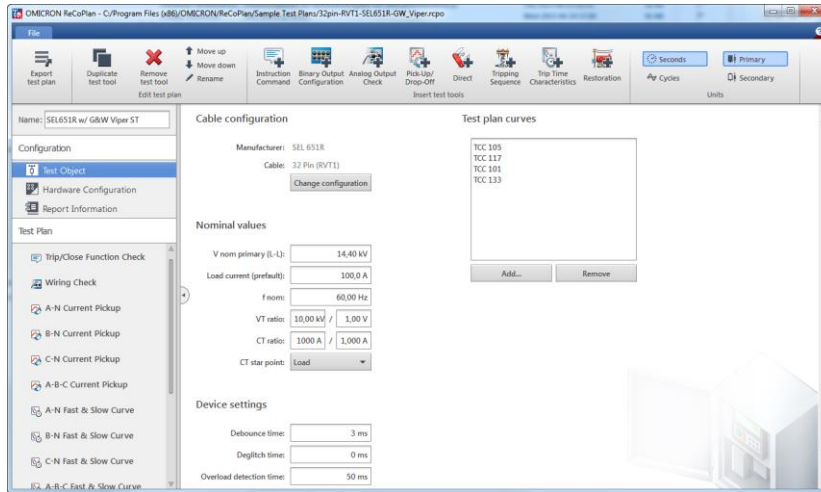


- > Create your own test plans using the PC-based software **ReCoPlan**
- > Using the existing tools of CMControl R

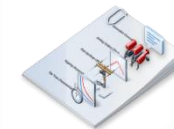
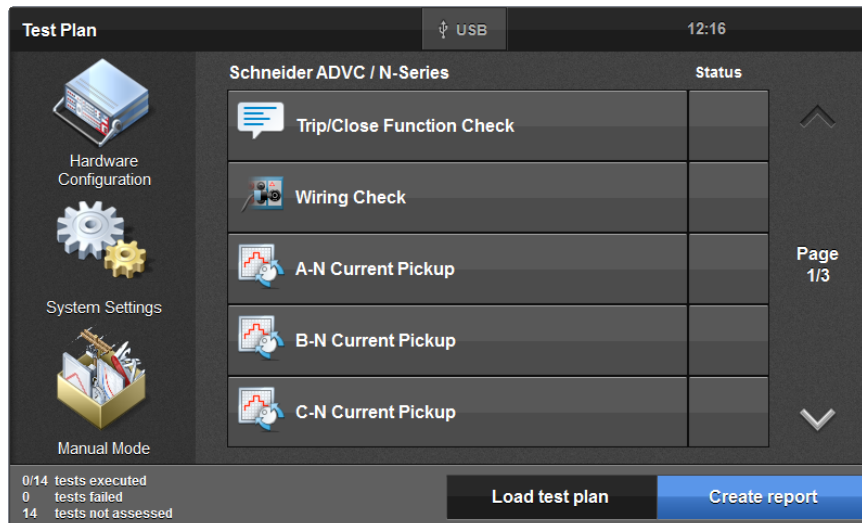


# Test Plan Workflow

## Create test plan with *ReCoPlan*



2. Export  
Export test plan to USB stick



Load on CMControl R  
and execute one by one

## Benefits

- > Create test plans on Windows PC and distribute to all CMControls in the utility to define testing standards
- > Give working instructions to test technician using the Instruction Command tool (e.g. between tests to read values off the front panel, switch breaker position,...)
- > Store several test plans on one CMControl
- > Save time and money with pre-defined test tools and test values for each test
- > Easy to modify existing test plans
- > One combined report after testing

## CMC Test Sets & Test Universe

- > With a CMC test set and Test Universe the user can set up customized tests, which allows e.g. testing of a complex recloser logic. Standard recloser parameters can be tested fully automated using free-of-charge downloadable test templates for dedicated recloser controls



# Automated Test Routines in Test Universe

> Structured recloser parameter user interface

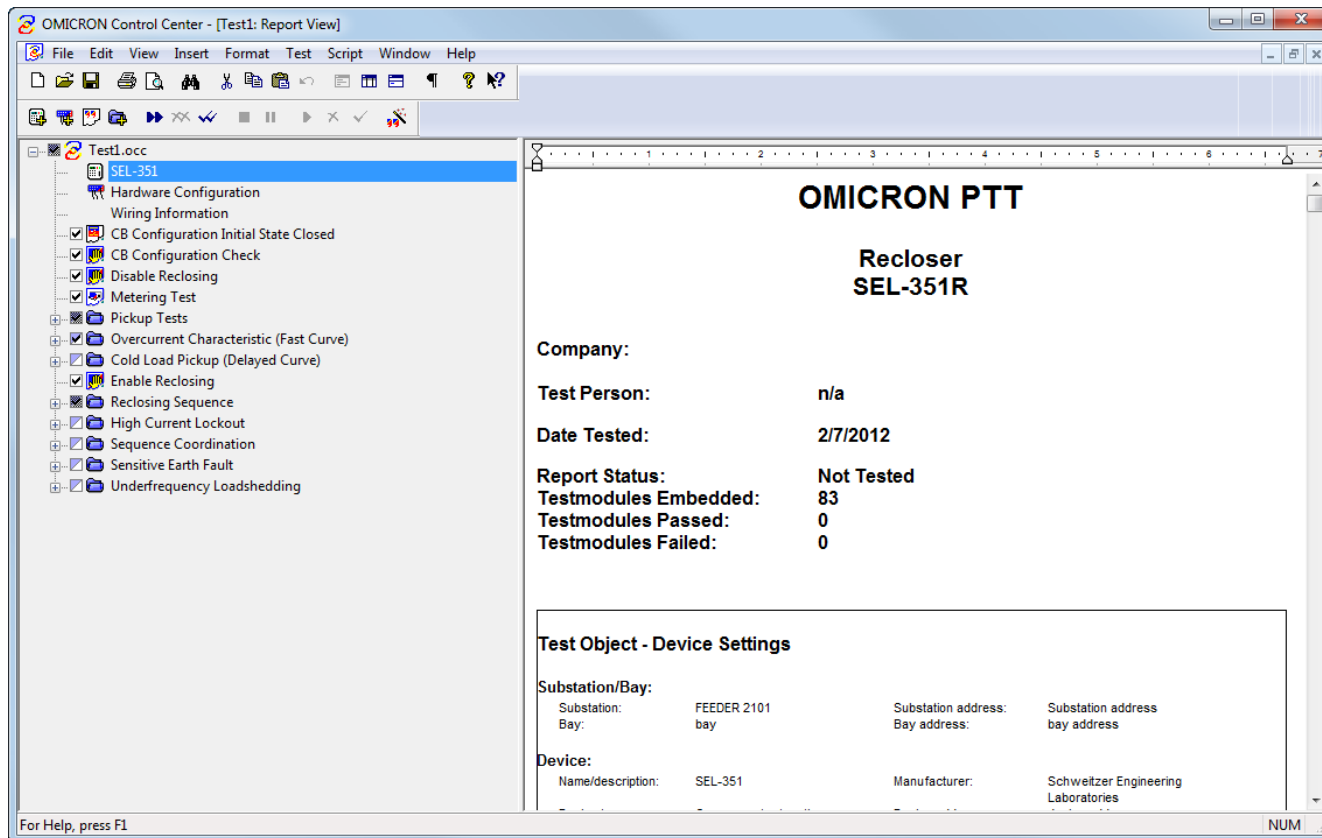
The screenshot shows the 'Test Object' application window. On the left is a tree view of the test object structure, with 'EZ1 Operations and Times' selected. The main area displays a table of parameters for 'EZ1 Operations and Times'.

Stat	Name	Foreign ID	Description	Value	Unit
▶ ✓	TDSEF Time d	TDSEF	Time delay - SEF	0,00	cy
✓	OPPFC Operati	OPPFC	Operations - phase fast curve	2	
✓	OPGFC Operat	OPGFC	Operations - ground fast curve	2	
✓	OPTLPHASE O	OPTLPHA	Operations to lockout - phase	4	
✓	OPTLGND Ope	OPTLGND	Operations to lockout - ground	4	
✓	OPTLSEF Oper	OPTLSEF	Operations to lockout - SEF	+inf	
✓	RCL1 Reclose i	RCL1	Reclose interval 1	300,00	cy
✓	RCL2 Reclose i	RCL2	Reclose interval 2	600,00	cy
✓	RCL3 Reclose i	RCL3	Reclose interval 3	600,00	cy
✓	RCL4 Reclose i	RCL4	Reclose interval 4	0,00	cy
✓	RTAR Reset ti	RTAR	Reset time for auto-reclose	1800,00	cy
✓	RTLO Reset ti	RTLO	Reset time from lockout	600,00	cy
✓	CPWT Close p	CPWT	Close power wait time	900,00	cy

At the bottom of the window, there is a status bar showing 'I: 0 W: 0 E: 0' and a green checkmark icon. The 'OK' and 'Cancel' buttons are visible in the bottom right corner.

# Automated Test Routines in Test Universe

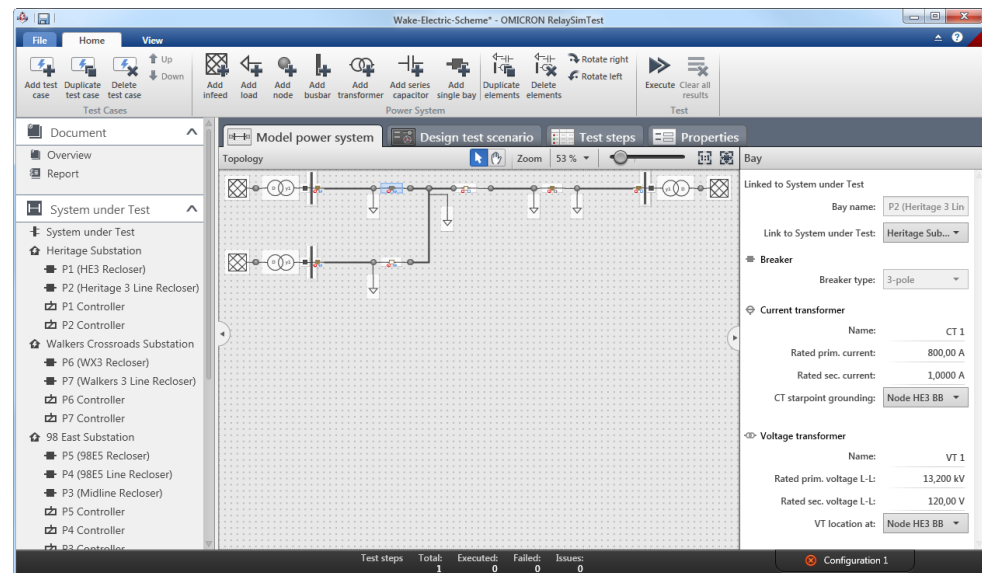
- > Once the parameters are entered, the whole test can be run at once with a single click



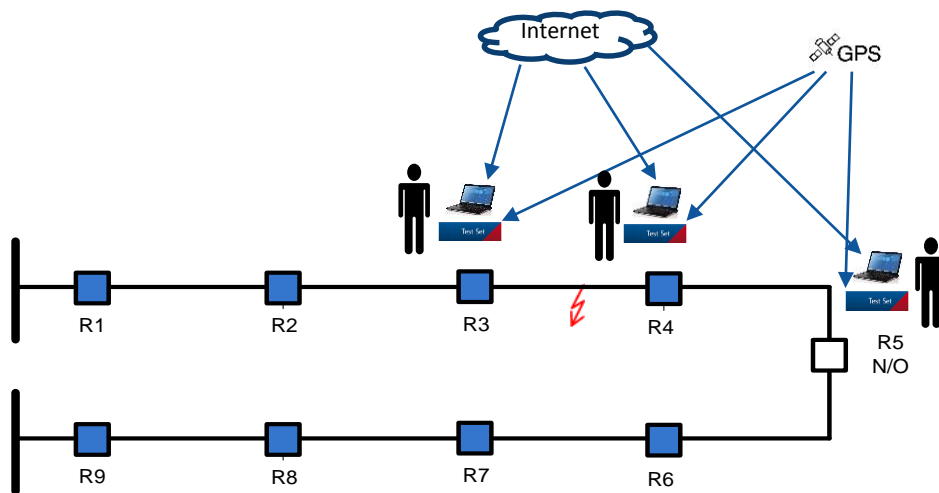


# Skúš. zariadenia CMC & RelaySimTest

- > With multiple **GPS-synchronized CMC test sets** and **RelaySimTest** automated restoration schemes can be tested easily. The software calculates transient signals for different faults at different locations in the distribution grid.



# Skúšky kompl. systému pomocou RelaySimTest



- > Communication to remote CMCs via Internet (e.g. Mobile Phone Data Service)
- > Only 1 test file
- > Immediate analysis of results from all locations in one SW
- > Easy troubleshooting
- > Control several test sets
- > Synchronized via PTP IEEE 1588

# Záver

**Reclosers and Sectionalizers** are widely used and need **to be tested** to ensure a reliable distribution grid

- > **OMICRON** offers a wide range of **interfacing cables to recloser** controls of different manufacturers for easy testing
- > **Test Universe** and **CMControl R** provide the required testing functionality for manufacturers and all types of users
- > **RelaySimTest** allows testing of automated restoration schemes under real-life conditions

