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Memorandum

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TO: WECC REMTF

FROM: Electric Power Research Institute

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SUBJECT: **TEST PROTOCOL FOR BENCHMARKING OF REGC_B+REEC_D MODEL ACROSS SOFTWARE PLATFORMS**

This document describes the proposed test protocol for testing and benchmarking across the commercial software platforms the recently developed REGC_B and REEC_D models. Additionally, the performance of these models will also be compared against the performance of the REGC_A model.

Figure 1 shows the test system setup that will be used for the benchmarking process while Table 1 tabulates the network details.

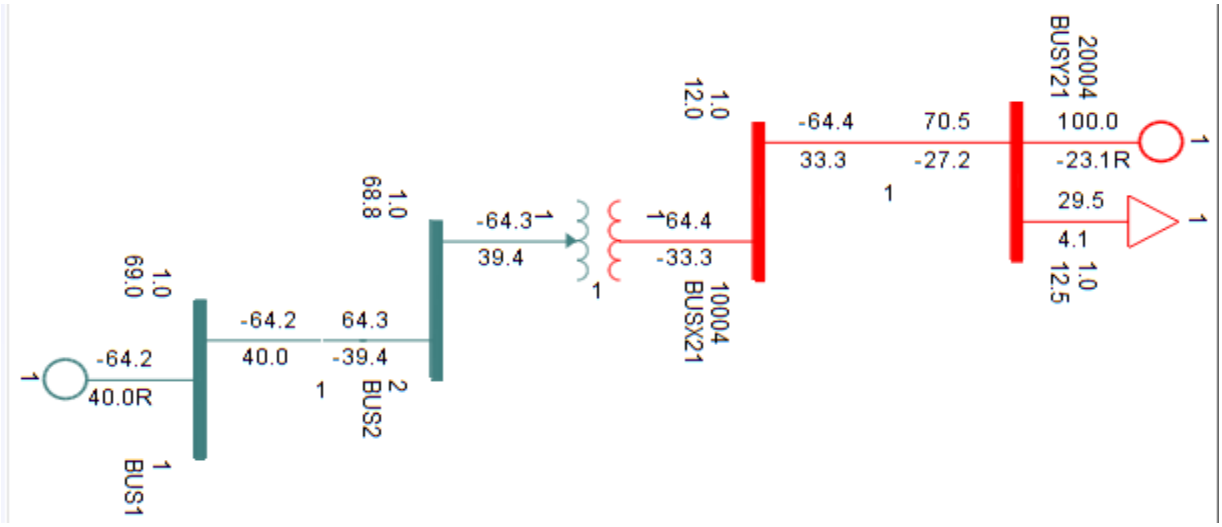

Figure 1
Benchmark test system

Table 1
Details of the network

From Bus	From Bus Name	To Bus	To Bus Name	R (pu)	X (pu)	Charging B (pu)
1	BUS1 69.000	2	BUS2 69.000	0.0025	0.01	0
2	BUS2 69.000	10004	BUSX21 12.470	0.0008	0.106670	
10004	BUSX21 12.470	20004	BUSY21 12.470	0.106670	0.106670	0

The source at Bus 1 will be modeled as a synchronous machine (GENROU) with an excitation system (ESAC4A) whose parameters are provided in Table 6 and Table 7 respectively. In tests 1 and 2, a comparison of the behavior of the REGC_A model with the REGC_B model when used to represent the dynamic behavior of the source at Bus 20004 will be carried out. The MVA base of the source at Bus 20004 and the transformer between Bus 2 and Bus 10004 will be 100 MVA. The load at Bus 20004 can be modeled as constant current load for the active power portion and constant impedance load for the reactive power portion.

Table 2 tabulates the various tests that will be performed in this round of testing the model while Tables 3 and 4 provide values for the parameters of REGC_B and REGC_A (while will be used as a comparison of performance). The time step of integration would be 0.00416s. For all tests, output quantities to be compared would be the active power output of the REGC model, reactive power output of the REGC model, terminal voltage magnitude at bus 20004, and magnitude of current injected by the REGC model.

Table 2
List of various tests to be performed

Test number		**Description**	
Test 1	A-a/b	To test the voltage source interface, apply an X=0.005pu fault on Bus 2 for 8 cycles	$X_{10004\text{-}20004}$ = 0.106pu, GEN_{MVA} = 10000.0, H=5.0
	B-a/b		$X_{10004\text{-}20004}$ = 0.206pu, GEN_{MVA} = 10000.0, H=5.0

	C-a/b		$X_{10004\text{-}20004}$ = 0.406pu, GEN_{MVA} = 10000.0, H=5.0
	D-a/b		$X_{10004\text{-}20004}$ = 0.706pu, GEN_{MVA} = 10000.0, H=5.0
Test 2	A-a/b		$X_{10004\text{-}20004}$ = 0.706pu, GEN_{MVA} = 100.0, H=2.5
	B-b-negative		P_{REGC_B} = -100.0 MW, $X_{10004\text{-}20004}$ = 0.706pu, GEN_{MVA} = 100.0, H=2.5

GEN_{MVA} refers to the generator at bus 1. The small letter *a* denotes that the test is to be run with REGC_A while the small letter *b* denotes that the test is to be run with REGC_B. For example, Test 1A-a denotes Test 1A to be carried out with REGC_A and REEC_D while Test 1A-b denotes Test 1A to be carried out with REGC_B and REEC_D. In these two tests, the REEC_D will be used with PfFlag=0; VFlag = 0; QFlag=0; Vcmpflag=0; PFlag=0. Additionally, the model will be set in Q priority mode.

Table 3
Parameter values of REGC_B

DESCRIPTION	UNITS	Value
Tg	(s),	0.02
rrpwr	(pu/s),	0.5
RateFlag		0
Imax	(pu),	1.2
Tfltr	(s),	0.02
Iqrmax	(pu/s),	0.5
Iqrmin	(pu/s),	-0.5
Te	(s),	0.02
re	(pu),	0.0025
Xe	(pu),	0.2

Table 4
Parameter values of REGC_A

DESCRIPTION	UNITS	Value
Tg	(s),	0.02
rrpwr	(pu/s),	0.5
Brkpt	(pu),	0.8
Zerox	(pu),	0.4
Lvpl1	(pu),	1.2
Volim	(pu),	1.1
Lvpnt1	(pu),	0.8
Lvpnt0	(pu),	0.4
Iolim	(pu),	-1.1
Tfltr	(s),	0.02
Khv		1.0
Iqrmax	(pu/s),	0.5

Iqrmin	(pu/s),	-0.5	Lvplsw		0
Accel		0.9			

The REEC_D model will be used (with varied flag settings) in addition to the REGC_B model. The model will be in Q priority mode for all tests. Further, only the REGC_B model will be used in these subsequent tests with the network configuration as in Test 2.

Test Number	Flag Setting	Description
Test 3	PfFlag=1; VFlag = 0; QFlag=0; Vcmpflag=1; PFlag=0	Step change of 0.1pu in Vref0, $X_{10004\text{-}20004}$ = 0.106pu, GEN_{MVA} = 10000.0, H=5.0
Test 4Ai	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=0; PFlag=0	Step change of 0.2pu in Qext $X_{10004\text{-}20004}$ = 0.106pu, GEN_{MVA} = 10000.0, H=5.0
Test 4Aii	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=0; PFlag=0	Step change of 0.2pu in Qext $X_{10004\text{-}20004}$ = 0.706pu, GEN_{MVA} = 100.0, H=2.5
Test 4Bi	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=1; PFlag=0	Step change of 0.2pu in Qext $X_{10004\text{-}20004}$ = 0.106pu, GEN_{MVA} = 10000.0, H=5.0
Test 4Bii	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=1; PFlag=0	Step change of 0.2pu in Qext $X_{10004\text{-}20004}$ = 0.706pu, GEN_{MVA} = 100.0, H=2.5
Test 5i	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=1; PFlag=0	Step change of 0.2pu in Paux, $X_{10004\text{-}20004}$ = 0.106pu, GEN_{MVA} = 10000.0, H=5.0
Test 5ii	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=1; PFlag=0	Step change of 0.2pu in Paux, $X_{10004\text{-}20004}$ = 0.706pu, GEN_{MVA} = 100.0, H=2.5
Test 6-Q	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=1; PFlag=0; PQpriority = Qpriority	Fault on Bus 2 for 8 cycles with X = 0.005pu, $X_{10004\text{-}20004}$ = 0.206pu, GEN_{MVA} = 100.0, H=2.5
Test 6-P	PfFlag=0; VFlag = 1; QFlag=1; Vcmpflag=1; PFlag=0; PQpriority = Ppriority	Fault on Bus 2 for 8 cycles with X = 0.005pu, $X_{10004\text{-}20004}$ = 0.206pu, GEN_{MVA} = 100.0, H=2.5

The values of parameters for the REEC_D model are as shown in the table below

Table 5
Parameter values for REEC_D

Parameter	Unit	Value

mvab		0
vdip	pu	0.7
vup	pu	1.1
trv	s	0
dbd1	pu	-0.05
dbd2	pu	0.05
kqv		5
iqh1	pu	1.05
iql1	pu	-1.05
vref0	pu	0
iqfrz	pu	0.5
thld	s	0.5
thld2	s	0.5
tp	s	0.05
qvmax	pu	1
qvmin	pu	-1
vmax	pu	1.1
vmin	pu	0.9
kqp		1
kqi		1.5
kvp		1
kvi		40
vref1	pu	0
tiq	s	0.02
dpmax	pu/sec	99
dpmin	pu/sec	-99
pmax	pu	1.12
pmin	pu	0.04
imax	pu	1.2
tpord	s	0.02
rc	pu	0.01
Xe	pu	0.08
Tr1	s	0.02
Kc		0.02
Ke		0
vq1	pu	0.3
iq1	pu	0
vq2	pu	0.4
iq2	pu	0.2
vq3	pu	0.7

iq3	pu	1.0
vq4	pu	0.9
iq4	pu	1.1
vq5	pu	1
iq5	pu	1.1
vq6	pu	1.05
iq6	pu	1.1
vq7	pu	1.15
iq7	pu	1.05
vq8	pu	1.2
iq8	pu	1.05
vq9	pu	1.25
iq9	pu	1.05
vq10	pu	1.3
iq10	pu	0
vp1	pu	0.3
ip1	pu	0
vp2	pu	0.4
ip2	pu	0.2
vp3	pu	0.7
ip3	pu	1.0
vp4	pu	0.9
ip4	pu	1.1
vp5	pu	1
ip5	pu	1.1
vp6	pu	1.05
ip6	pu	1.1
vp7	pu	1.15
ip7	pu	1.05
vp8	pu	1.2
ip8	pu	1.05
vp9	pu	1.25
ip9	pu	1.05
vp10	pu	1.3
ip10	pu	0
vblkl	pu	0.5
vblkh	pu	1.2
Tblk	s	0.5

Table 6
Parameter values for GENROU

Parameter	Unit	Value
MVA base	MVA	as specified in the test description
Xd	pu	2.0
Xq	pu	1.9
X'd	pu	0.2
X'q	pu	0.5
X"d=X"q	pu	0.18
Xl	pu	0.15
T'd0	s	7.0
T"d0	s	0.03
T'q0	s	0.5
T"q0	s	0.05
H	s	as specified in the test description
D		0.0
Ra	pu	0.0
S1		0.05
S2		0.3
No current compensation		

Table 7
Parameter values for ESAC4A

Parameter	Unit	Value
Tr	s	0.03
Vimax	pu	999
Vimin	pu	-999
Tc	s	1
Tb	s	10
Ka	pu	200
Ta	s	0.03
Vrmax	pu	8
Vrmin	pu	-8
Kc	pu	0.05