# **OPF-RA** Remedial Action Determination Using OPF

OPF-RA is an add-on module for VSAT. It can help identify measures to alleviate thermal and voltage stability violations of a power system under pre- and post-contingency conditions.



OPF-RA is integrated with VSAT, providing a user-friendly interface and seamless interaction with VSAT models and data, as well as the relevant VSAT analysis options. The resulting powerflow case with the RA implemented can be directly opened by other DSA*Tools*<sup>™</sup> modules for further studies.

## **APPROACH**

Whereas conventional remedial action studies for resolving thermal and voltage insecurity issues rely on significant human effort by systematically adjusting system control settings to reach a satisfactory solution, OPF-RA formulates and solves an optimal powerflow (OPF) problem, which automatically determines the appropriate remedial actions enough to bring the system back to security, based on a set of user-defined controls and system operational criteria.

### OPF-RA is based on the following techniques:

- Full AC OPF formulation
- Robust primal-dual interior-point solution algorithm

### Control measures incorporated into OPF-RA:

- Generator voltage settings
- SVC/shunt voltage settings
- Switchable shunts
- Transformer taps
- Generator active power dispatches
- Load shedding

#### Types of constraints enforceable in OPF-RA:

- Bus voltage limits
- Branch thermal limits (MVA, Ampere, MW, MVAr)
- Interface flow limits (MVA and MVAr)
- Generator MW and MVAr limits
- Switchable, continuous/discrete shunt limits
- Transformer tap limits
- Load shedding limits
- All contingencies supported by VSAT

## **APPLICATIONS**

OPF-RA's fast and efficient solution algorithm allows system planners and operators to solve various power systems problems, such as:

- Relieve base-case and post-contingency thermal and voltage stability violations
- Maximize system power transfer capability
- Improve system voltage profile



## **PRODUCT FEATURES:**

- Fully integrated with VSAT in terms of UI, input data compatibility, and computation engine
- Identification of remedial actions to resolve thermal and voltage stability violations
- Complementary to the existing sensitivity-base RA method in VSAT
- Capable of handling systems of very large size (up to 100,000 buses)
- Robust and highly efficient solver
- Customizable optimization and solution parameters

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## **OPF-RA** Optimal Power Flow Remedial Actions

B Scenario Powerflow	Rened	ial Control									
Powerflow Re-Conditioning Parameter In Transfer	Rene	dial Control File	C:\DPF\	IEEE59VEEE53.mc			Enabled Controls Generator voltage settings SVE/shunt voltage settings Svitchable shunts				
In Otteria	Name	1	RA OPF								
Margin	Detci										
Contingency	pion	IEEE 59 test case				Transformer tap settings					
Script							Load shedding				
- D Full-set	and services and				1	Generation dispatch					
Screening Parameter		oproach	-								
Montor	Os	ensitivity based	۲	OPF based							
hterface	1 Court	Control Groups					Composition of Group 5				
Generator Capability	Lon						+ ~				
Generator Coupling	+	+ ~ X					1.59				
Governor Response	No	Туре		OPF Pre-Ctg Mode	OPF Pos-Ctg Mode						
Load Conversion	1	Generation re-di		Optimizable	Optimizable						
h Load Swap		2 Generator volta		Local	Local						
Branch Rating	3	Switchable shurt Transformer tag		Optimizable	Local						
Modal Analysis Parameter		SVC/shunt voits		Optimizable Frozen	Optimizable						
	2	SVUranunt vota	2e	Telaten	Inoces						
Control Mode											
Control Mode SPS											
Control Mode											

Remedial A	ction									-		>
file Run												
Select Scenario 1 · IEEE59_0PF						(2D scenarios a	(betfimo ev					
Select the Operating Point by specifying the value of Source X: 1025												
Results												
Device	Control	Bus_Num	ID Ar	ea_Num	After_RA	Before_RA	Change	Bus_Name		Area	Name	
Gen	NW	29	1	1	0.6	0.1	0.5	ARTHU-GN	13.8	NTC .	AREA	
	MA	31		1	1.0			ARTHU-GN	13.8			
Gen	NOT	32	1	1	1.0			ARTHU-GN	13.8			
Gen	107	33	1	1	1.0			ARTHU-GN	13.8			
Gen	MON	34	1	1	1.0	0.1		ARTHU-GN	13.8			
	ULIC Tap	2		1	0.9878	0.9875		ABELSS-B	138.	NTC :	AREA	
	ULTC Tep	2	1	1	0.9878	0.9875		ABELSS-B	138.	NTC	ADEA	
Xformer	ULTC Tap	7	1	1	0.9886	0.9750	0.0136	ADAMSS-B	138.	NIC :	AREA	
Xformer	ULTC Tap	15	1	1	1.0003	1.0000	0.0003	ALDER-GN	18.5	NTC.	AREA	
Xformer	ULTC Tap	16	1	2	0.9997	1.0000	-0.0003	ALDER.BS	138.	NIC.	AREA	
Xformer	ULTC Tap	16	1	1	0.9997	1.0000	-0.0003	ALCER.BS	138.	NTC .	AREA	
Xformer	ULTC Tap	30	1	1	1.0006	1.0108	-0.0022	ARTHU-BU	230.	NIC	AREA	
Xformer	ULTC Tap	36	1	1	0.9625	0.9608	0.0017	ASSER-GN	18.0	NIC	AREA	
Xformer	ULIC Tap	43	1	1	0.9919	0.9983	-0.0064	ATTLE-GN	18.0	NIC .	AREA	
Xformer	ULIC Tap	52	1	1	0.9509	0.9500	0.0009	AUSTE-GN	18.0	NIC	AREA	
	ULTC Tap	53	1	1	0.9502		0.0002		230.			
Xformer	ULTC Tap	11	1	1	1.0065	1.0061	0.0004	ADLER.BS	138.	NIC	AREA	
Xformer	ULTC Tap	20	1	1	0.9773	0.9770	0.0003	ALLUS.85	138.	NTC	AREA	
Xformer	ULTC Tap	20	1	1	0.9772	0.9770	0.0002	ALLUS.BS	138.	NTC_	AREA	
Xformer	ULTC Tap	21	1	1	0.9306	0.9315	-0.0009	ALLEN. 33	138.	NTC_	AREA	
Xformer	ULTC Tap	21	1	1	0.9305	0.9315	-0.0010	ALLEN.85	138.	NIC	AREA	
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**OPF-RA** Control Selection Dialog

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Freihed	
OPF-RA Solution Result Display Window	

## SPECIFICATIONS AND REQUIREMENTS

• Runs on MS Windows 7/10/server 2012 R2/server 2016

## **OTHER POWERTECH SERVICES**

- Licensing of the power system analysis software package DSA*Tools*™
- Licensing of other software products for utility applications
- Implementation of on-line dynamic security assessment (DSA) systems
- Development of custom software systems
- Development of models for use in power system analysis
- Generator field testing, model development and validation
- Training

• Technical consultancy studies including

Requires VSAT to run

- Development of power system base cases
- System planning and operation studies
- Facility (including renewables) interconnection studies
- Compliancy studies (such as NERC TPL, CIP, UFLS, etc.)
- Post-mortem analysis of system disturbances

## **ABOUT POWERTECH LABS**

Powertech Labs Inc. is one of the largest testing and research laboratories in North America, situated in beautiful British Columbia, Canada. Our 11-acre facility offers 15 different testing labs for a one-stop-shop approach to managing utility generation, transmission and distribution power systems.

Outside of the utilities industry, Powertech provides routine testing capabilities, product development, research and consulting services to support an array of industrial-type operations, electrical equipment manufacturers and automotive original equipment manufacturers.

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