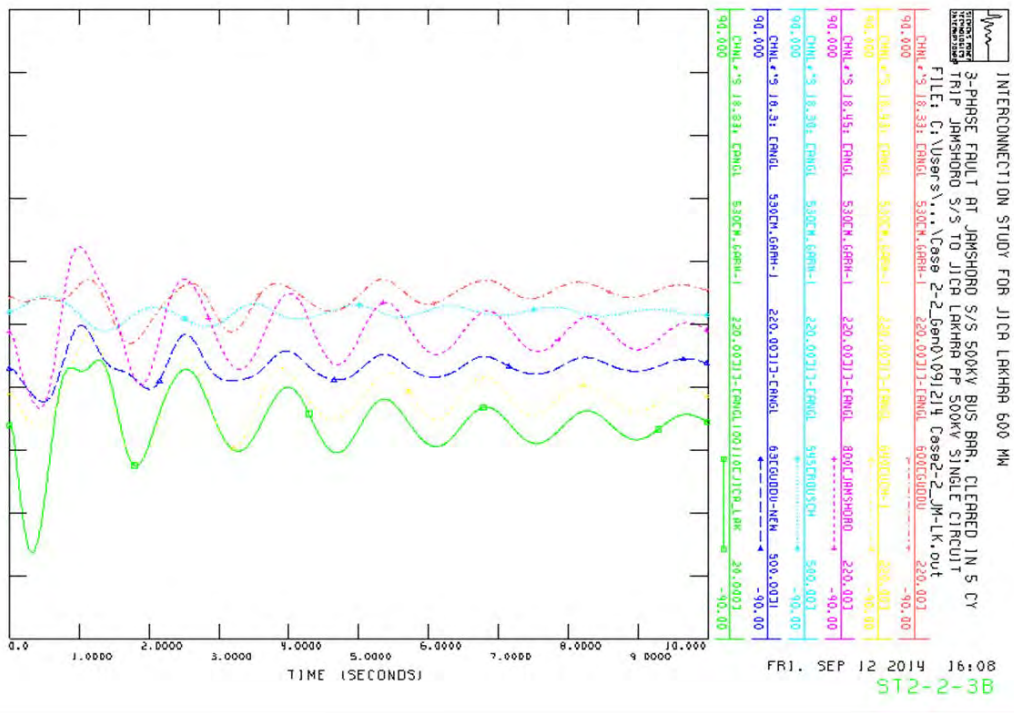
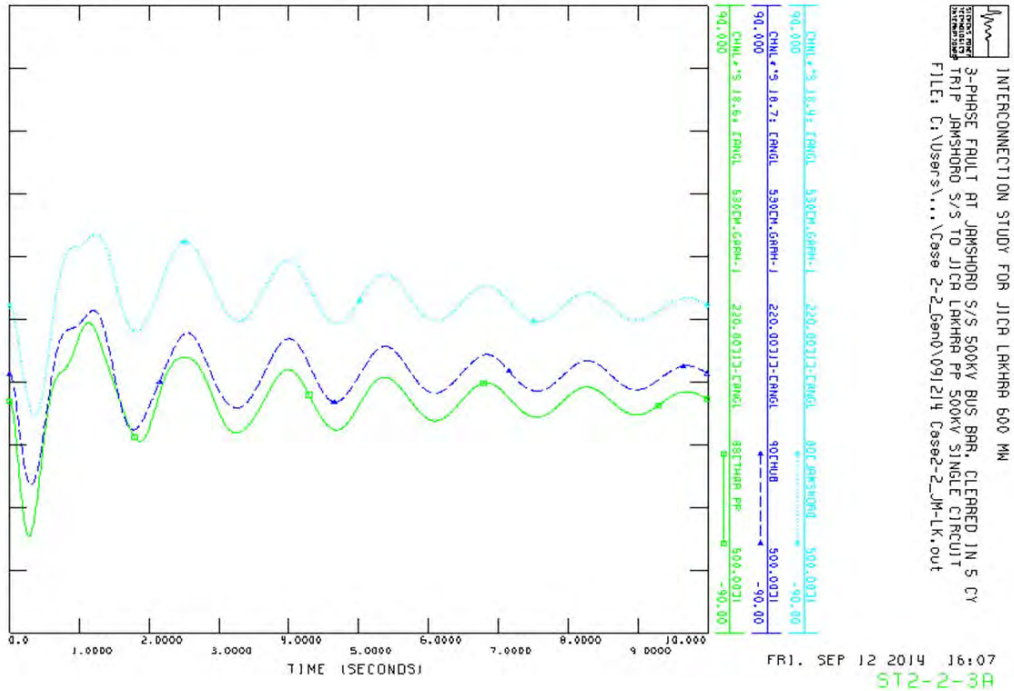


6 - 3 STABILITY ANALYSIS CASE ST2-2

Stability Analysis Result Case ST-2-2

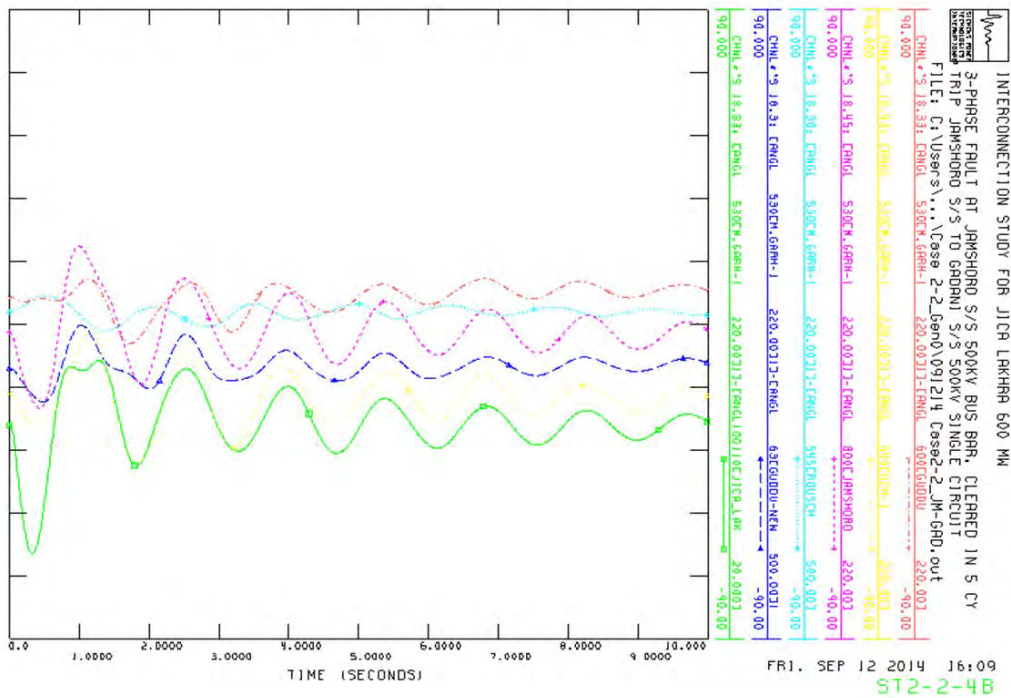
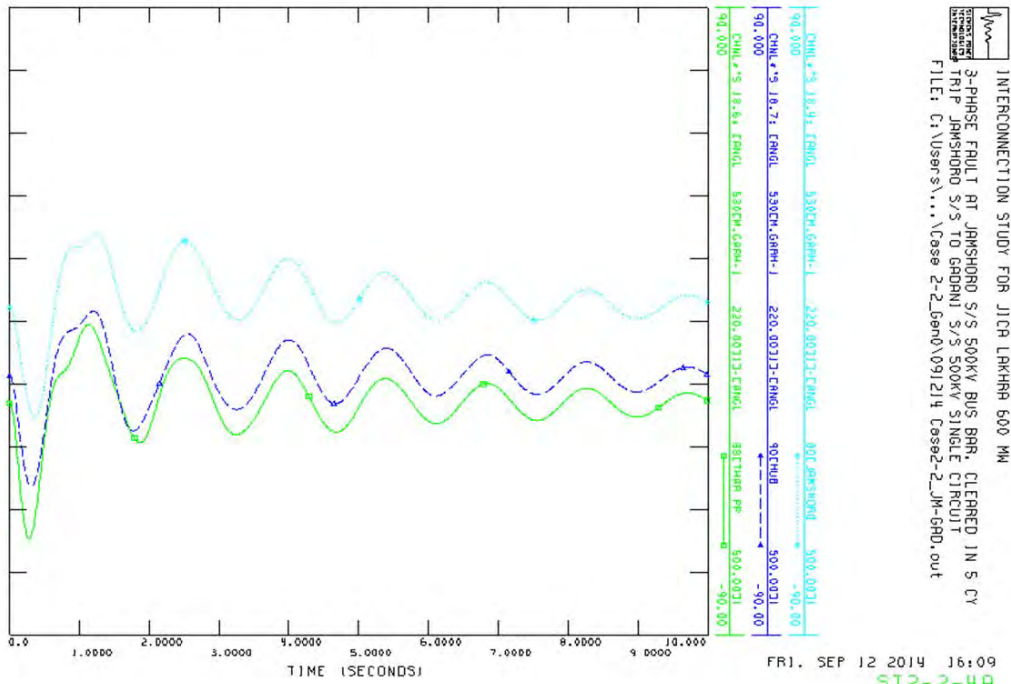
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – JICA Lakhra PP

Stability Analysis Result Case ST-2-2

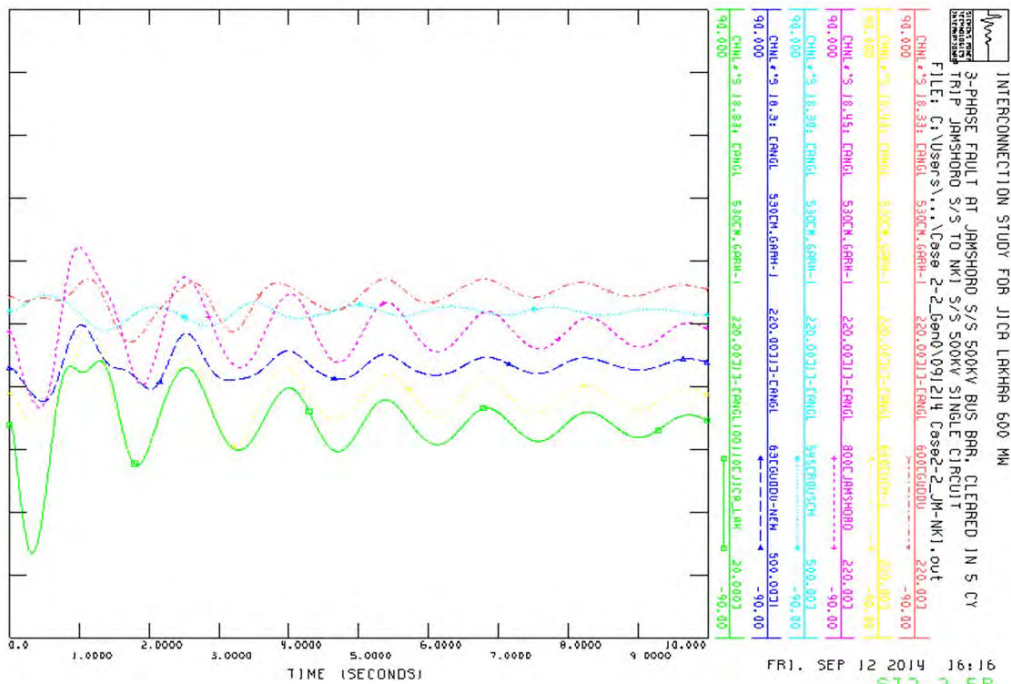
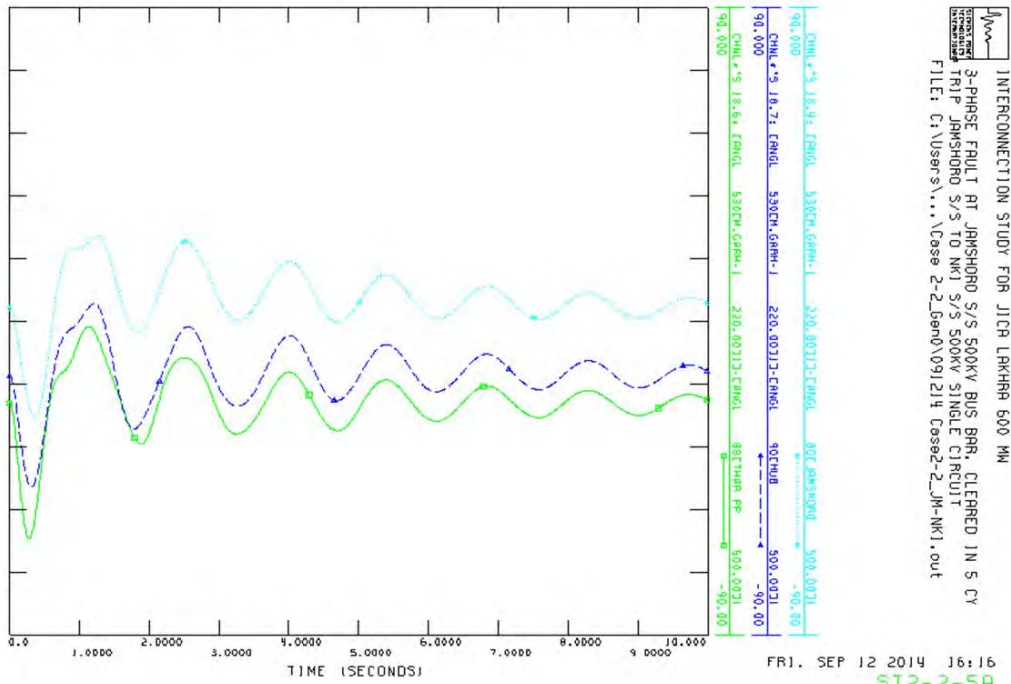
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – Gadani S/S

Stability Analysis Result Case ST-2-2

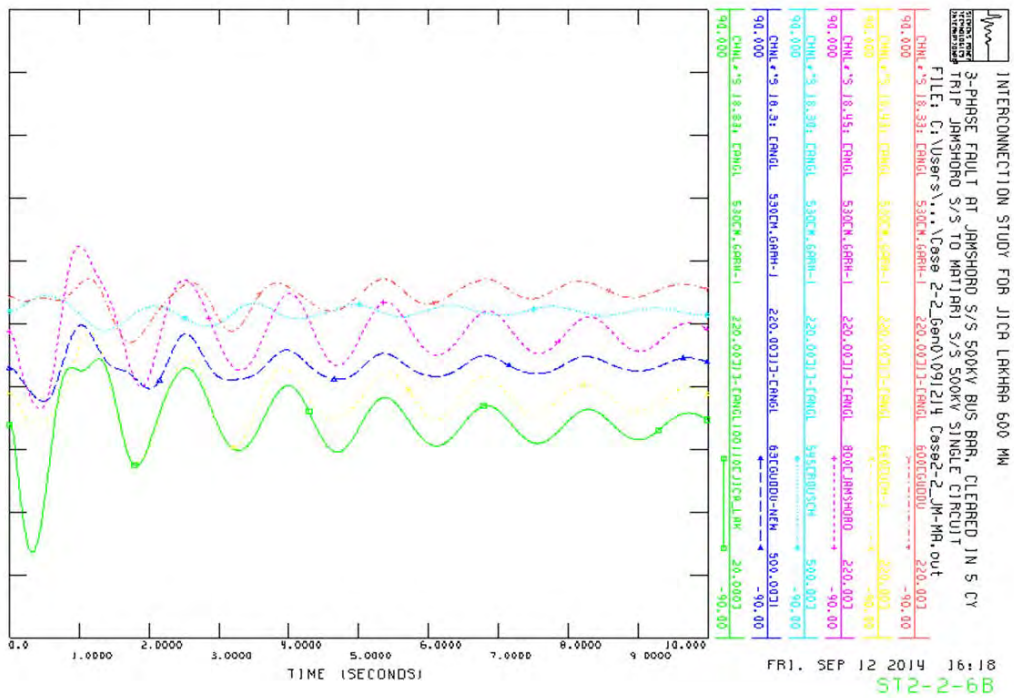
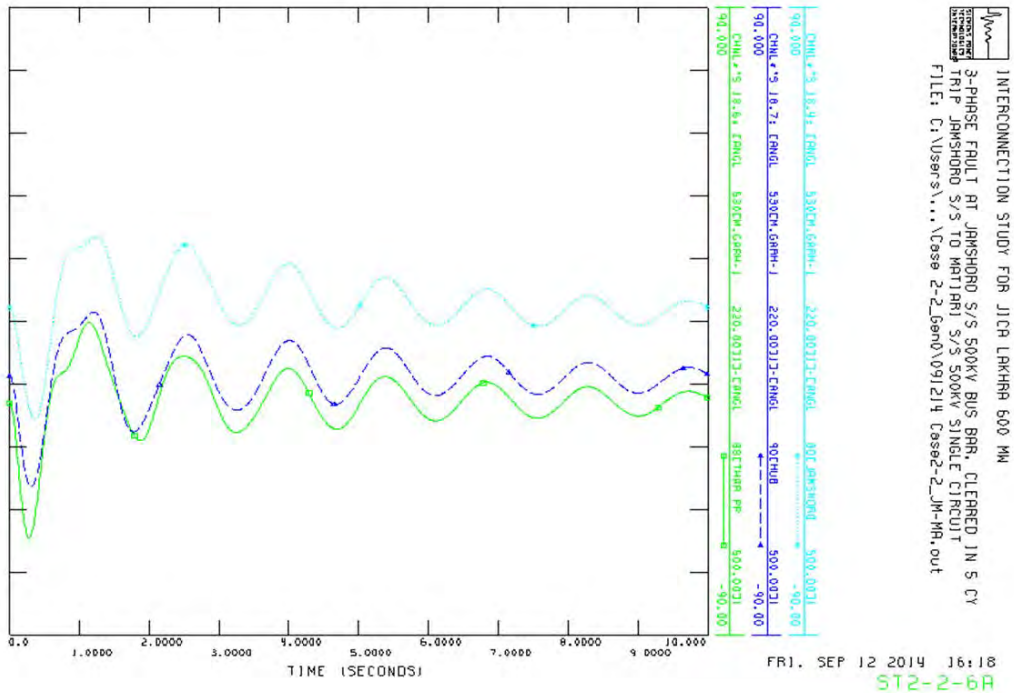
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – NKI S/S

Stability Analysis Result Case ST-2-2

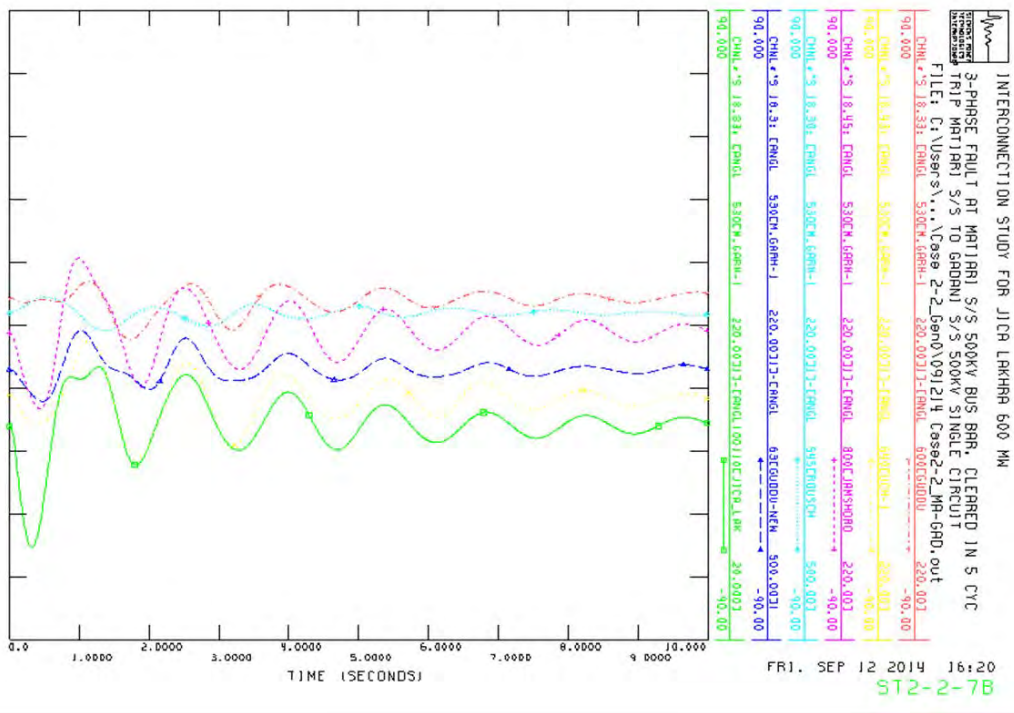
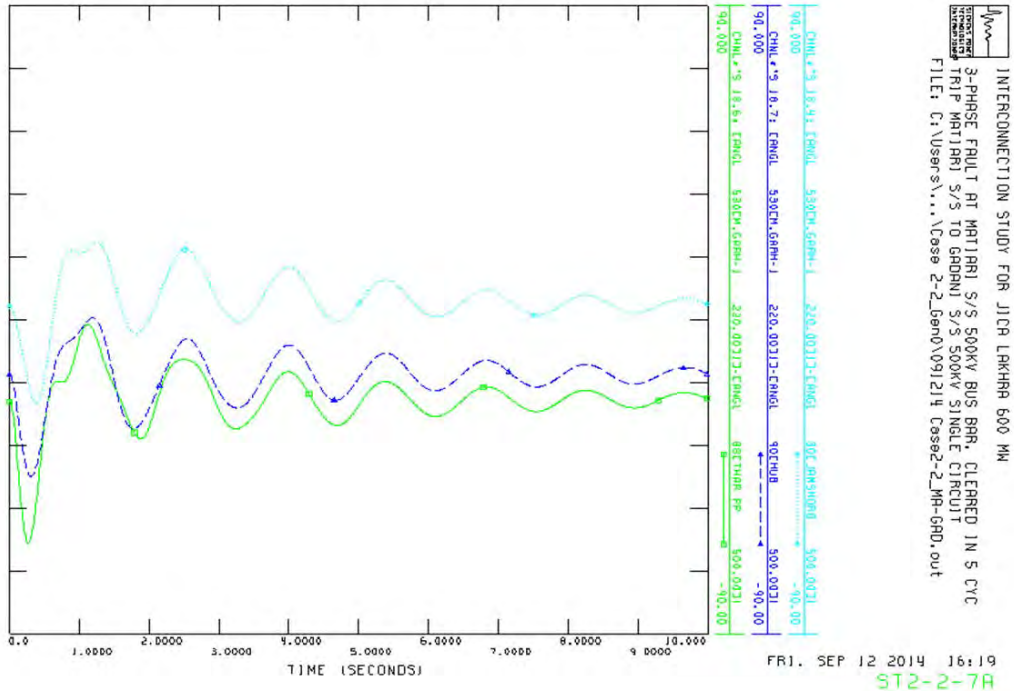
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – Matiari S/S

Stability Analysis Result Case ST-2-2

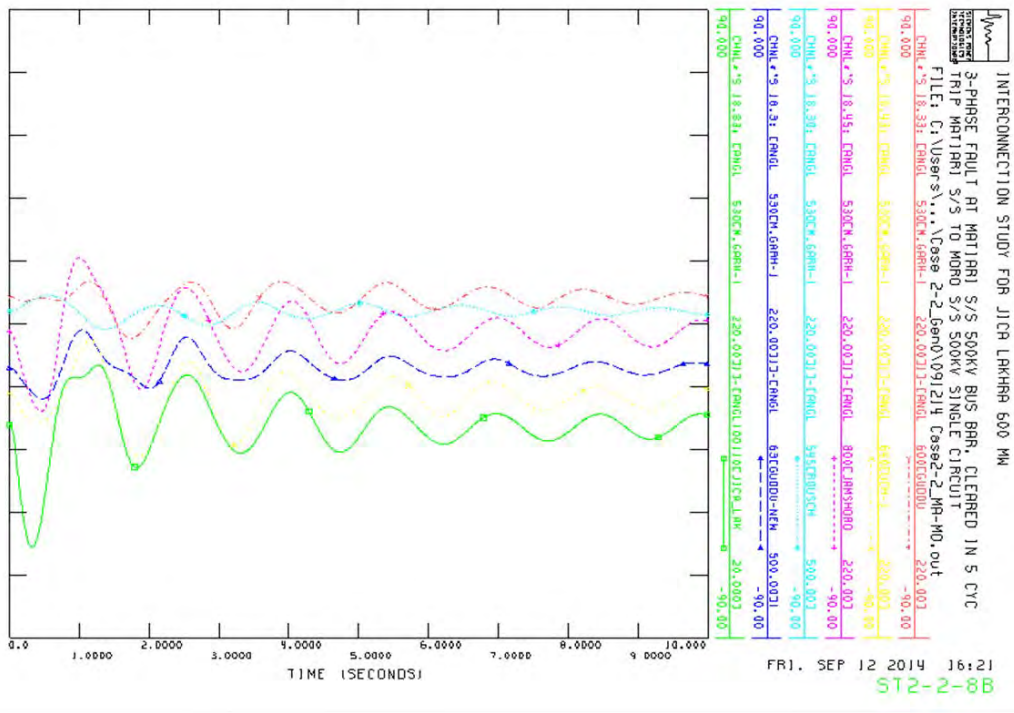
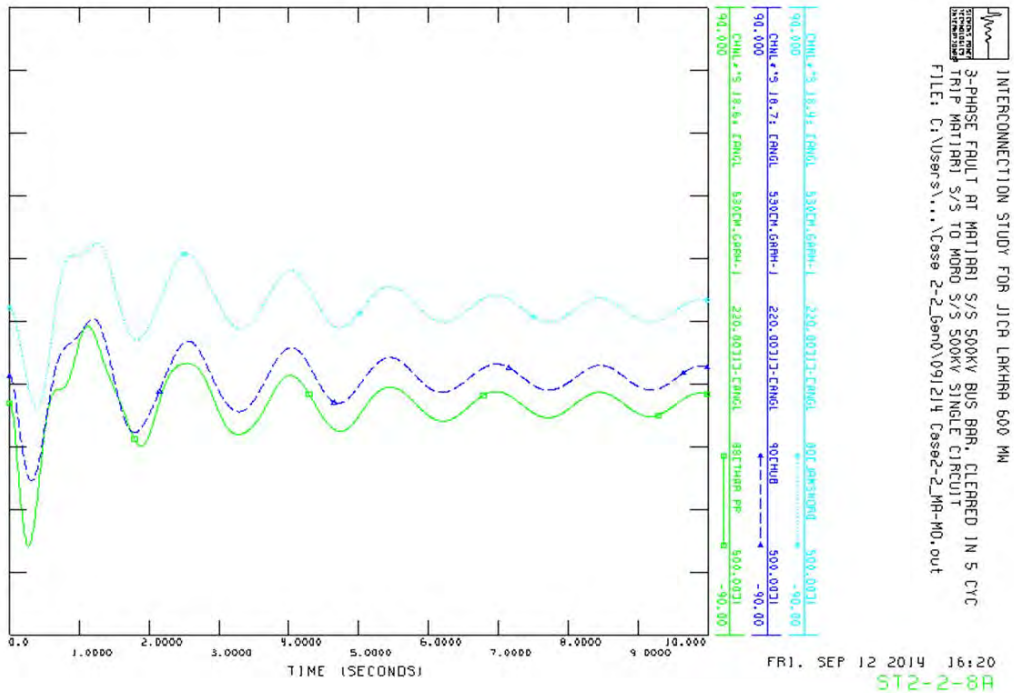
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Matiari S/S – Gadani S/S

Stability Analysis Result Case ST-2-2

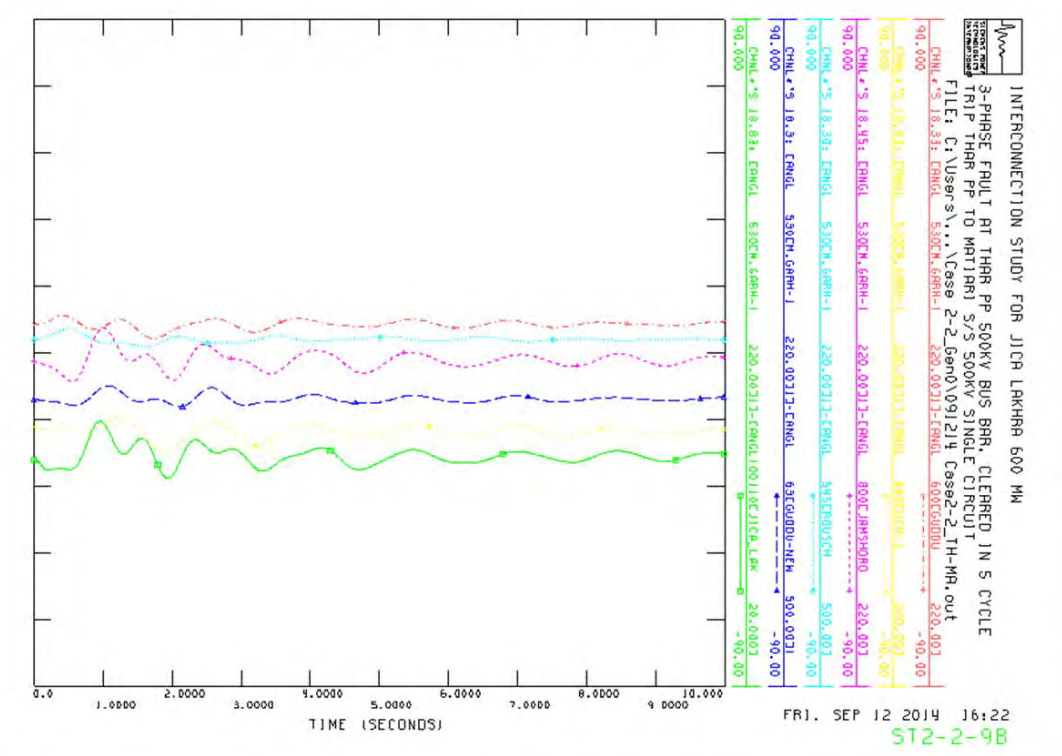
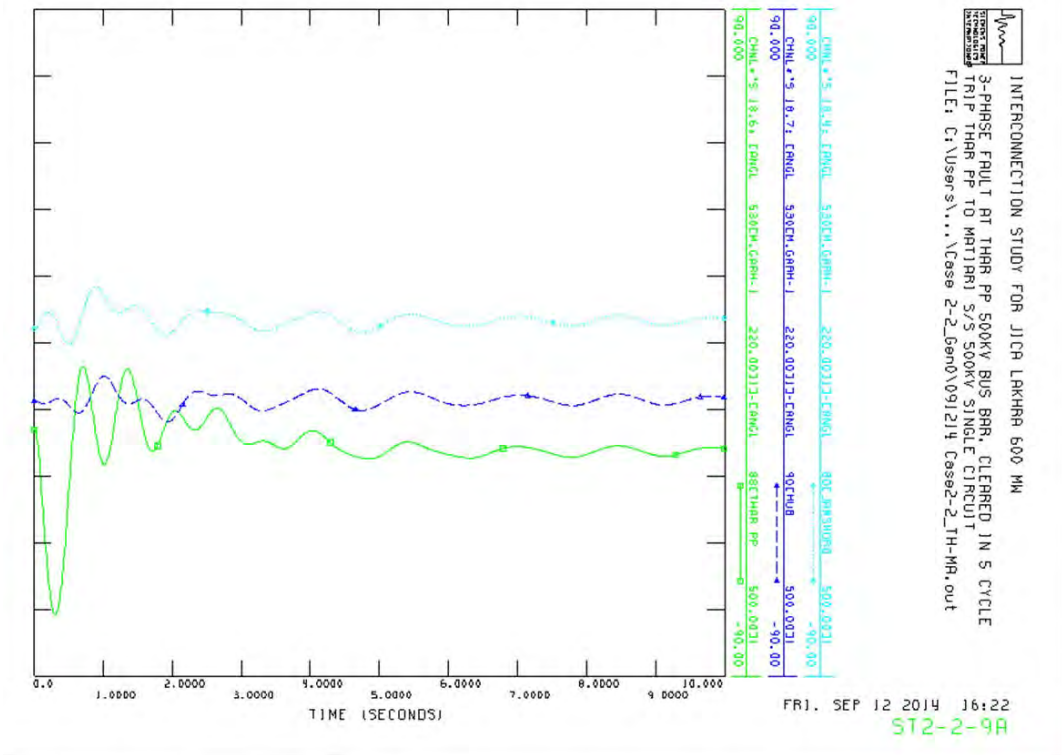
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Matiari S/S – Moro S/S

Stability Analysis Result Case ST-2-2

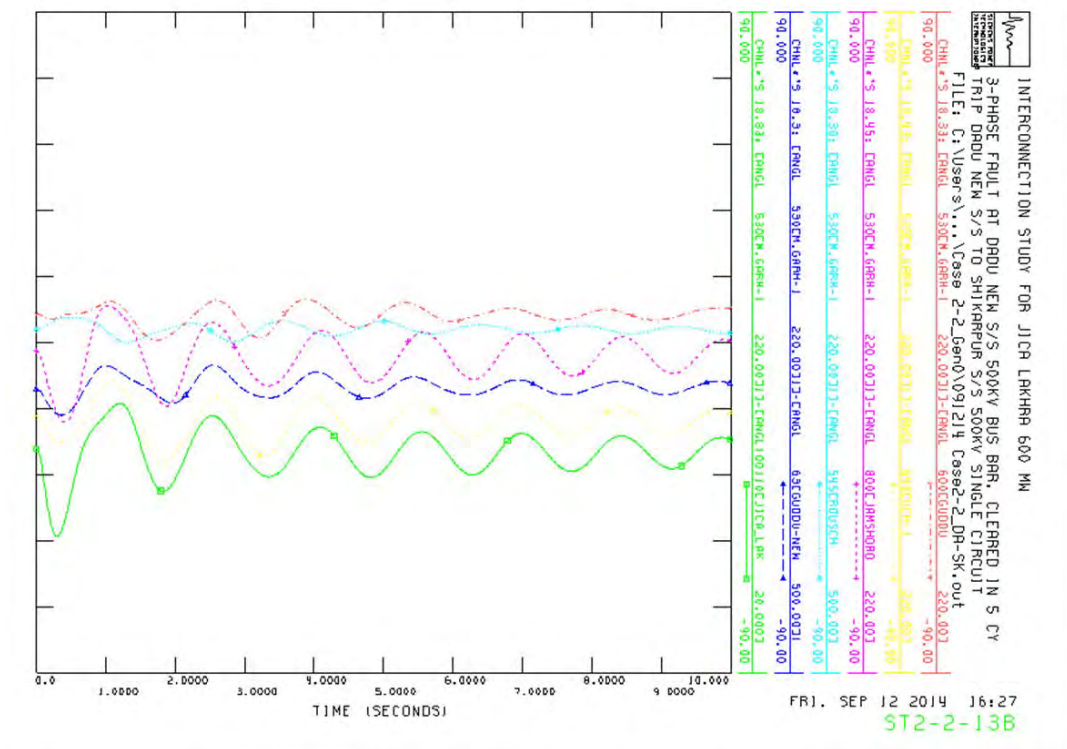
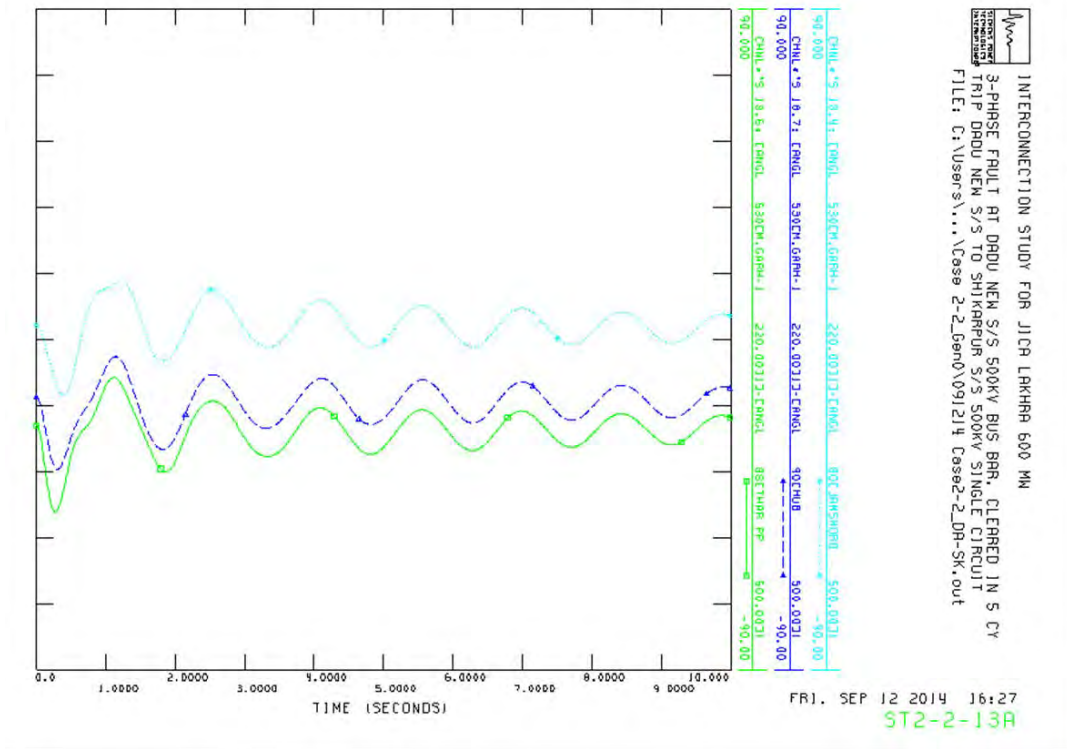
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Thar PP – Matiari S/S

Stability Analysis Result Case ST-2-2

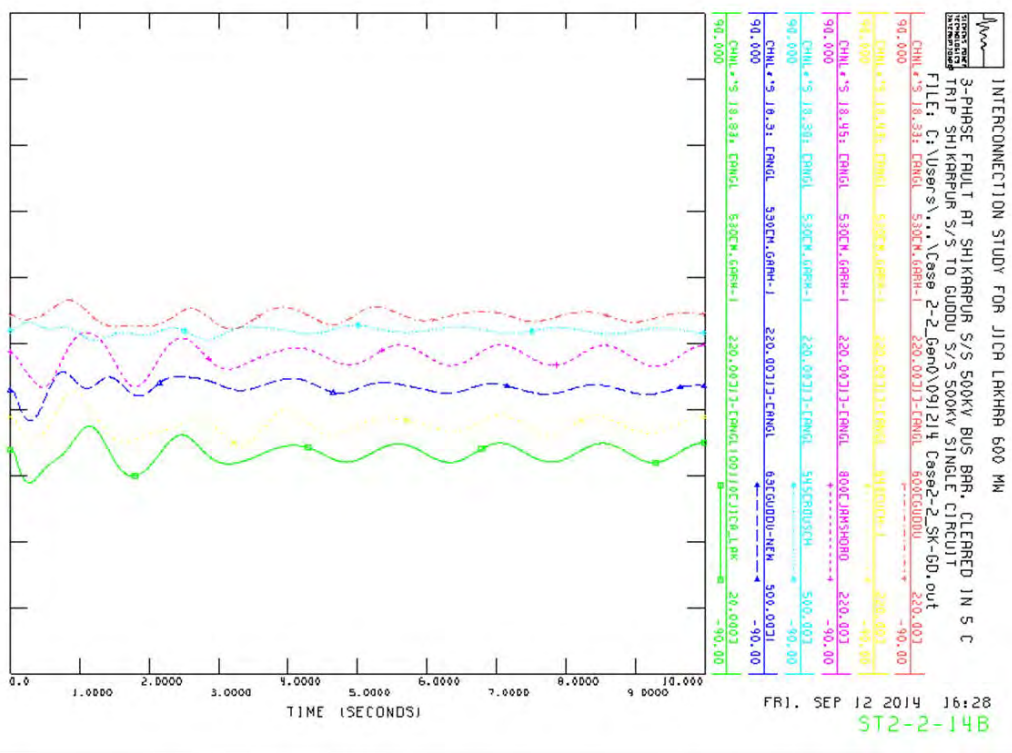
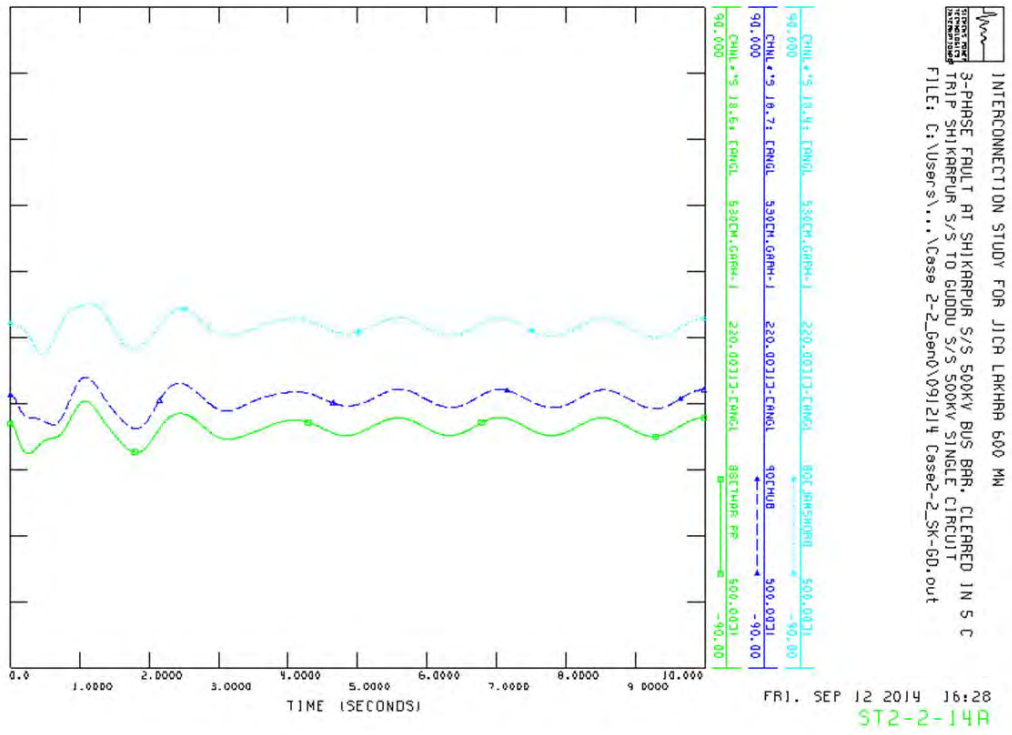
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Dadu New S/S – Shikarpur S/S

Stability Analysis Result Case ST-2-2

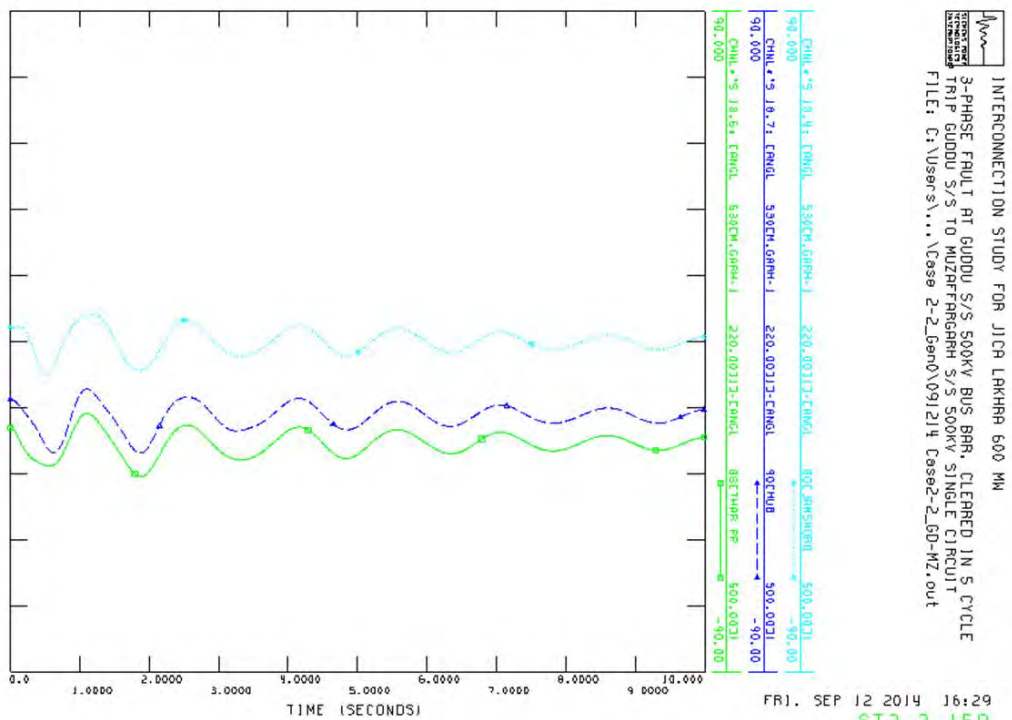
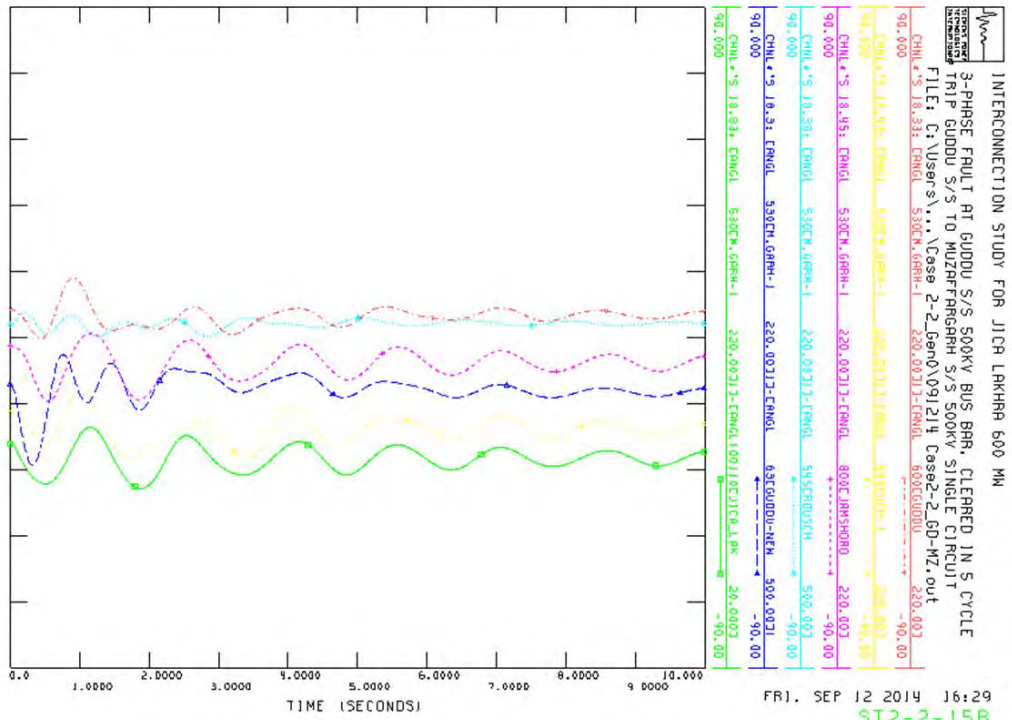
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Shikarpur S/S – Guddu S/S

Stability Analysis Result Case ST-2-2

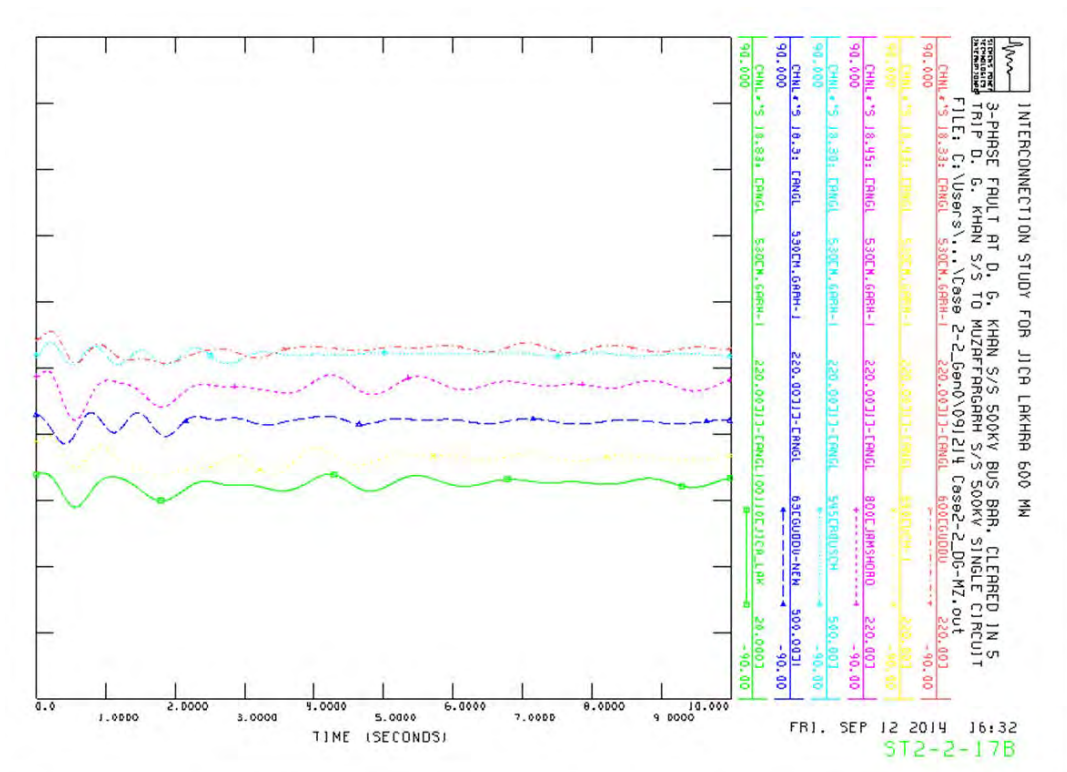
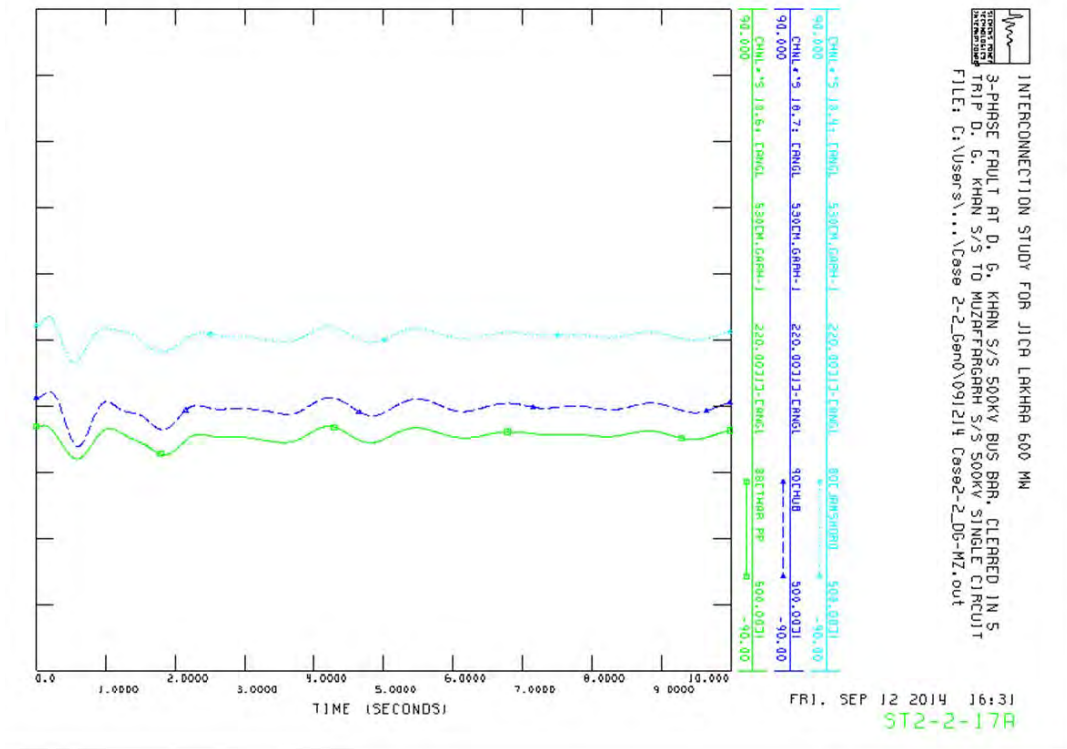
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Guddu S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-2-2

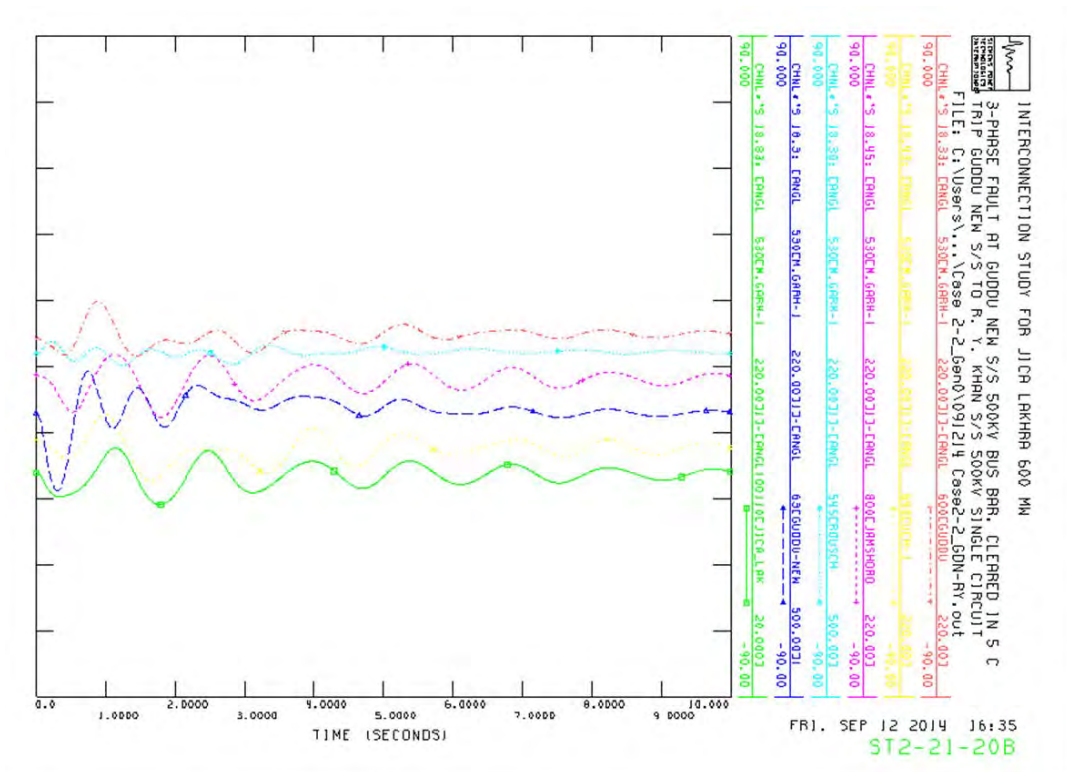
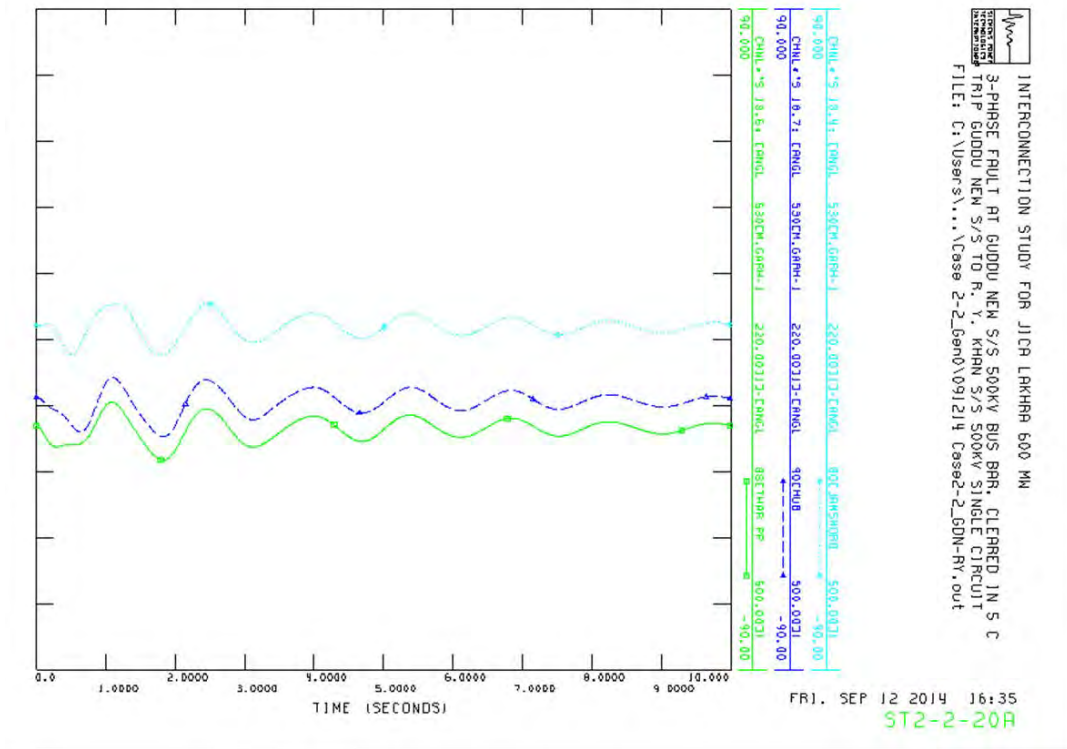
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: D. G. Khan S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-2-2

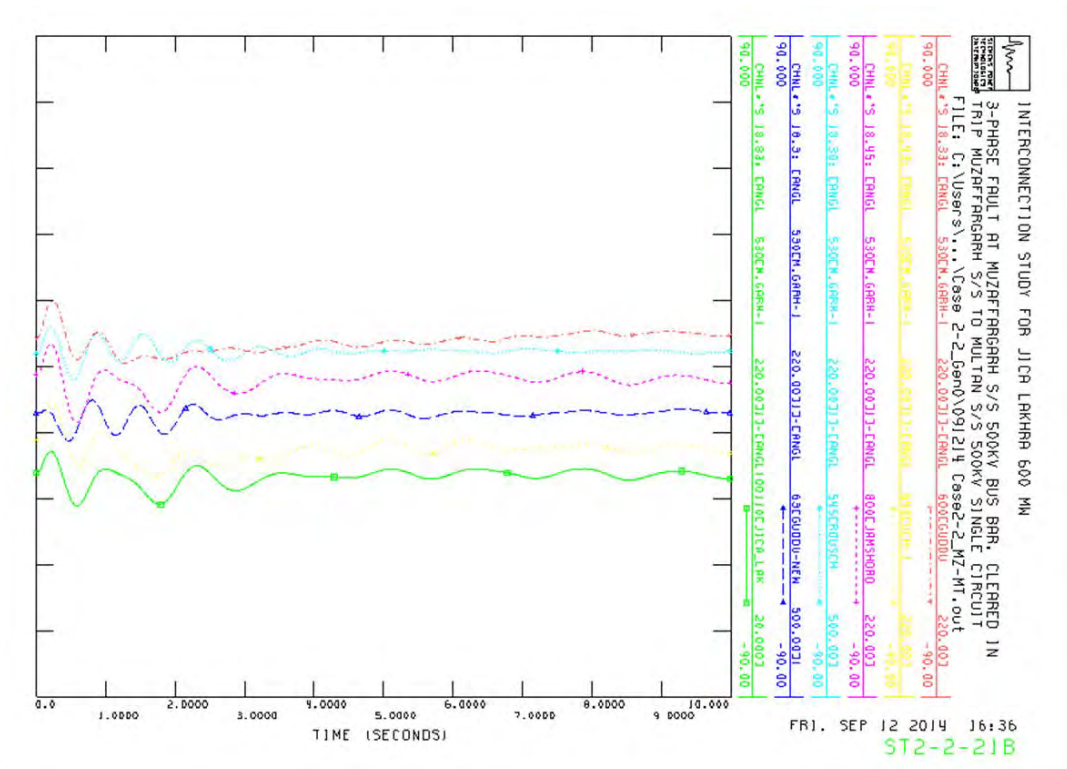
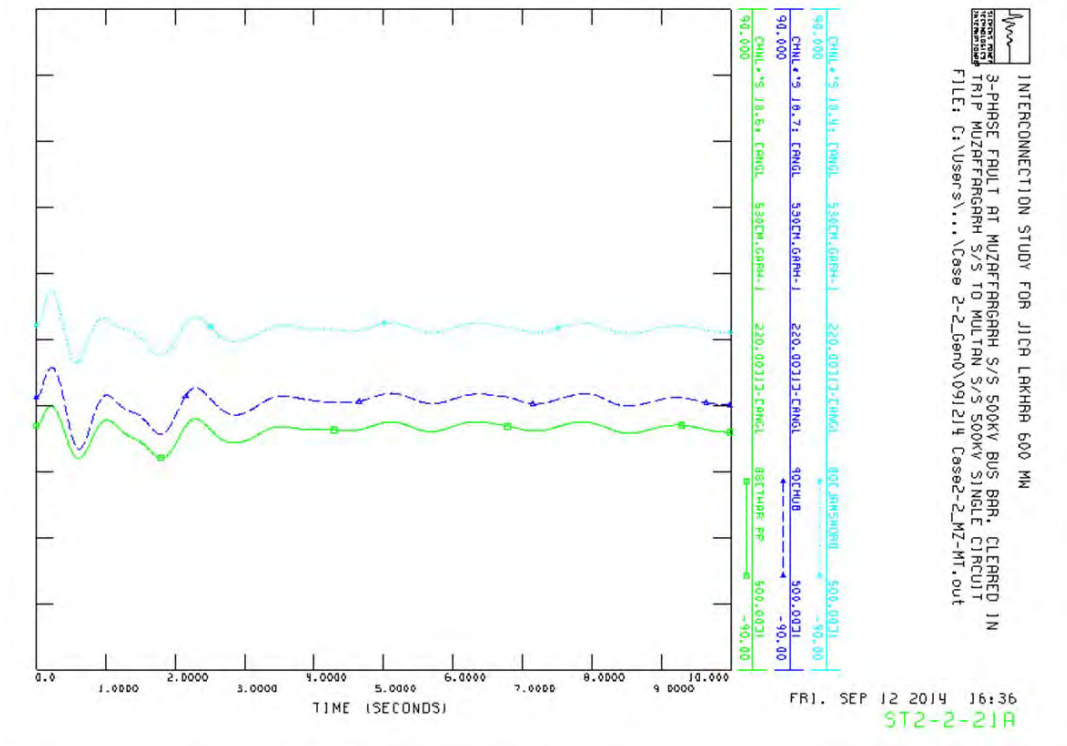
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Guddu New PP – R. Y. Khan S/S

Stability Analysis Result Case ST-2-2

(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Muzaffargarh S/S – Multan S/S

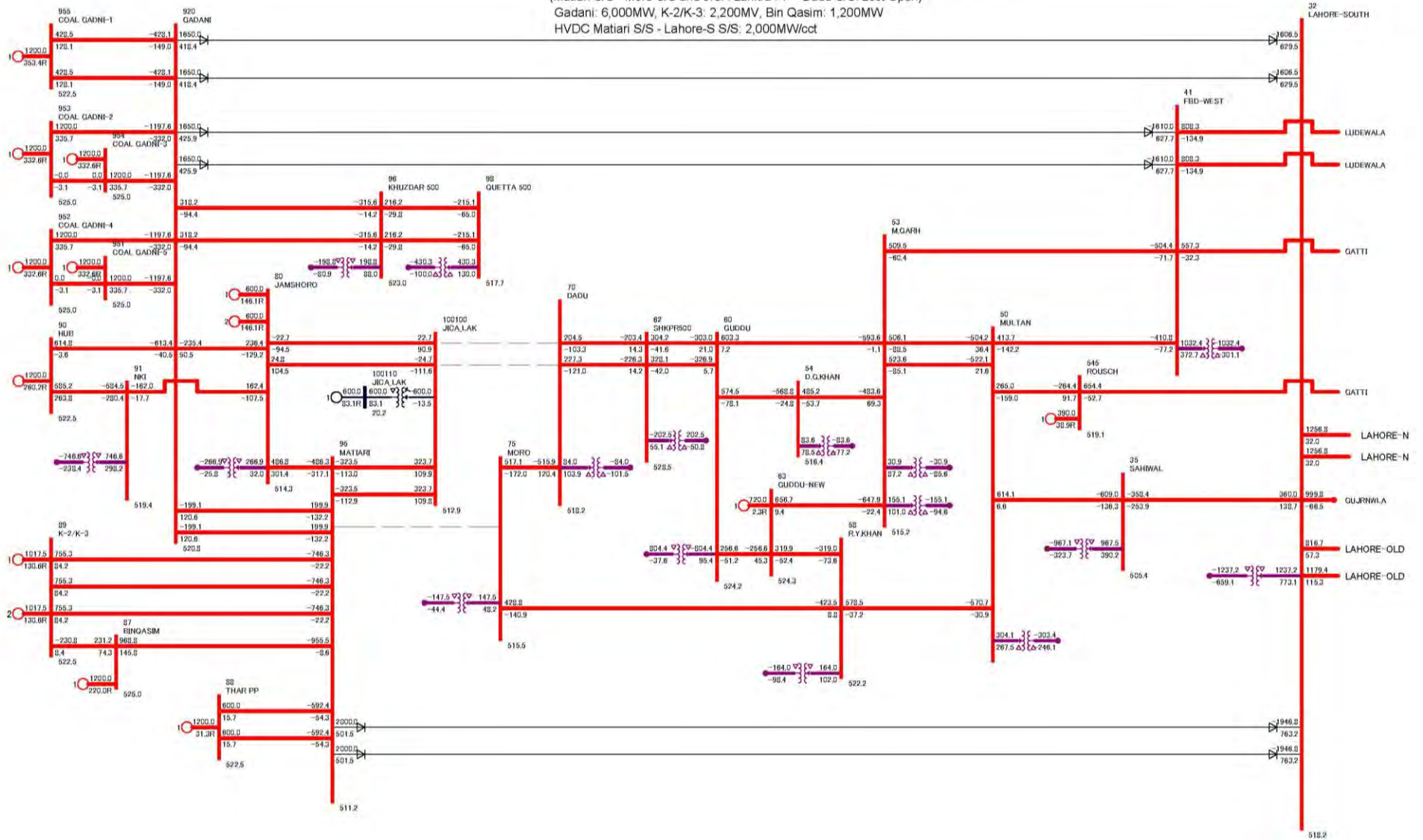
6 - 4 STABILITY ANALYSIS CASE ST3-1

Stability Analysis Result Case ST-3-1

(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)

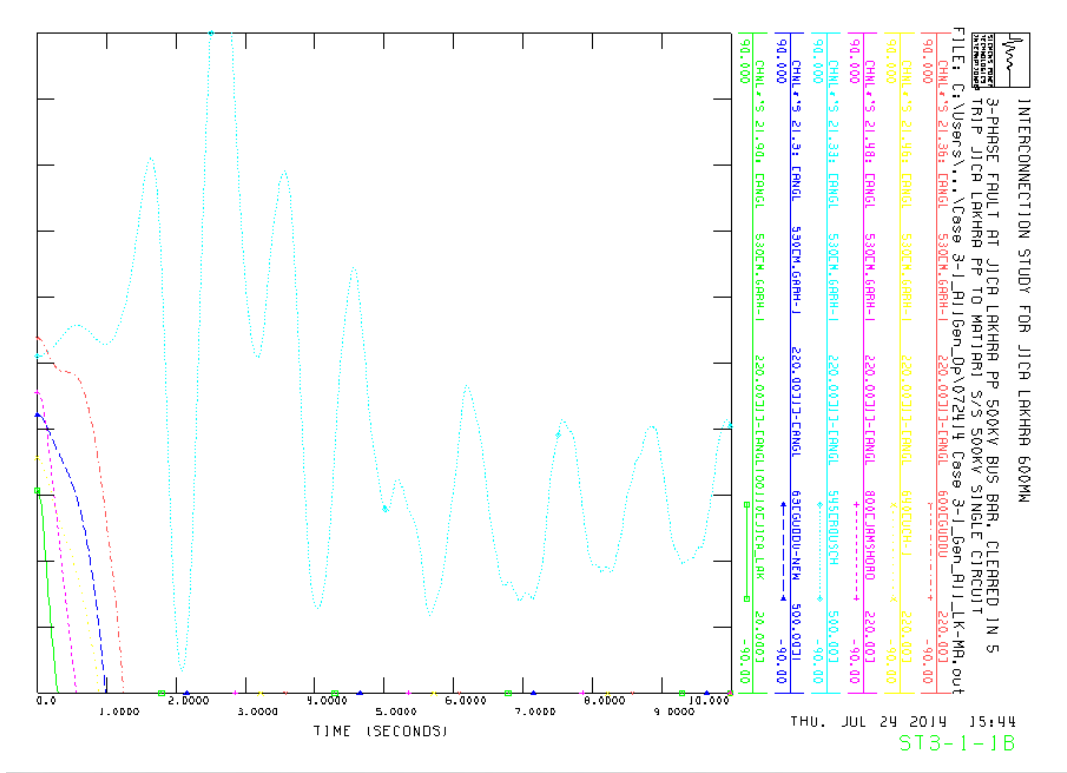
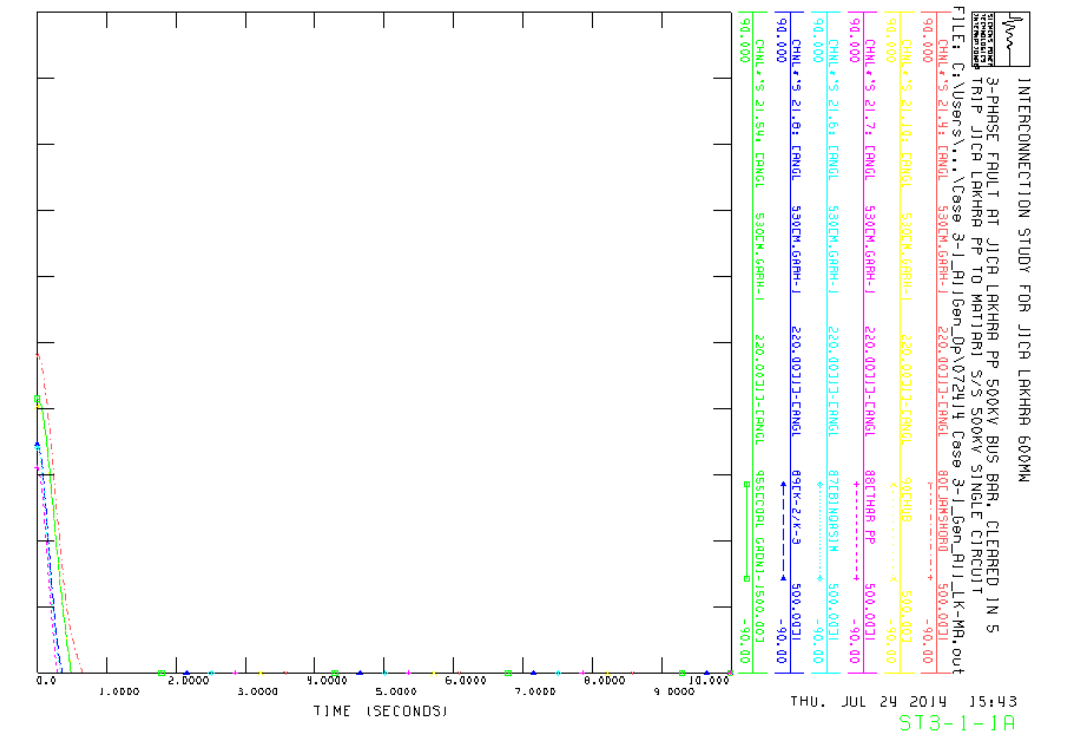
Power Flow Analysis Result: Case 3-1

Winter Case Jan-2021 (JICA Lakhra 600MW, Jamshoro 1,200MW, Thar 1,200MW)
 (Matiari S/S - JICA Lakhra PP : 2cct, Jamshoro S/S - JICA Lakhra PP - Dadu S/S: 2cct)
 (Matiari S/S - Moro S/S and JICA Lakhra PP - Dadu S/S: 2cct Open)
 Gadani: 6,000MW, K-2/K-3: 2,200MW, Bin Qasim: 1,200MW
 HVDC Matiari S/S - Lahore-S S/S: 2,000MW/cct



Stability Analysis Result Case ST-3-1

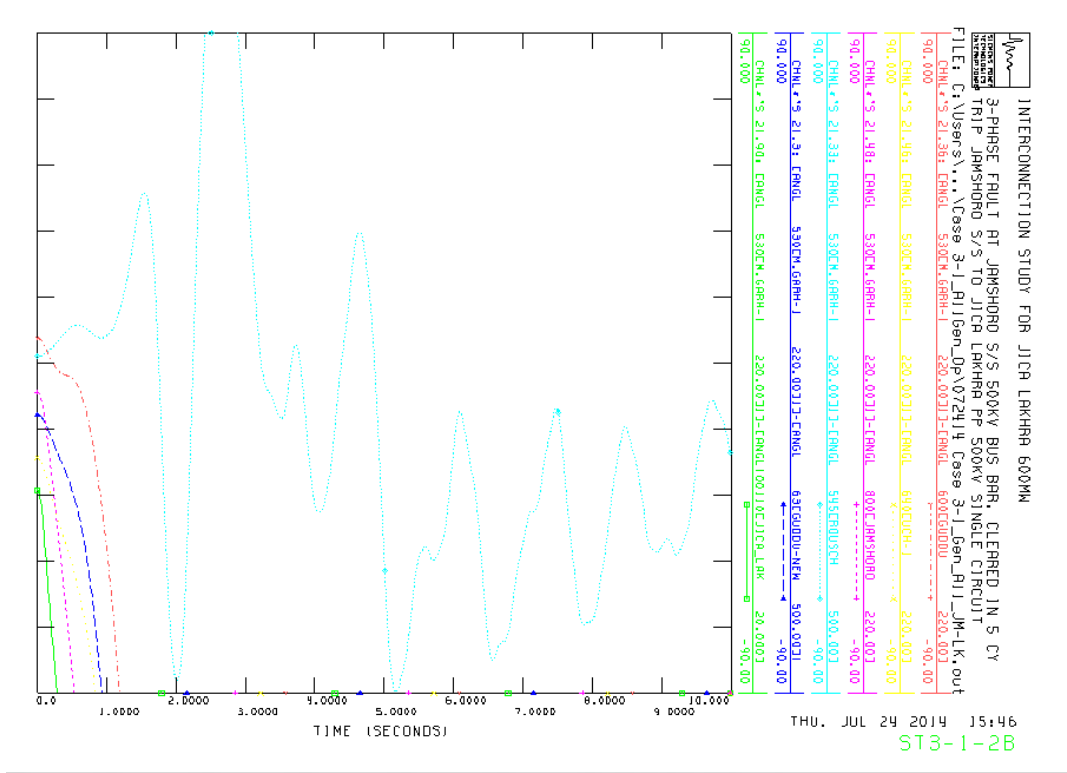
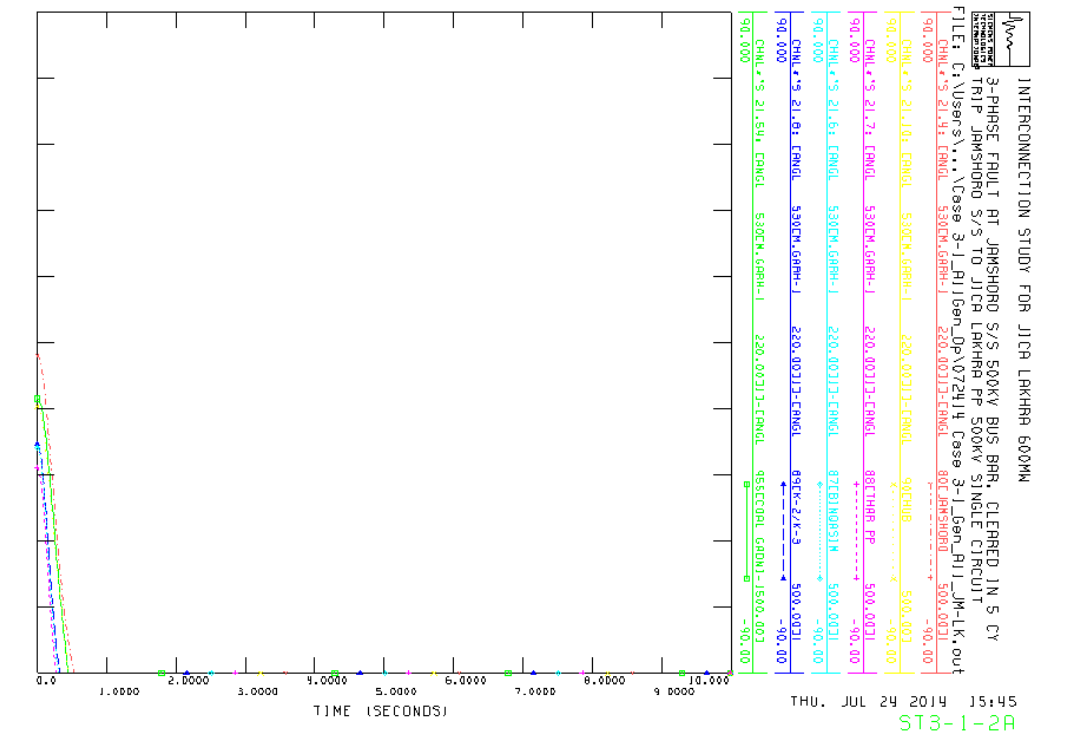
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: JICA Lakhra PP – Matiari S/S

Stability Analysis Result Case ST-3-1

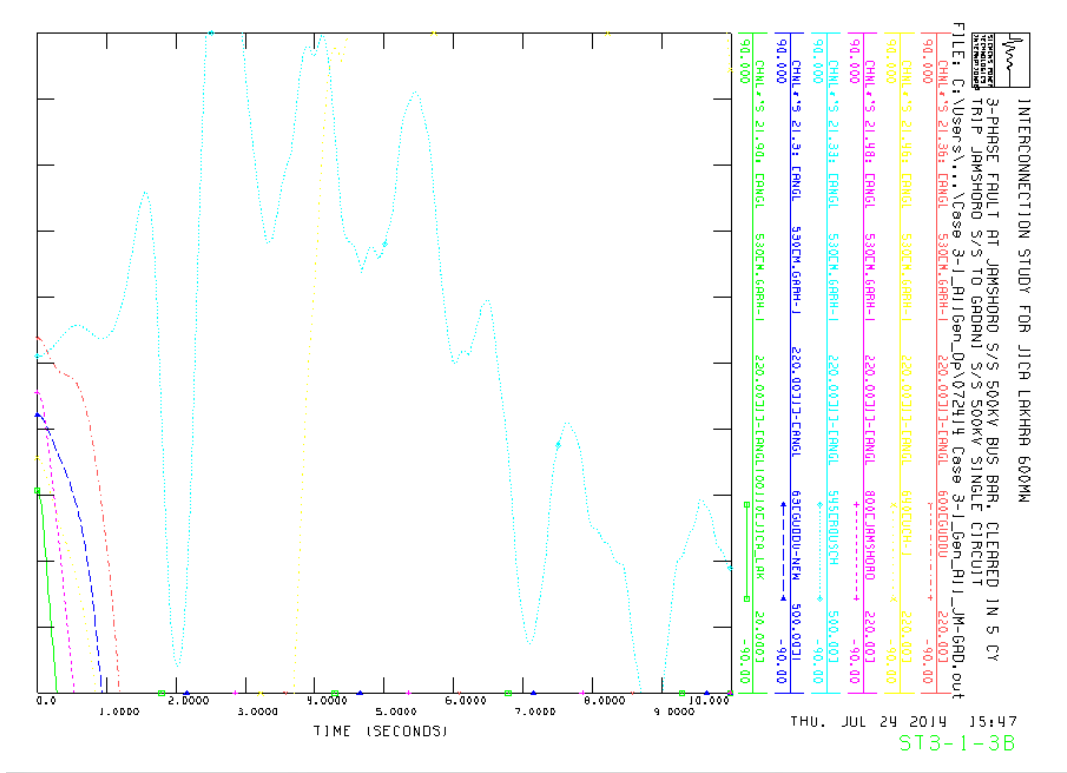
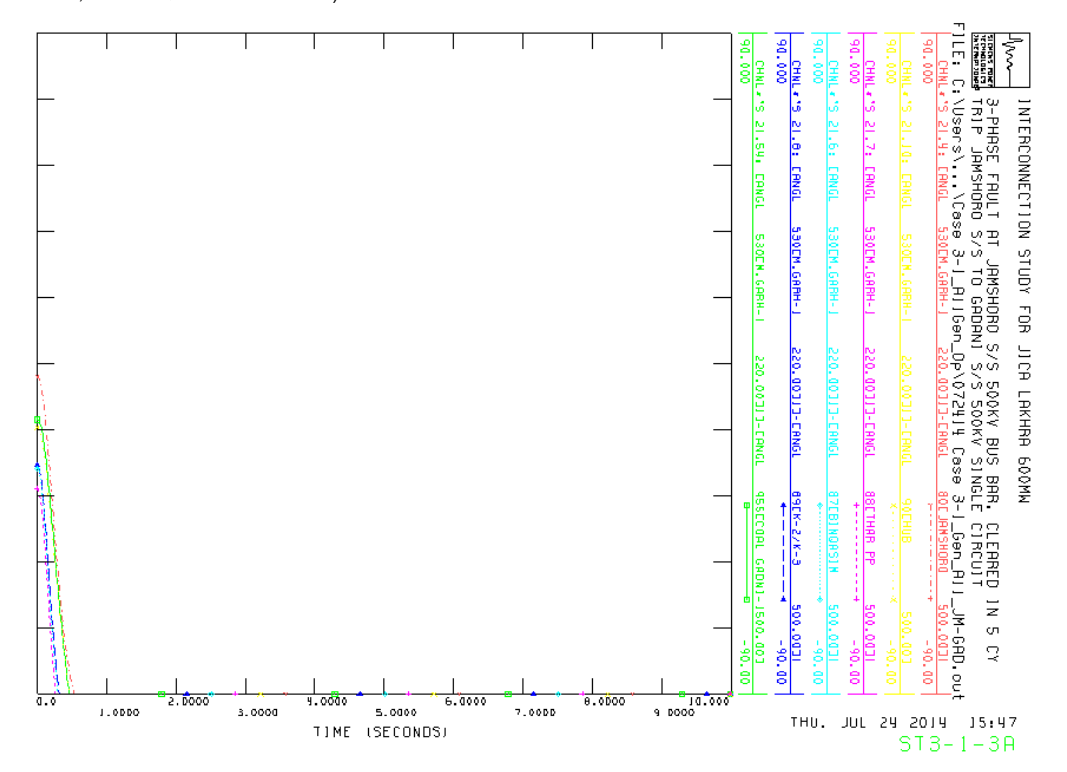
(Lakhra PP 2π Connection, Lakhra PP – Matiar S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiar S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Jamshoro S/S – JICA Lakhra PP

Stability Analysis Result Case ST-3-1

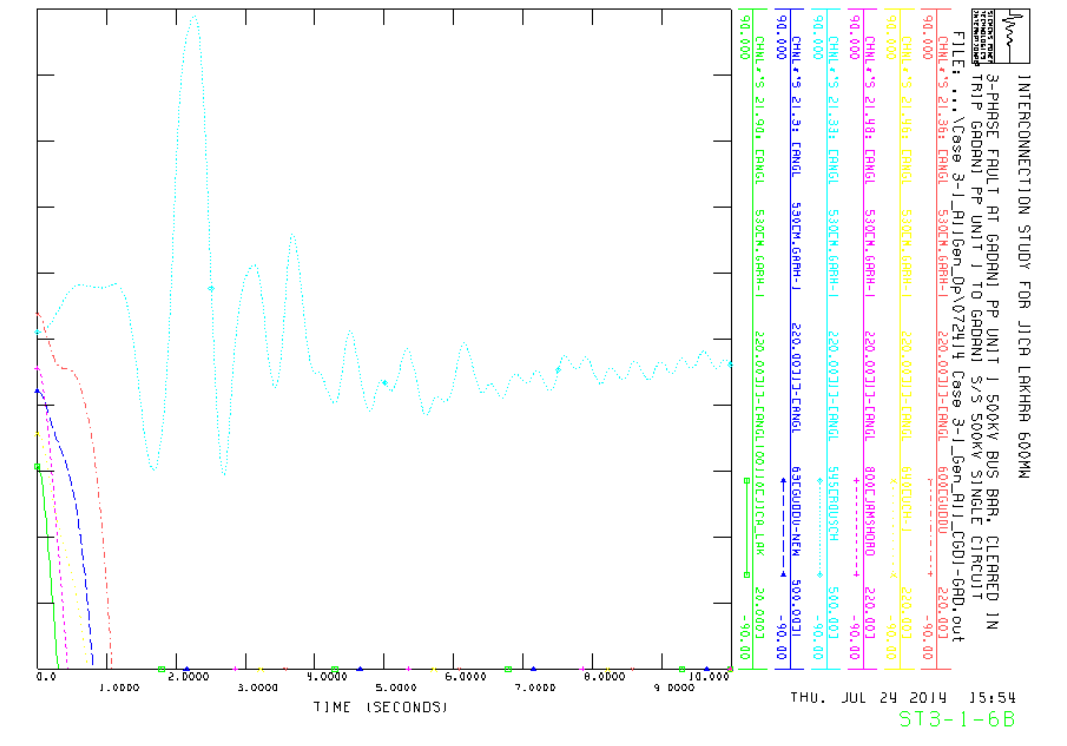
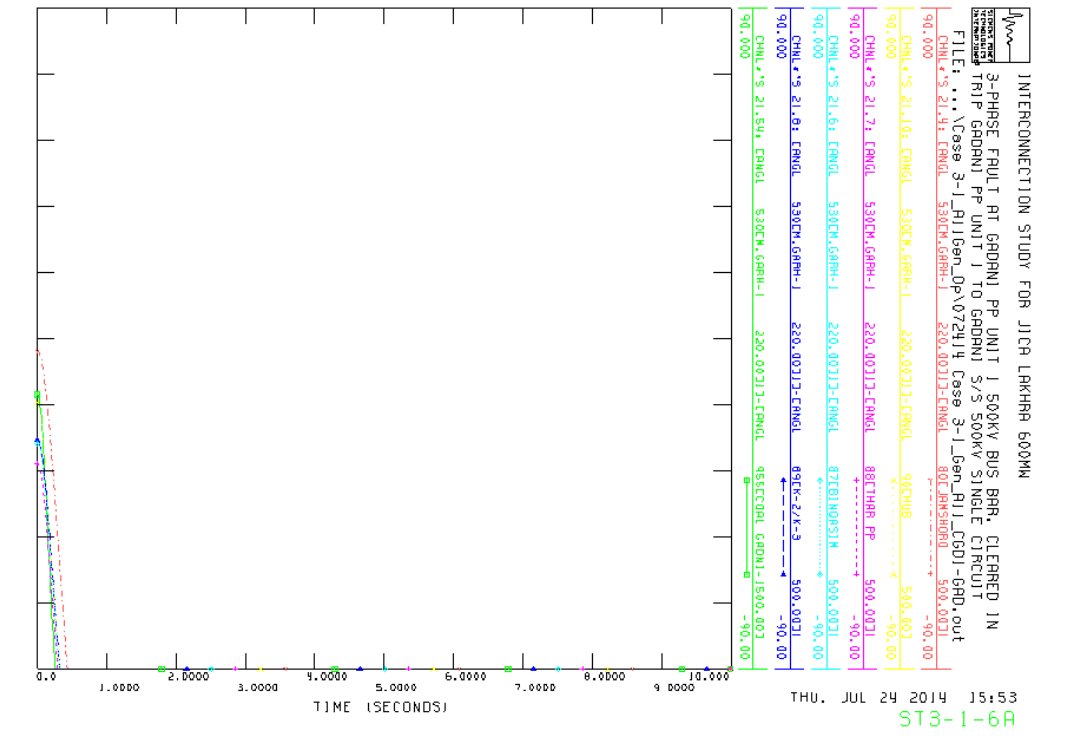
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Jamshoro S/S – Gadani S/S

Stability Analysis Result Case ST-3-1

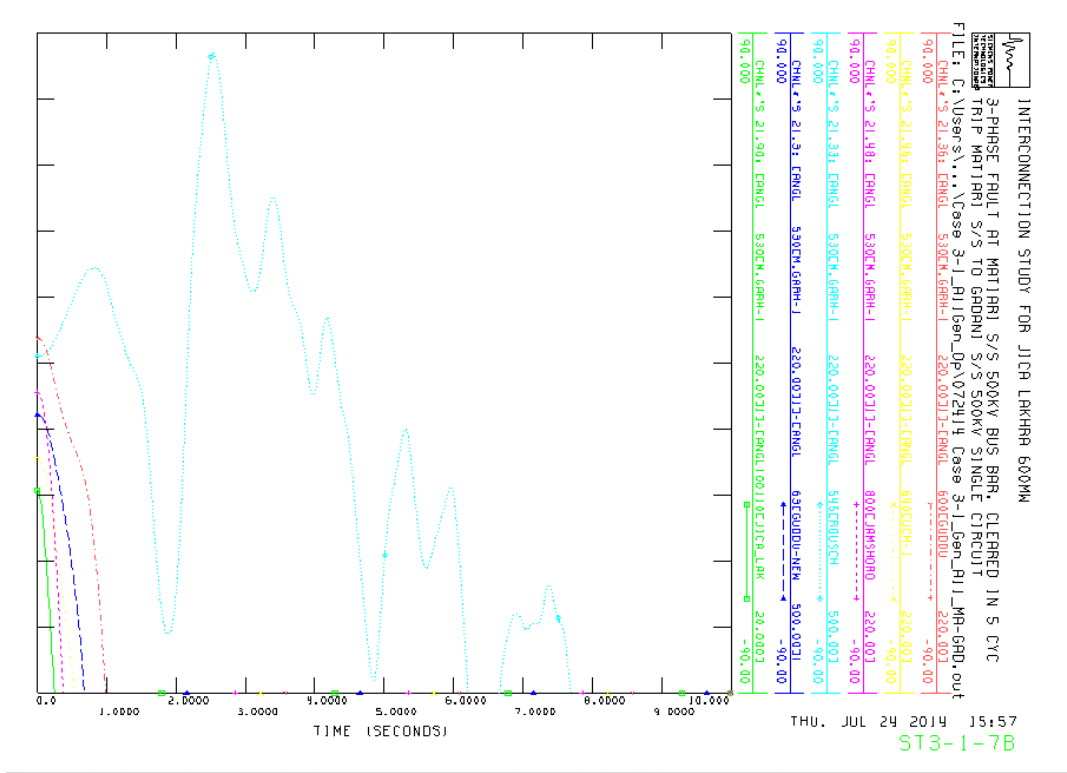
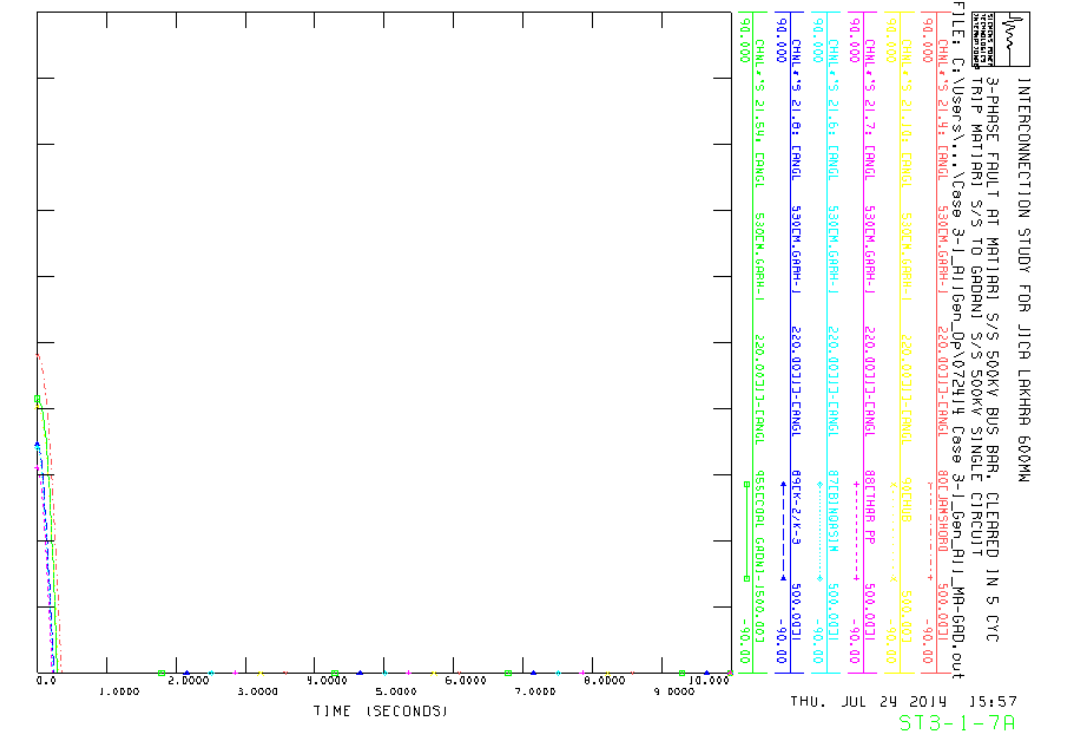
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Coal Gadani PP – Gadani S/S

Stability Analysis Result Case ST-3-1

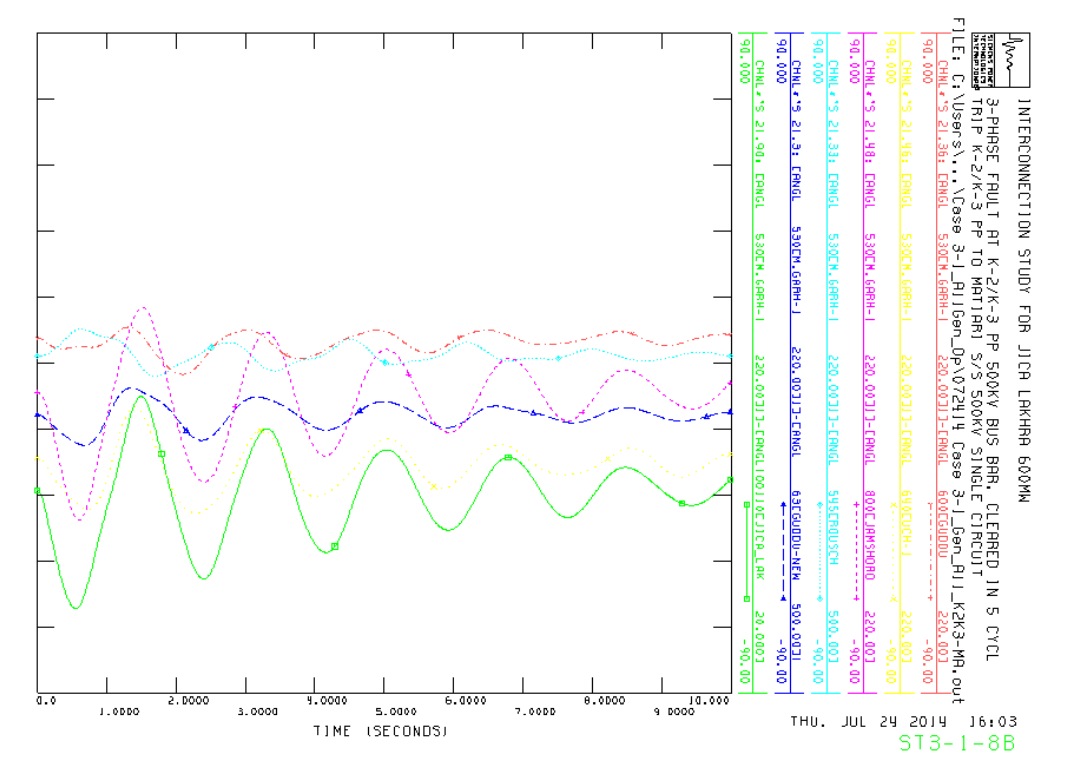
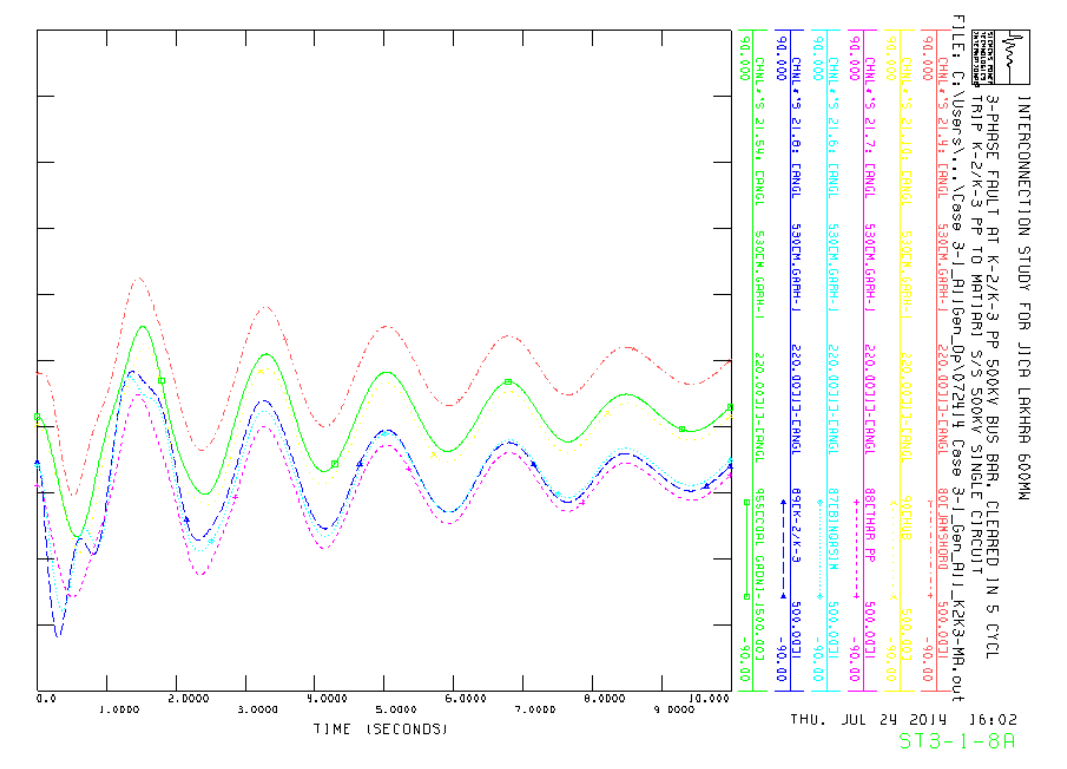
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Matiari S/S – Gadani S/S

Stability Analysis Result Case ST-3-1

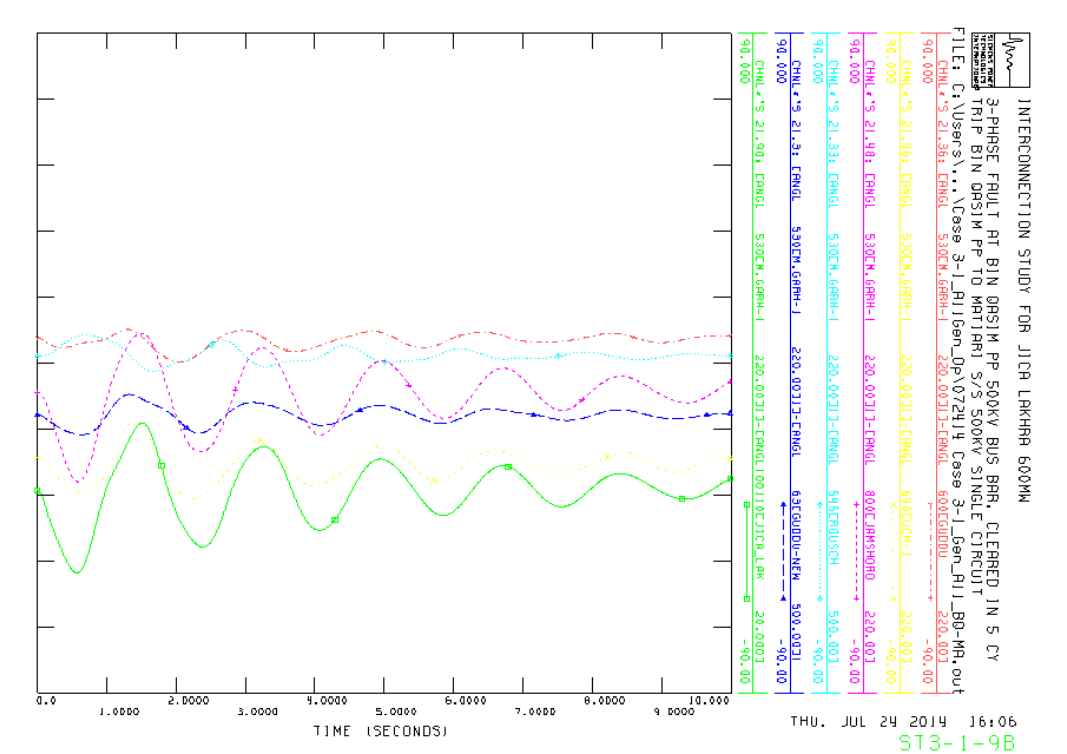
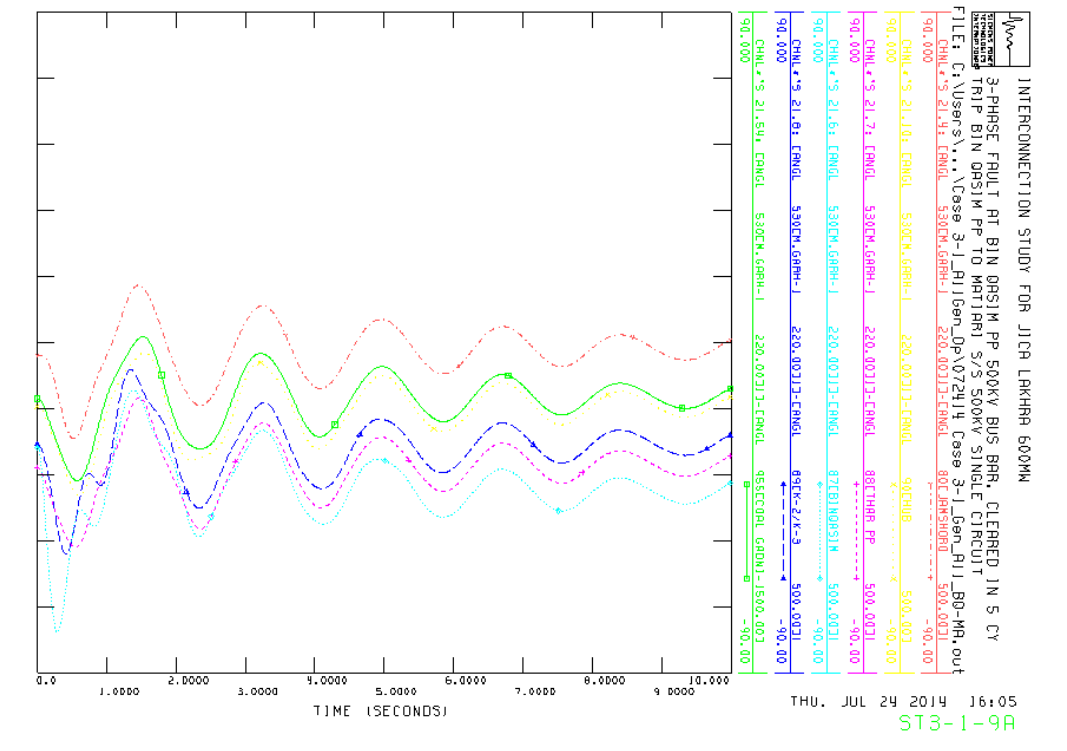
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: K-2/K-3 PP – Matiari S/S

Stability Analysis Result Case ST-3-1

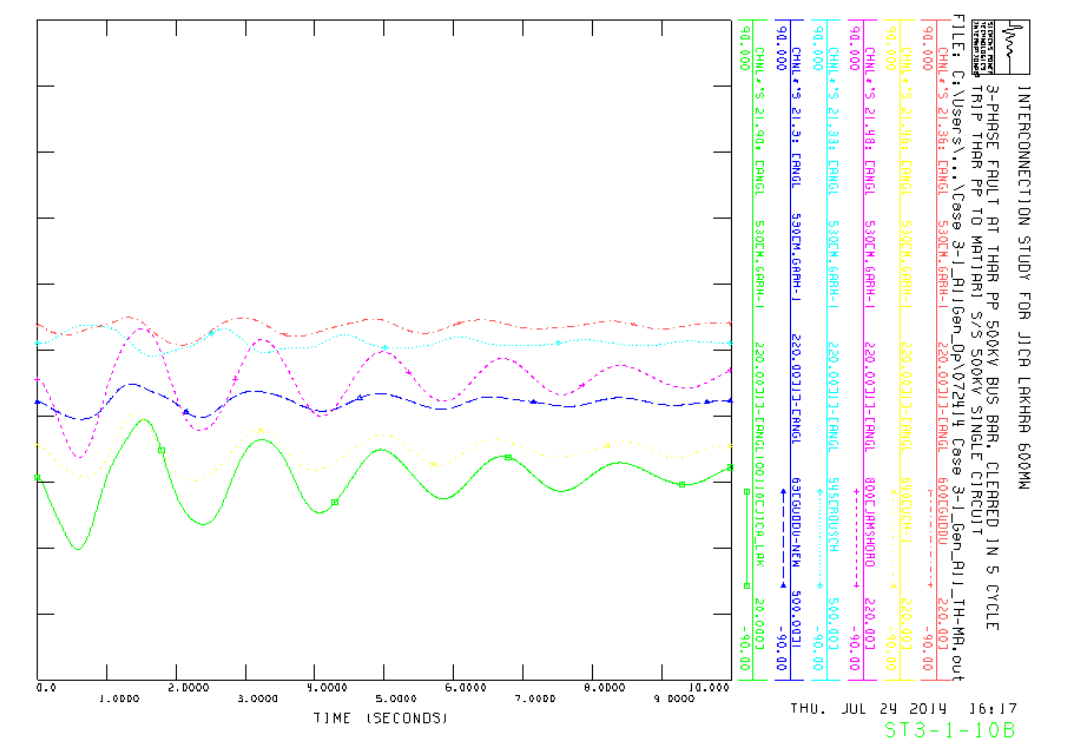
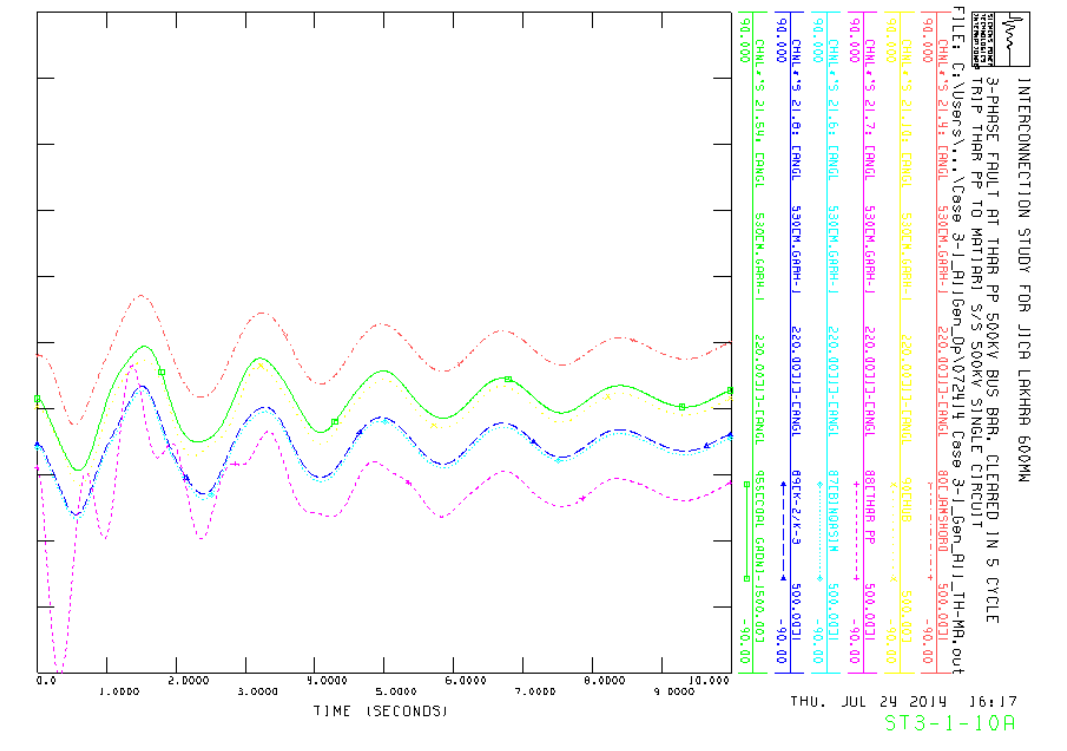
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Bin Qasim S/S – Matiari S/S

Stability Analysis Result Case ST-3-1

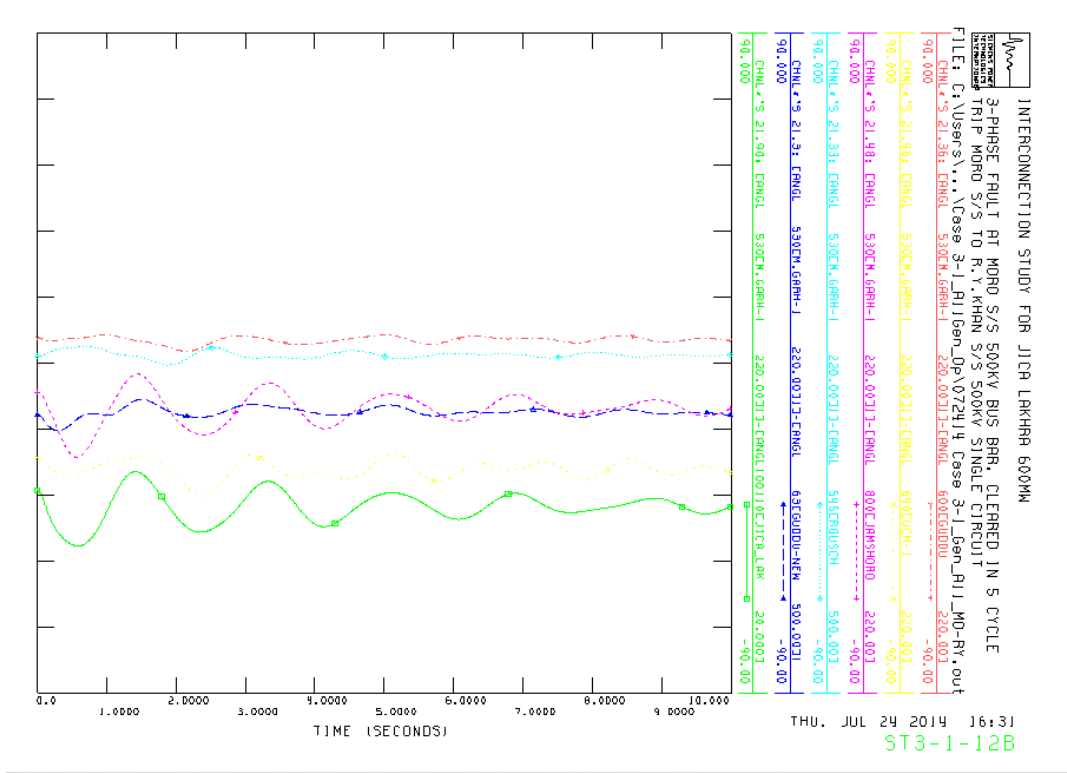
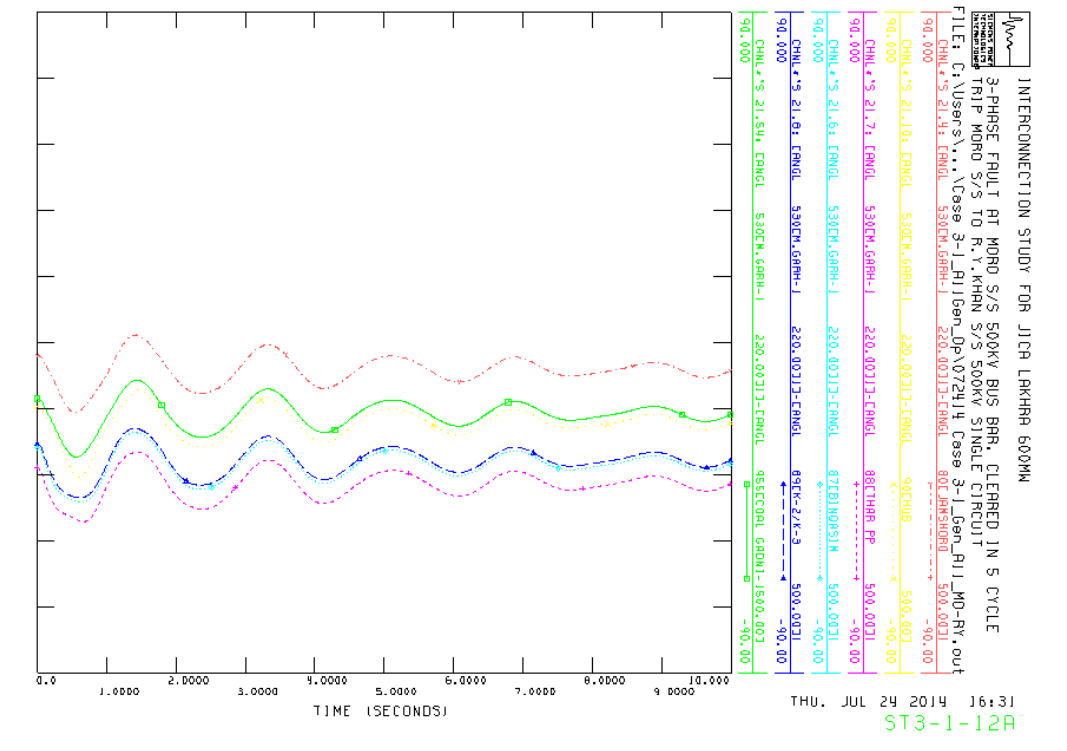
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Thar PP – Matiari S/S

Stability Analysis Result Case ST-3-1

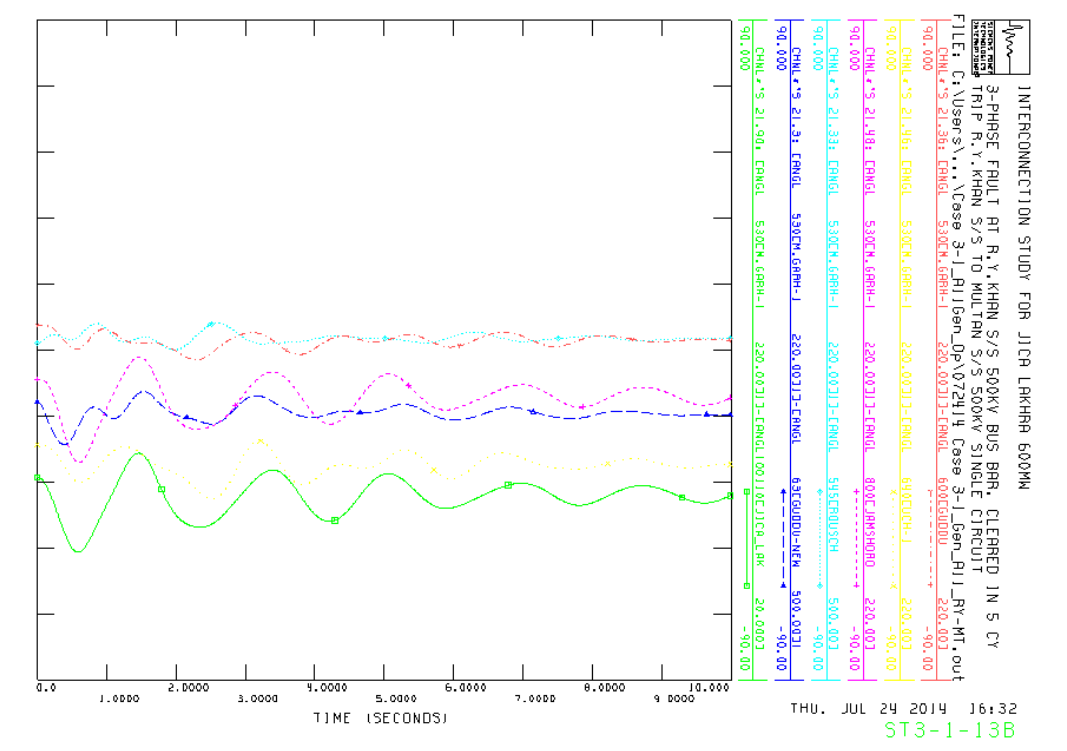
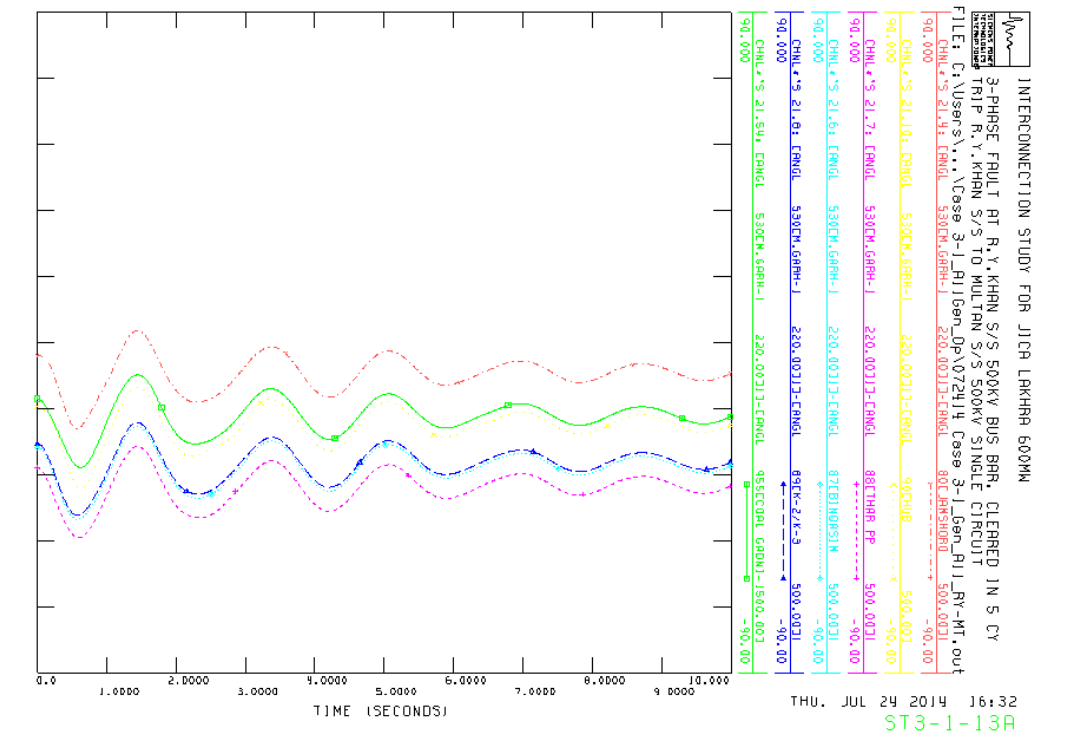
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Moro S/S – R. Y. Khan S/S

Stability Analysis Result Case ST-3-1

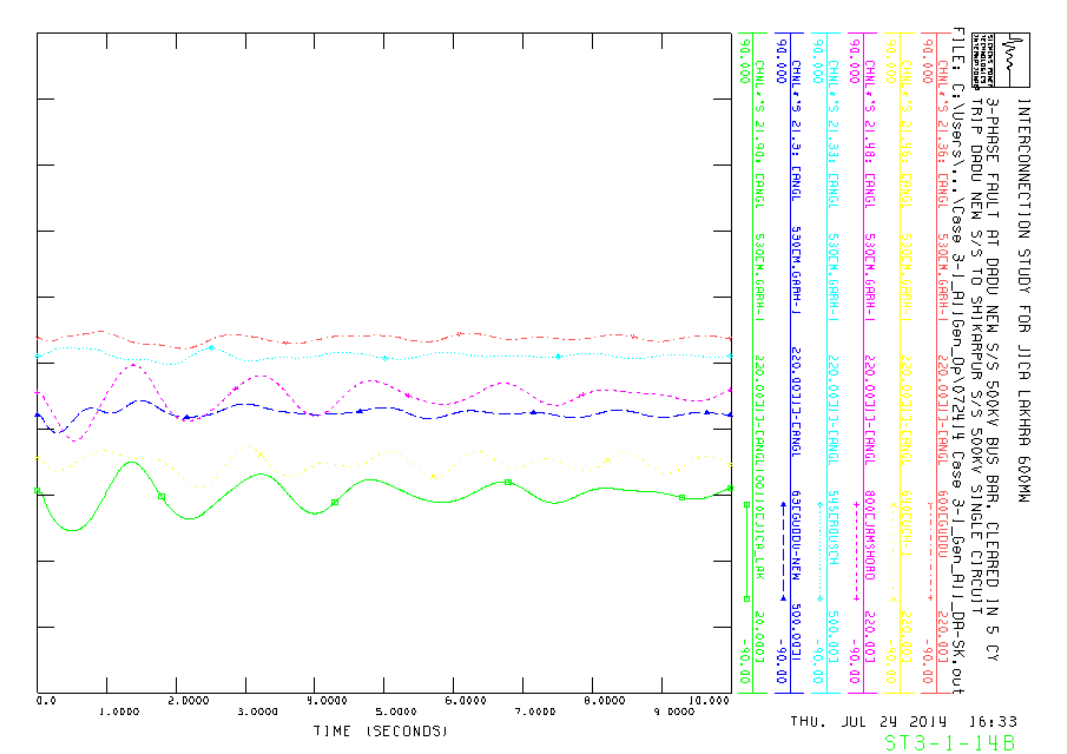
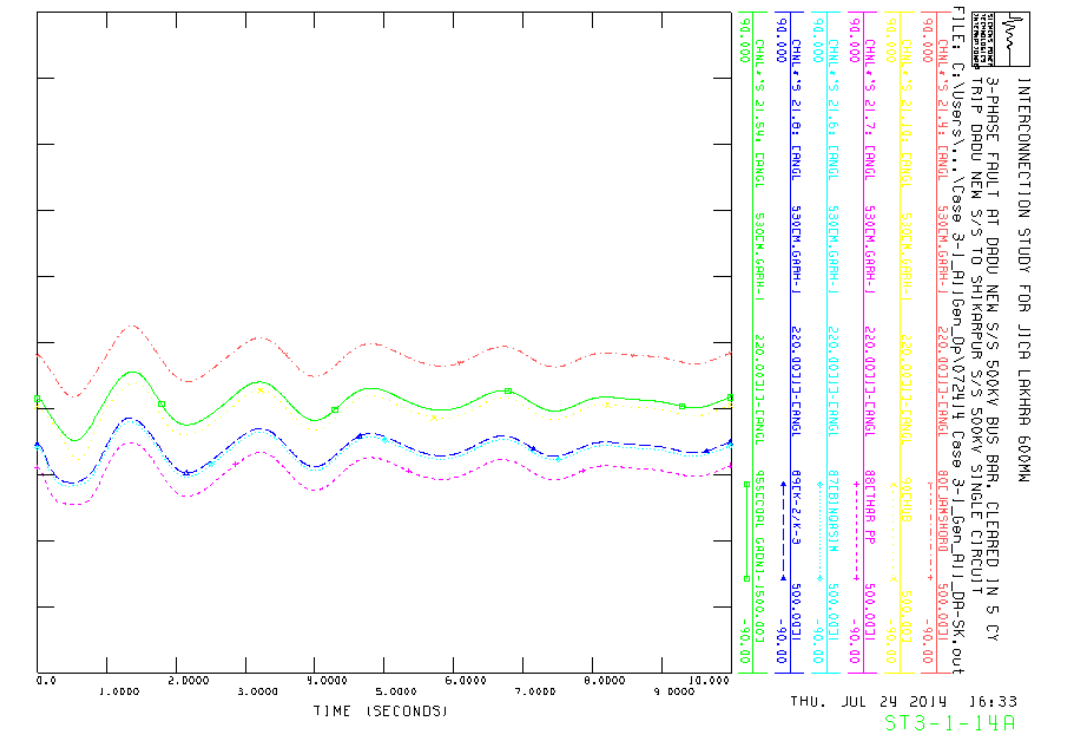
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: R. Y. Khan PP – Multan S/S

Stability Analysis Result Case ST-3-1

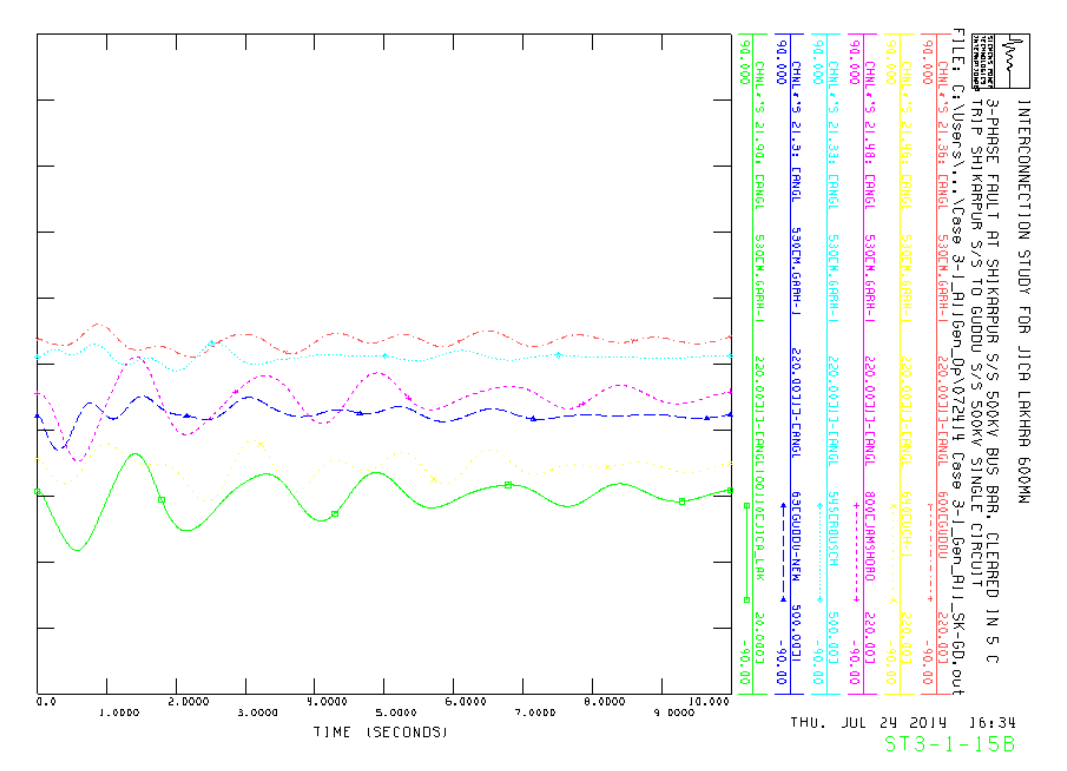
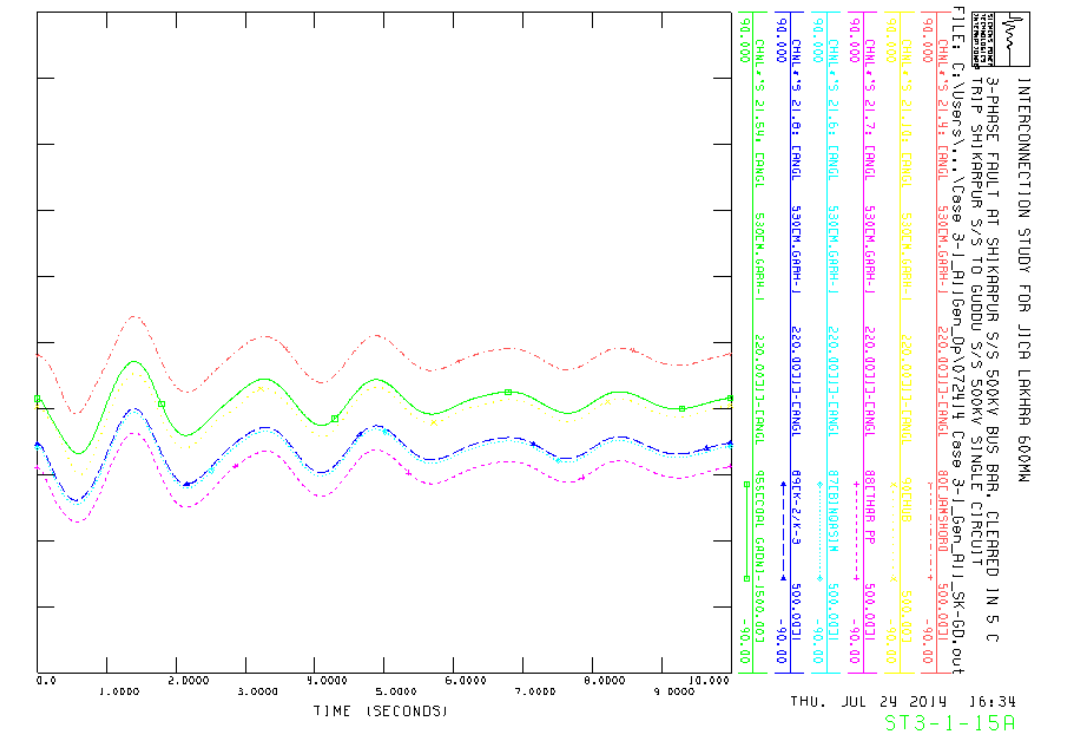
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Fault Section: Dadu New S/S – Shikarpur S/S

Stability Analysis Result Case ST-3-1

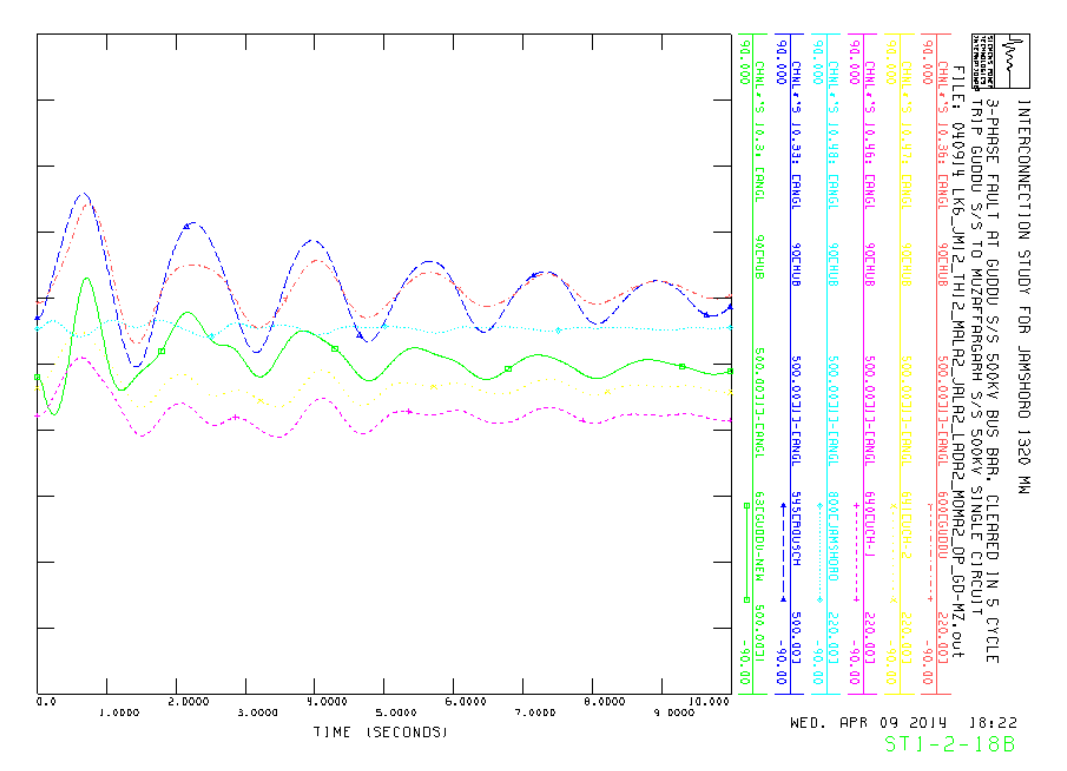
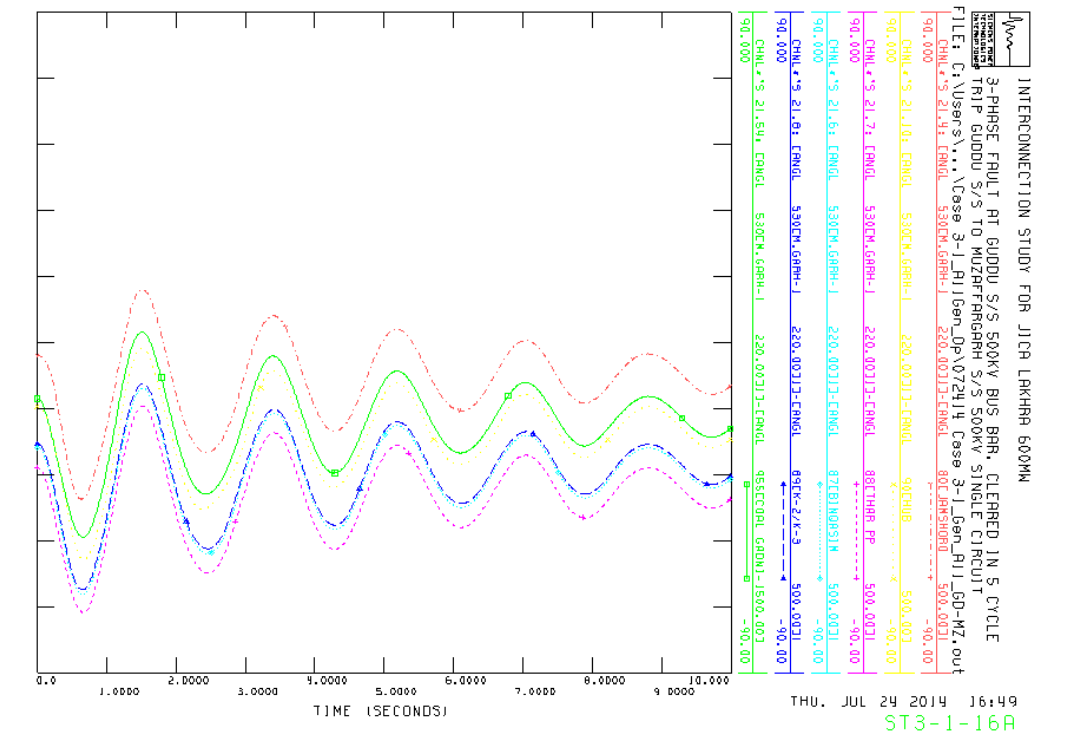
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Fault Section: Shikarpur S/S – Guddu S/S

Stability Analysis Result Case ST-3-1

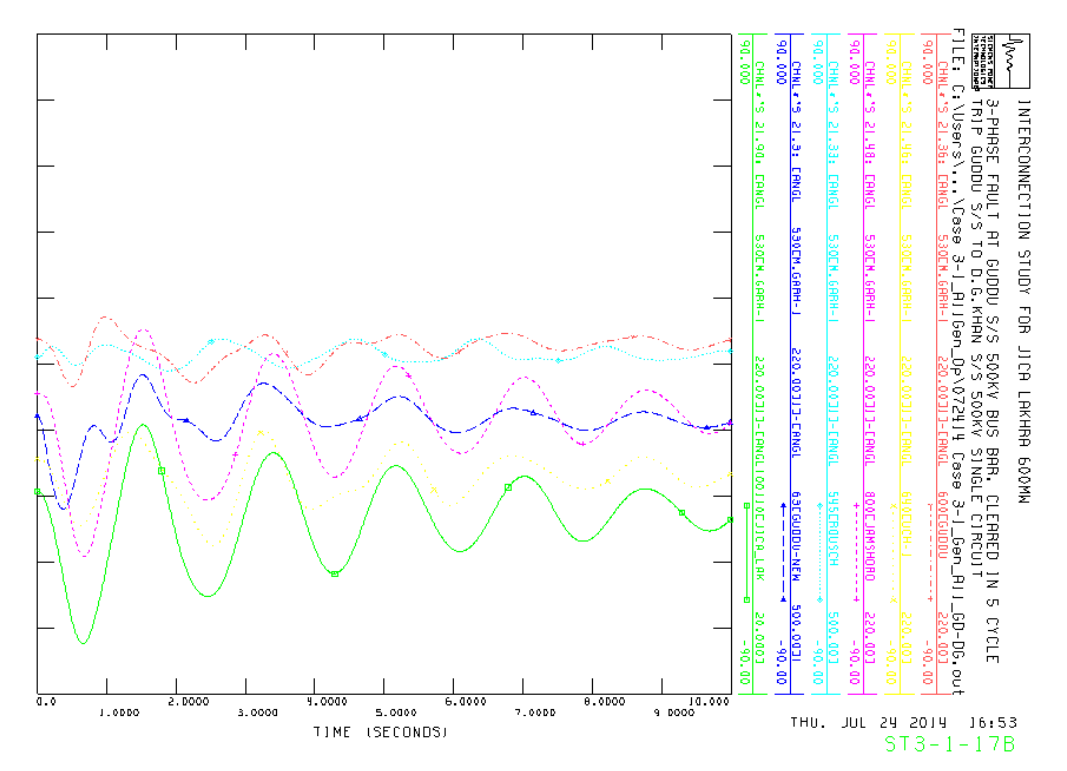
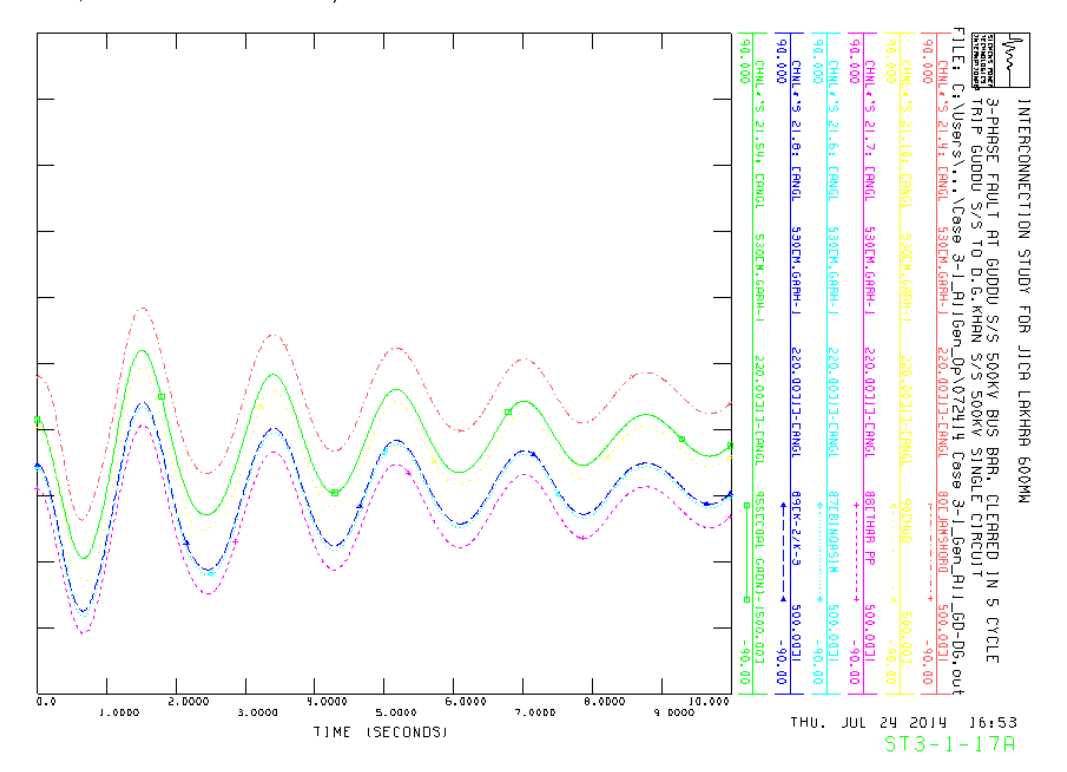
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Fault Section: Guddu S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-3-1

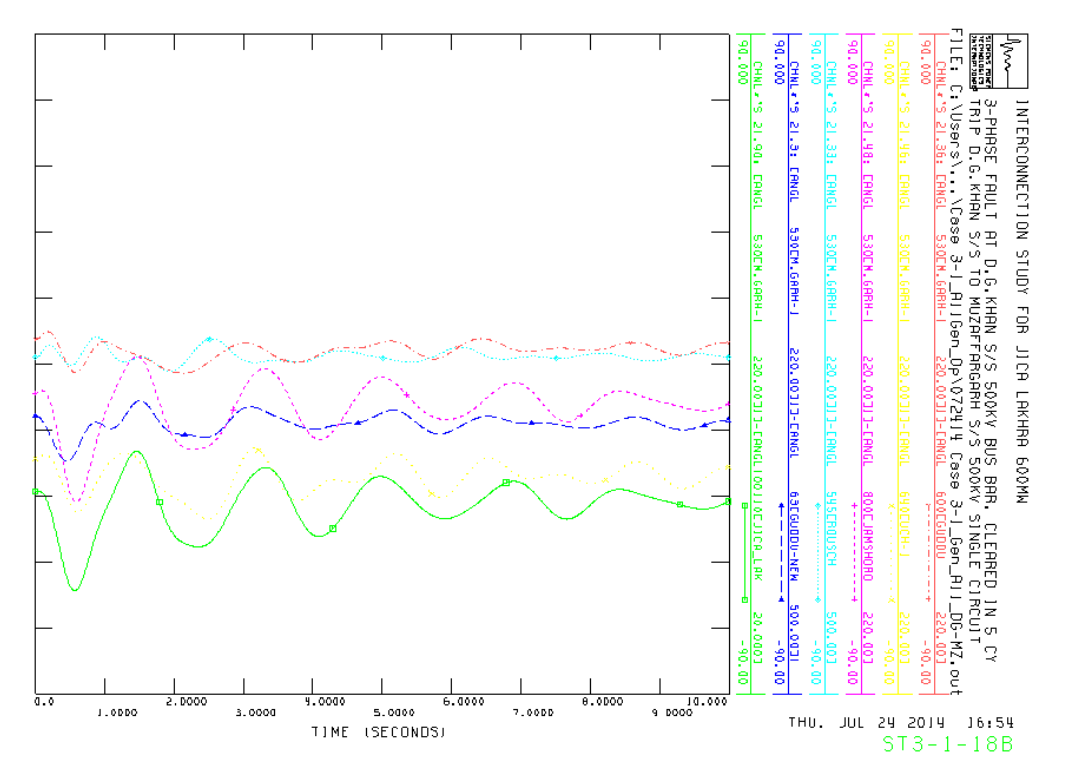
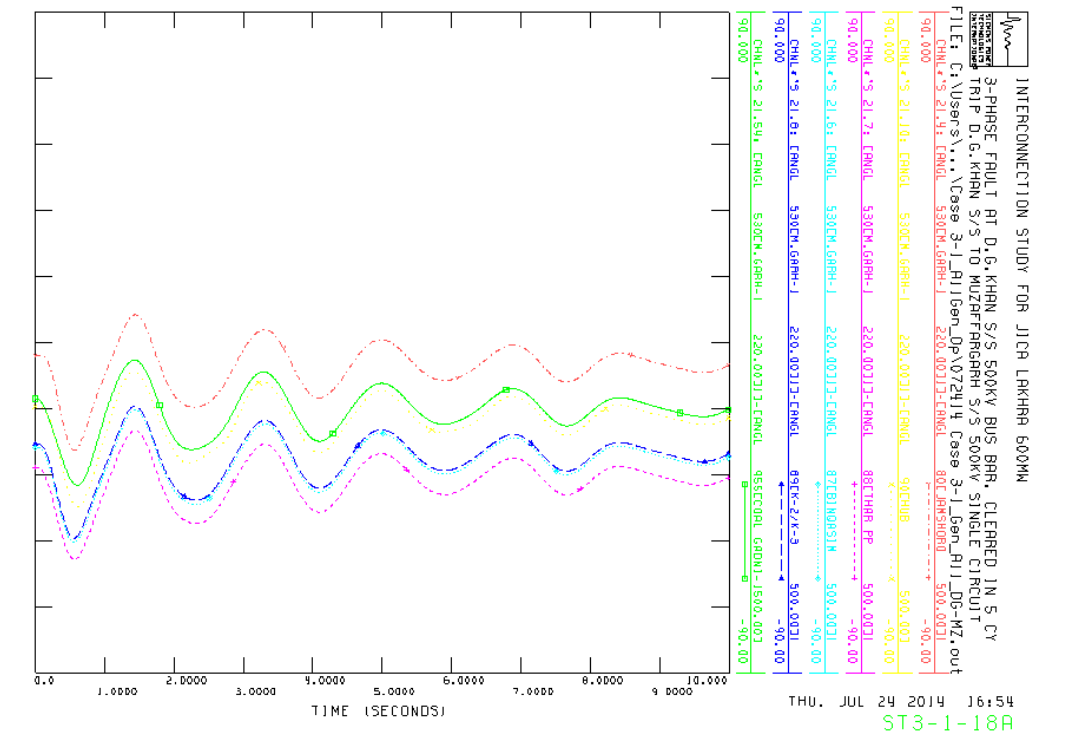
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Guddu S/S – D. G. Khan S/S

Stability Analysis Result Case ST-3-1

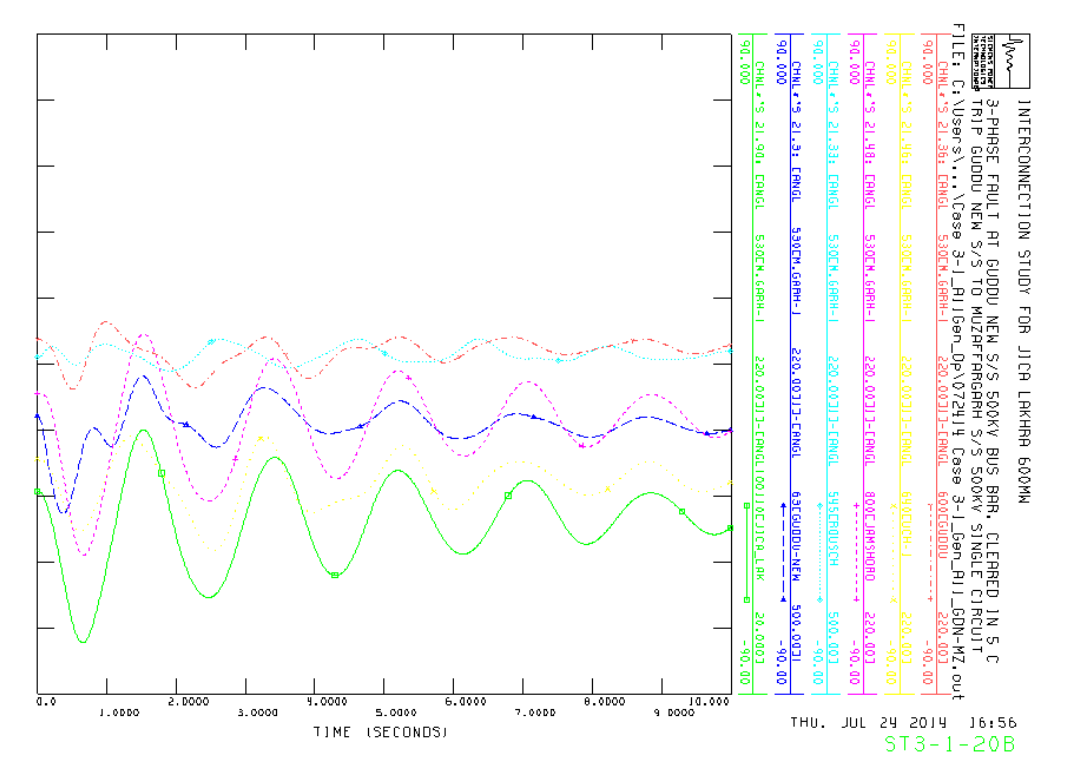
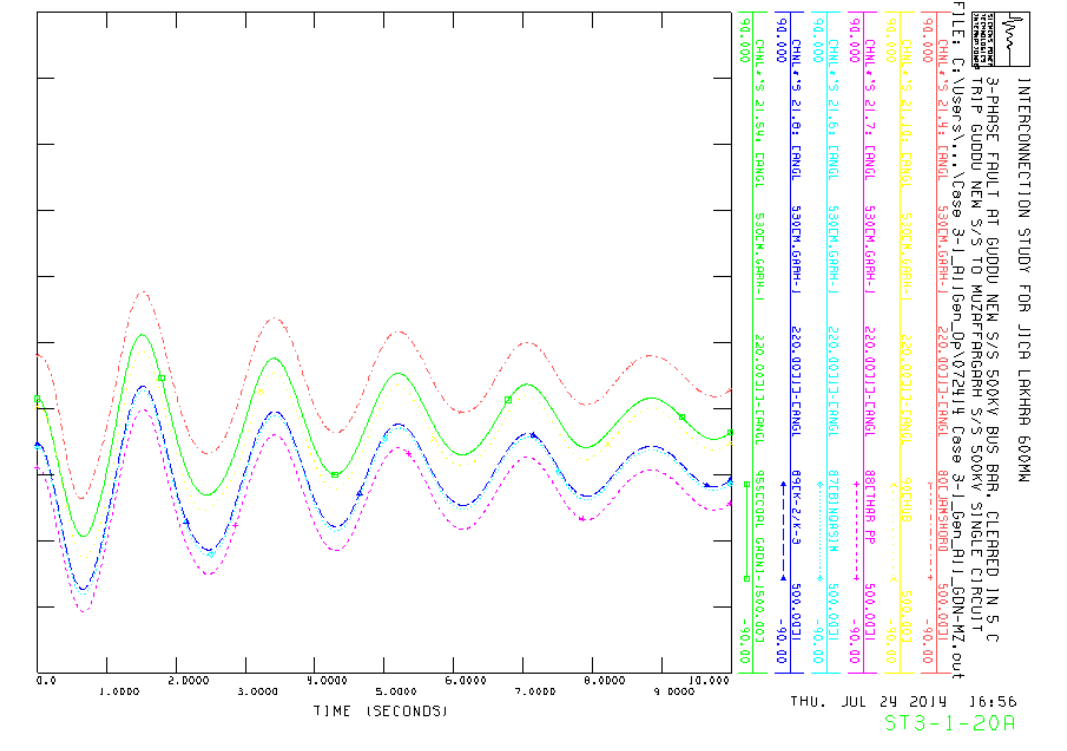
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: D. G. Khan S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-3-1

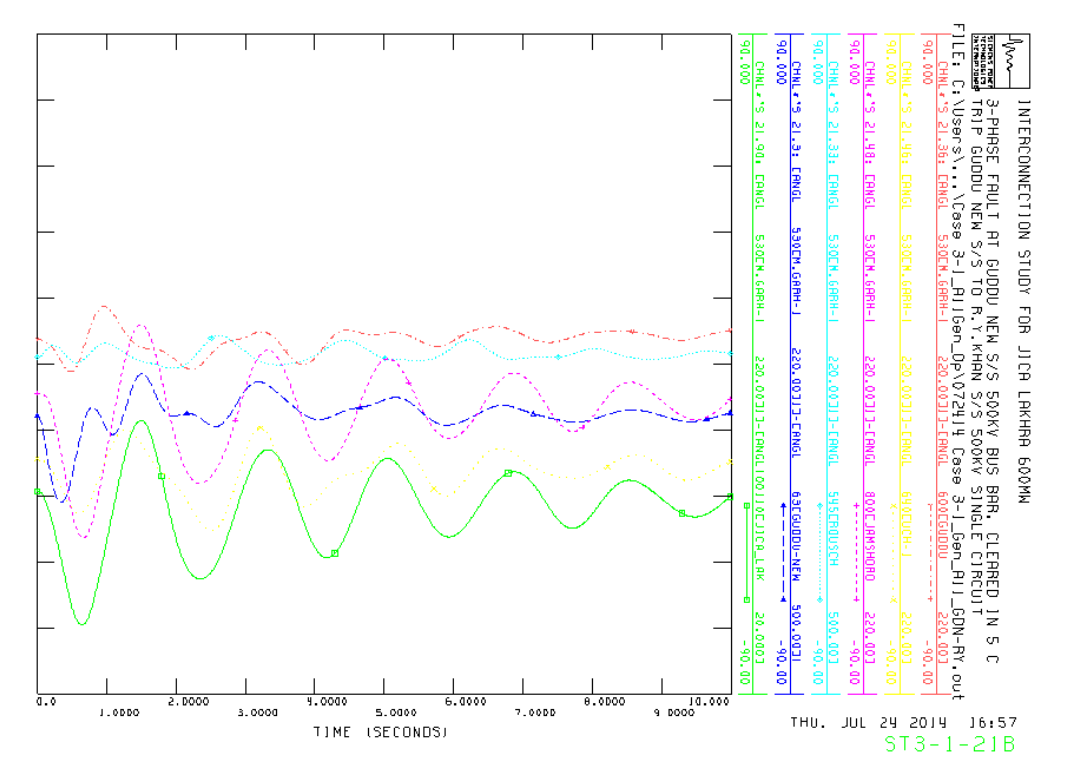
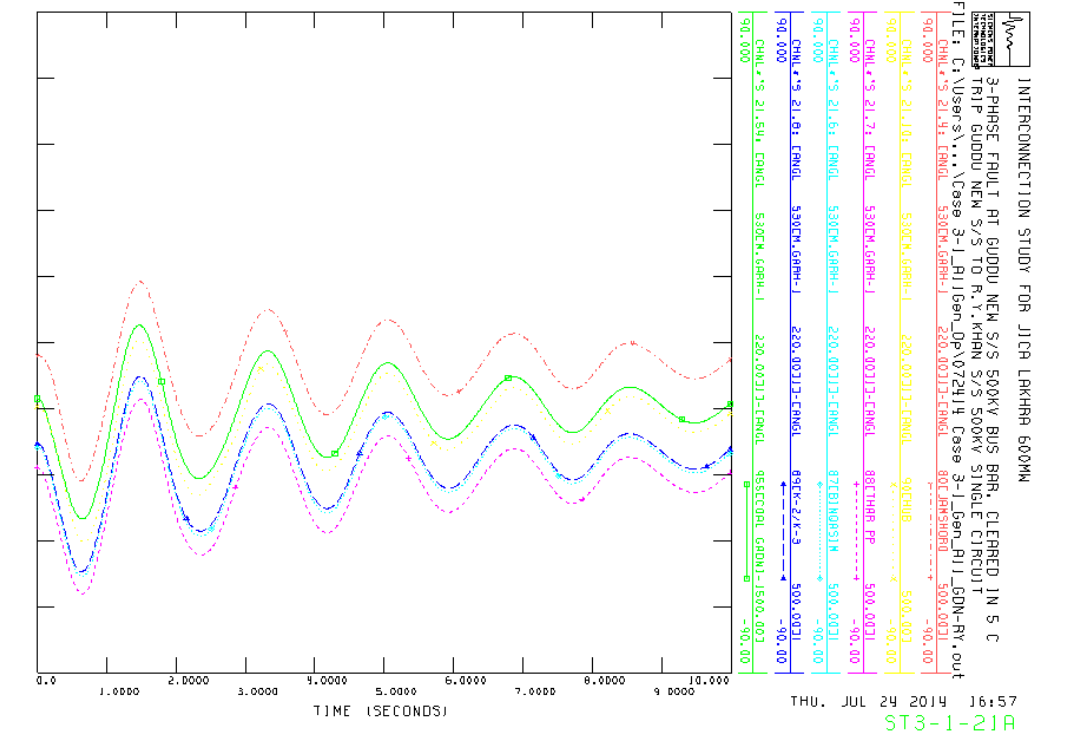
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Guddu New PP – Muzaffargarh S/S

Stability Analysis Result Case ST-3-1

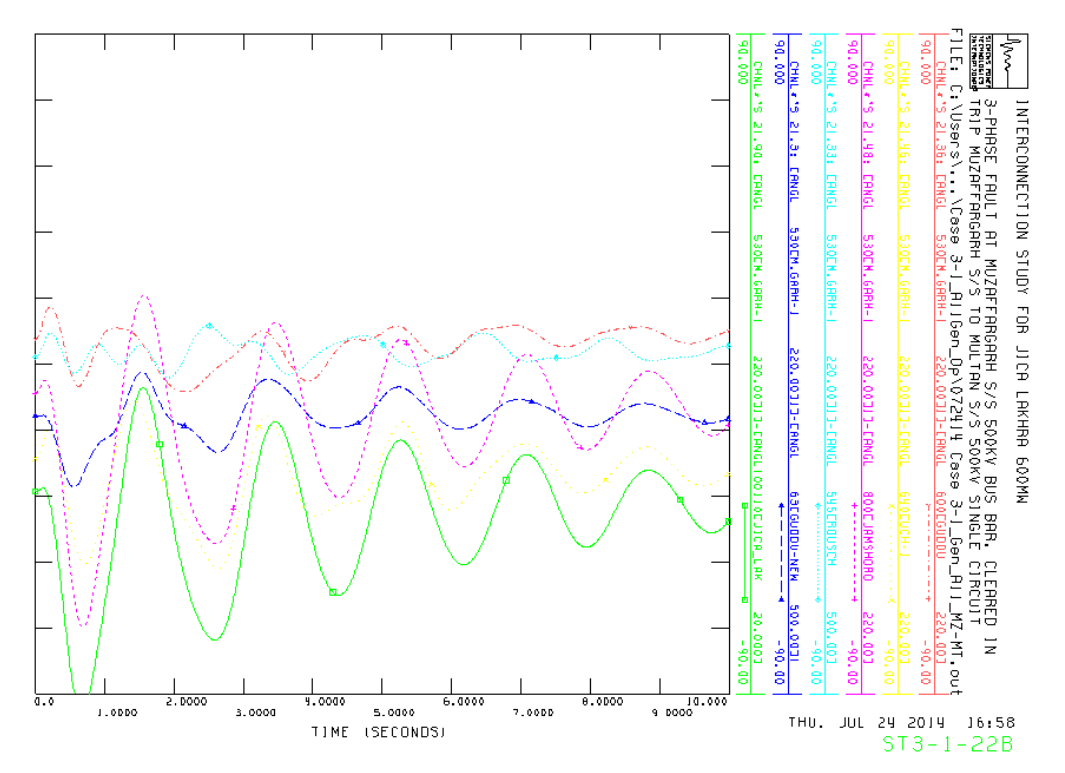
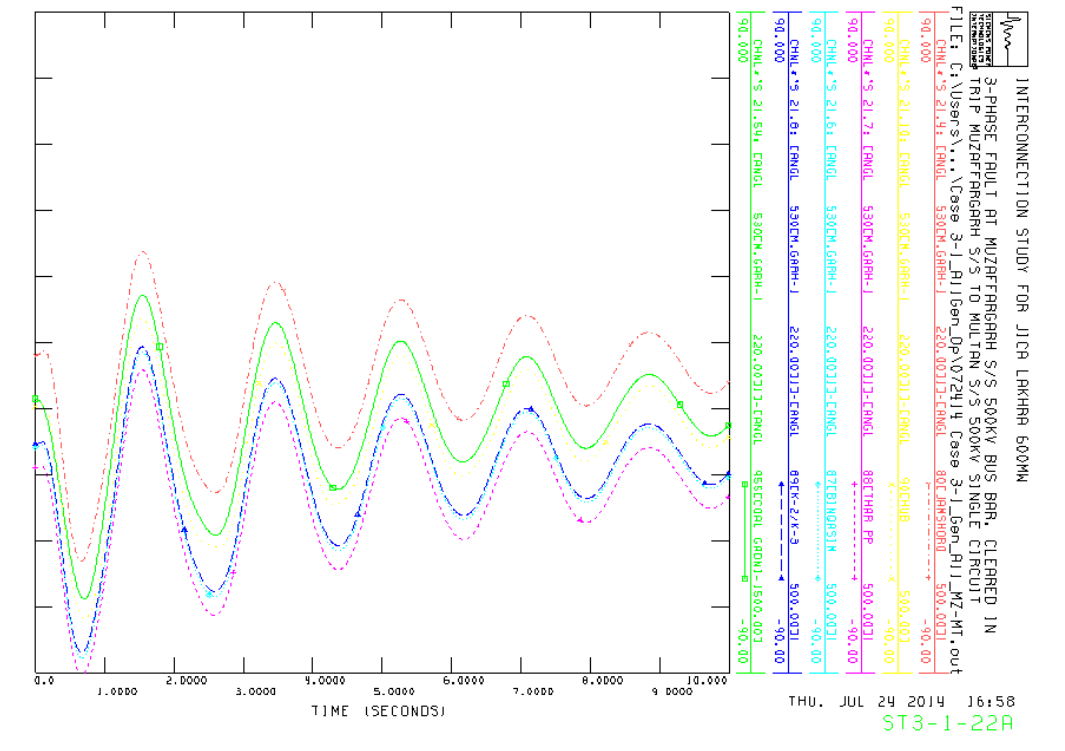
(Lakhra PP 2π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Guddu New PP – R. Y. Khan S/S

Stability Analysis Result Case ST-3-1

(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)

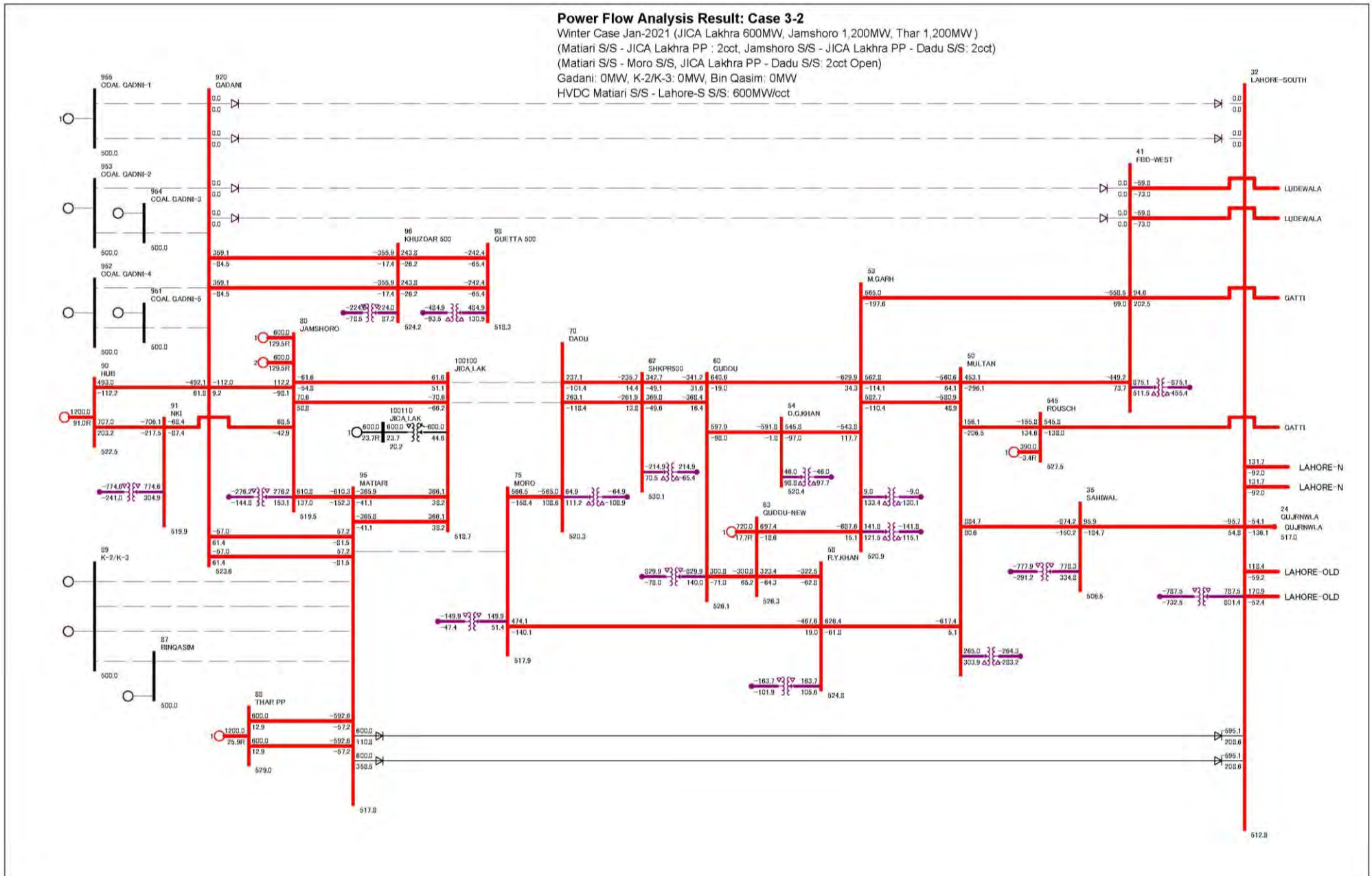


Fault Section: Muzaffargarh S/S – Multan S/S

6 - 5 STABILITY ANALYSIS CASE ST3-2

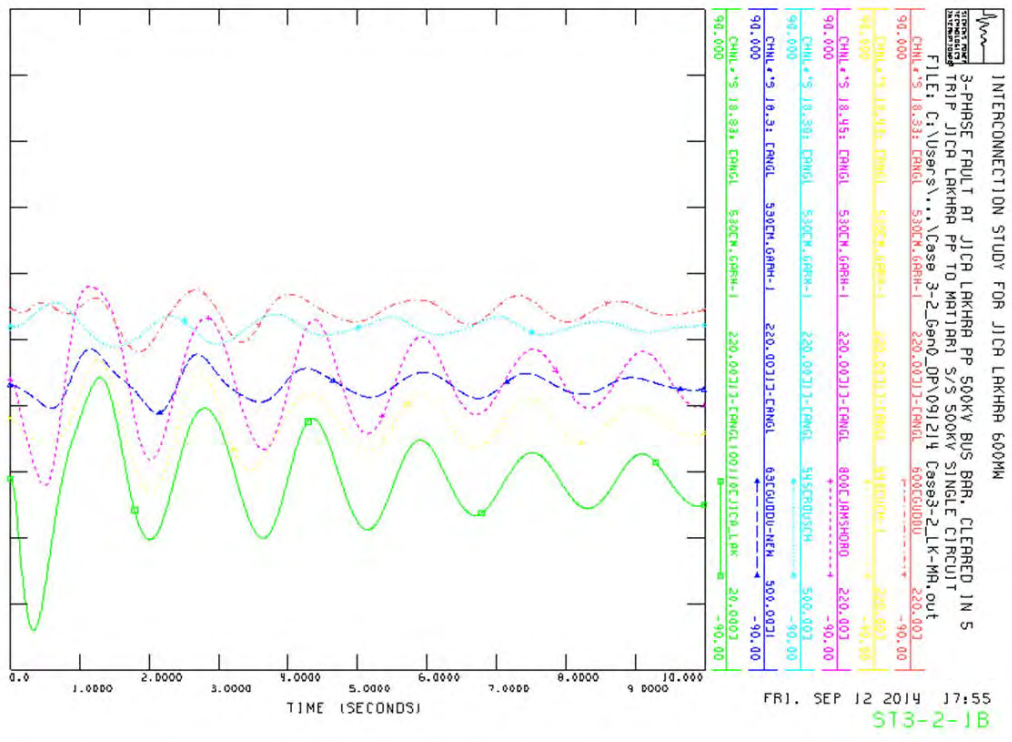
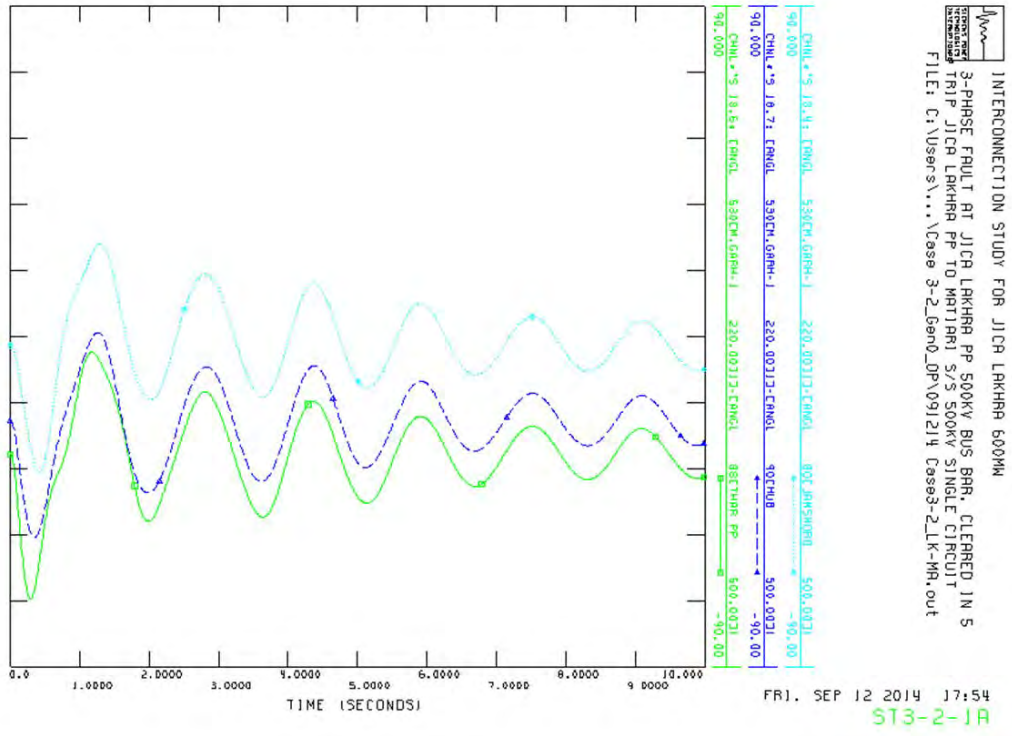
Stability Analysis Result Case ST-3-2

(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Stability Analysis Result Case ST-3-2

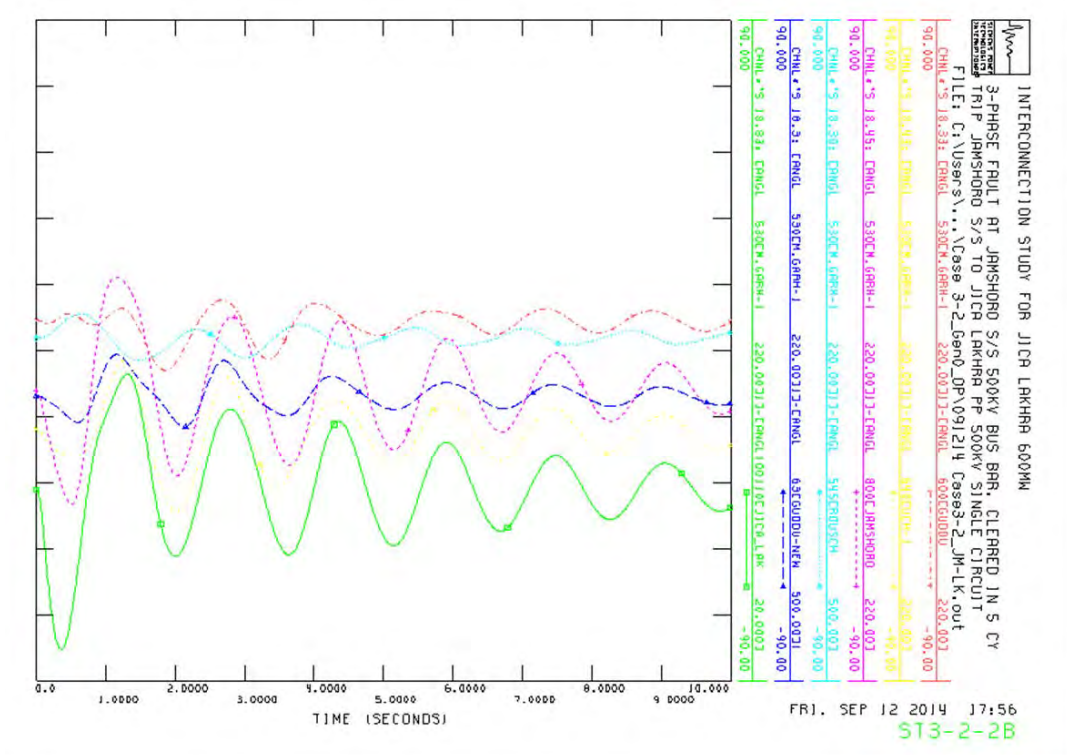
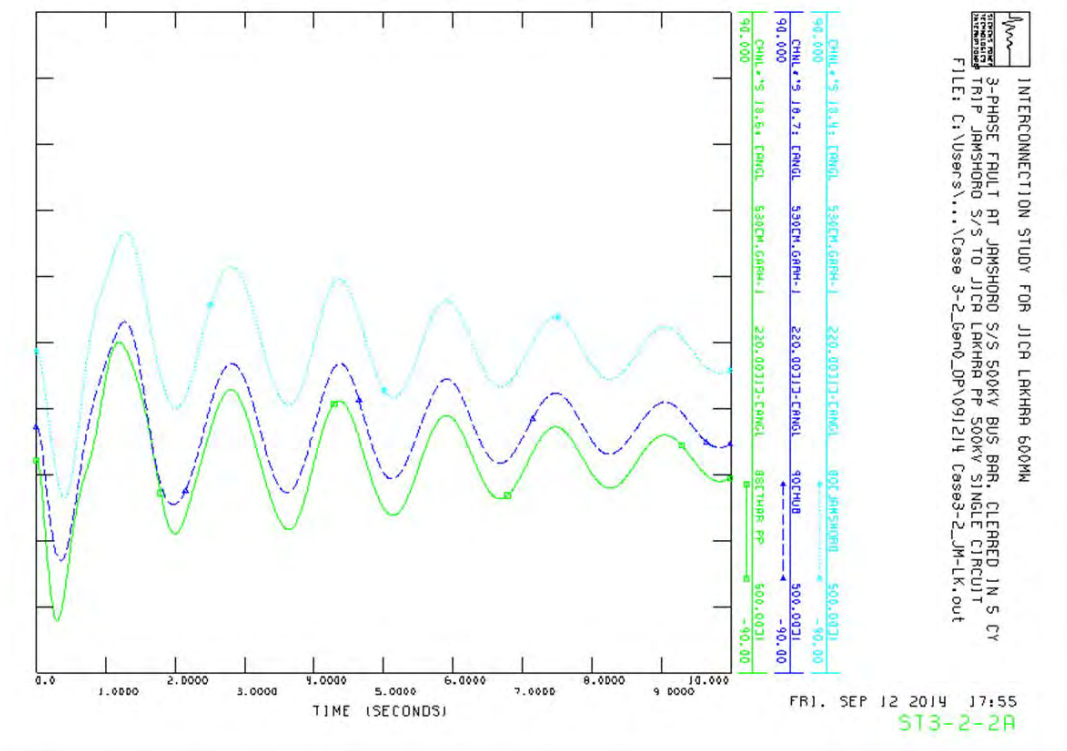
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: JICA Lakhra PP – Matiari S/S

Stability Analysis Result Case ST-3-2

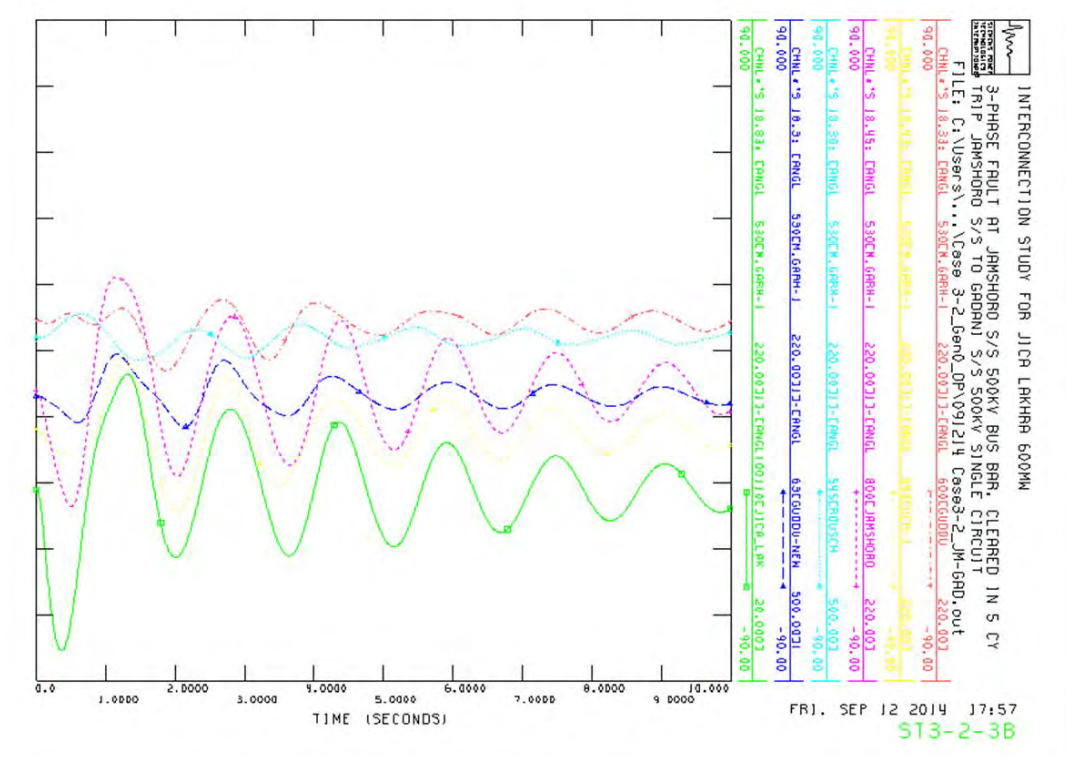
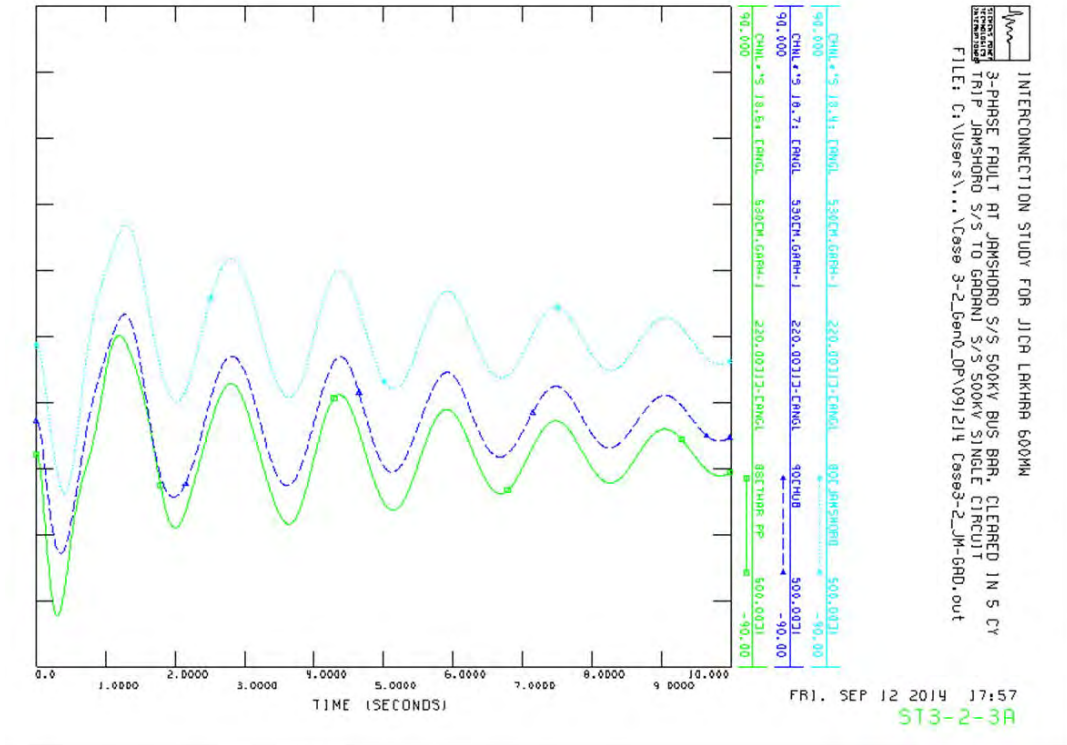
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – JICA Lakhra PP

Stability Analysis Result Case ST-3-2

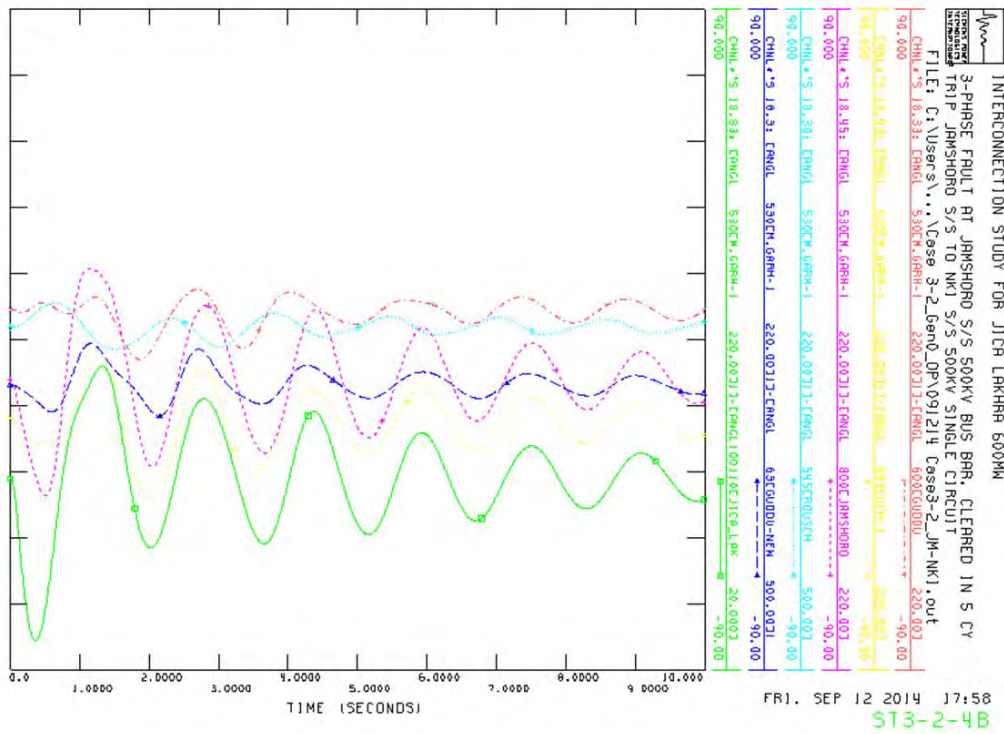
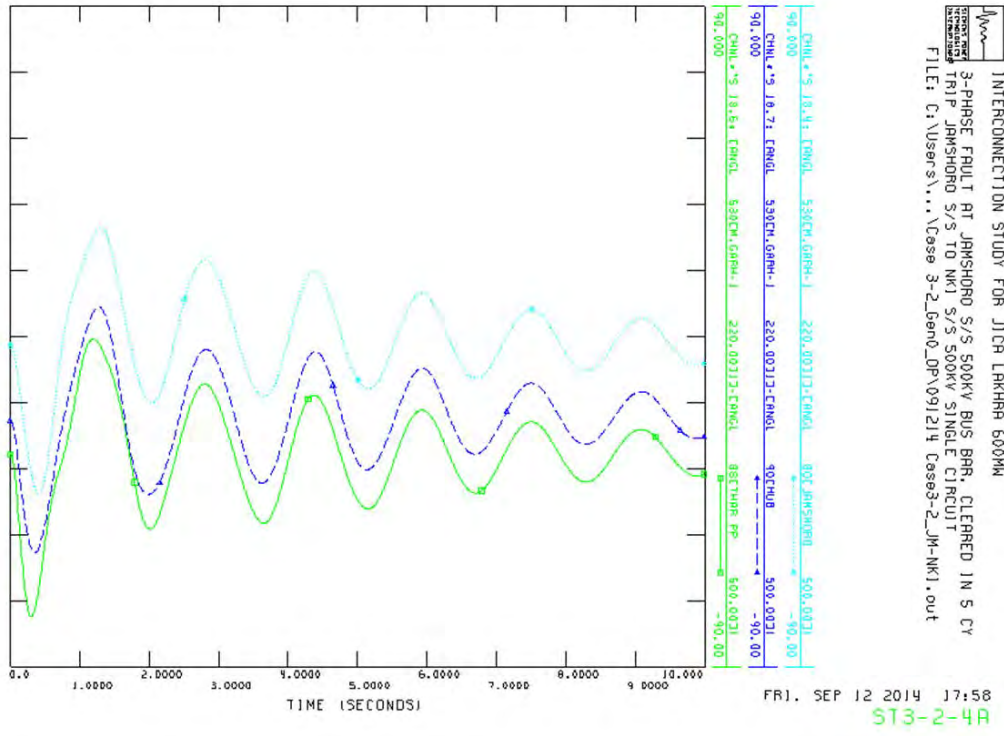
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – Gadani S/S

Stability Analysis Result Case ST-3-2

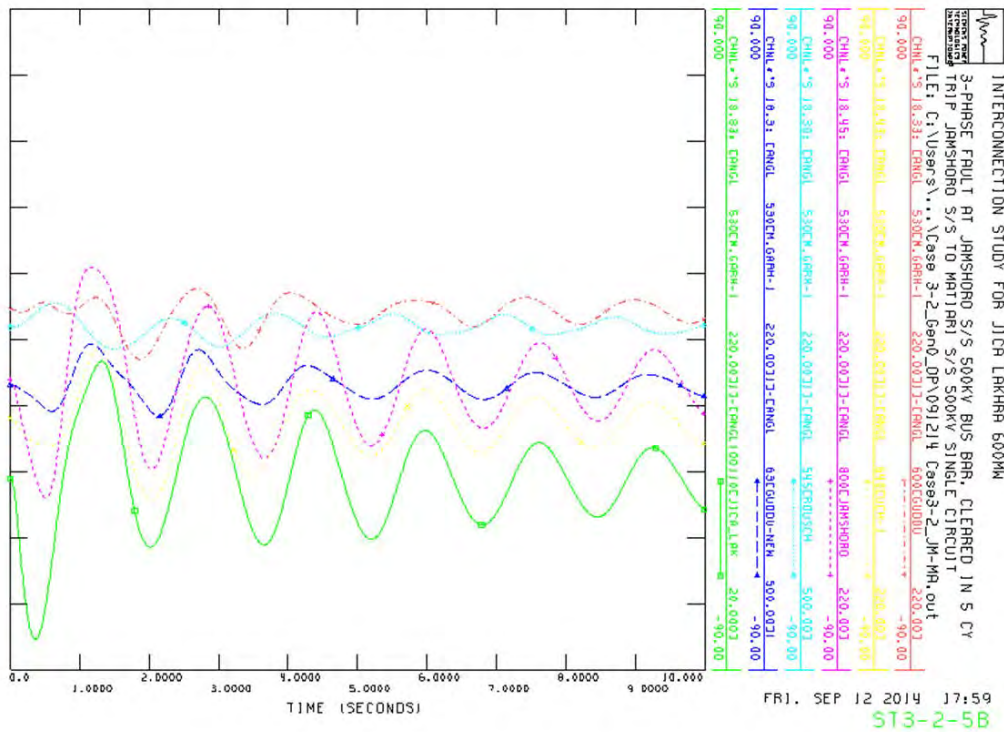
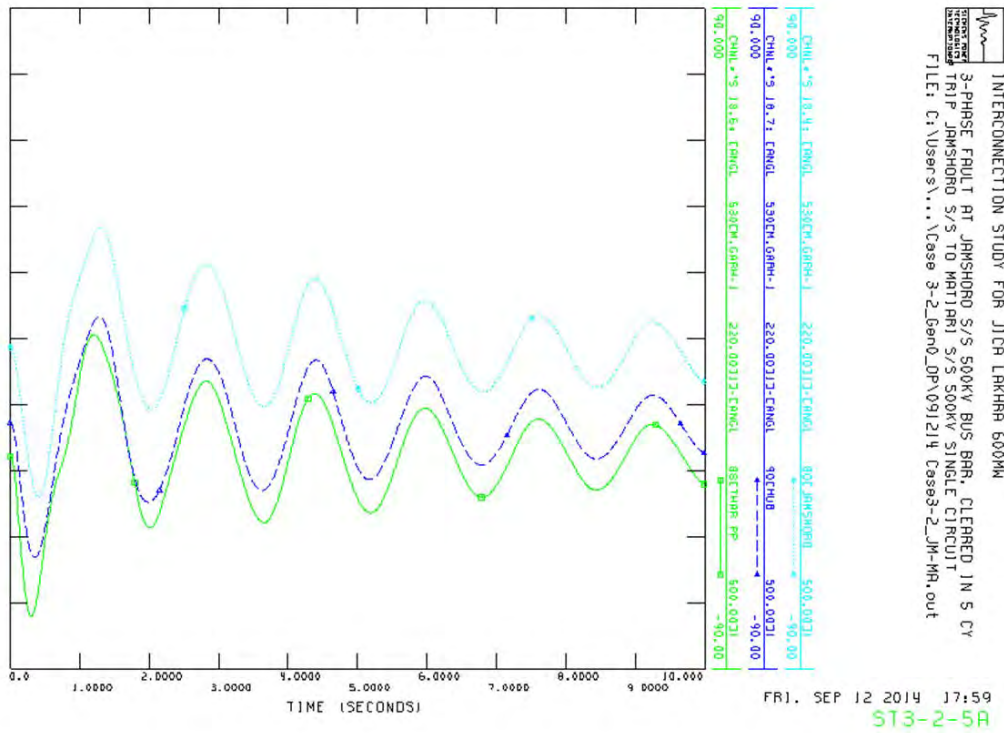
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – NK1 S/S

Stability Analysis Result Case ST-3-2

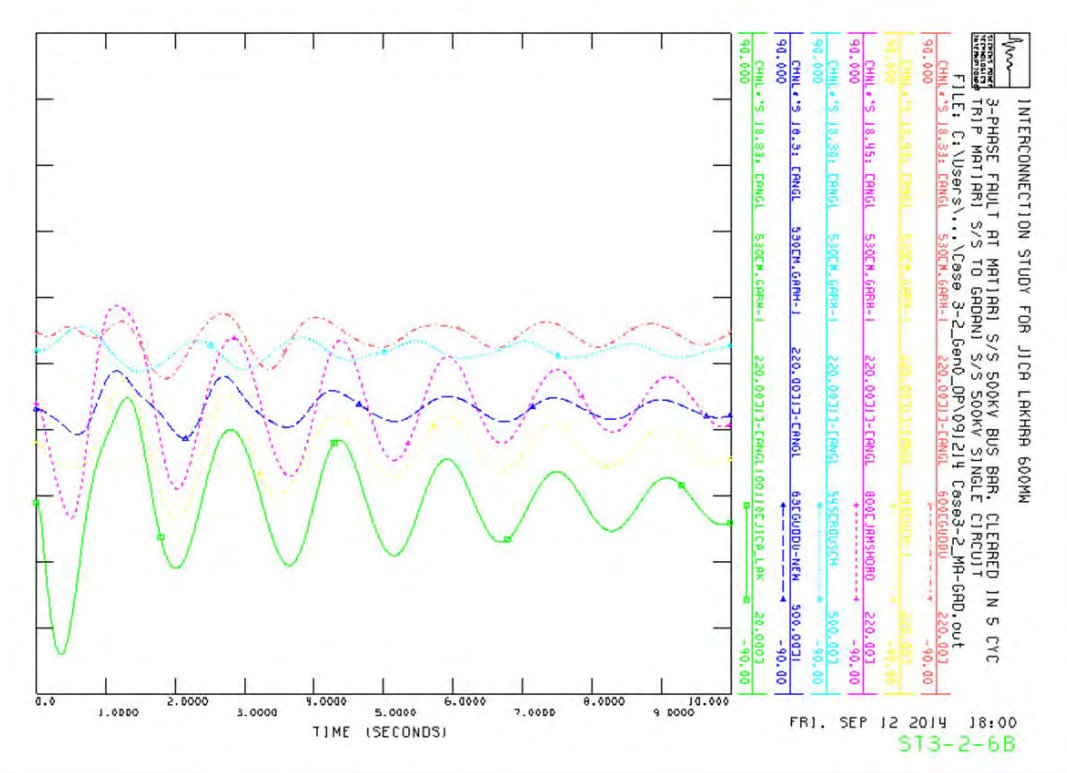
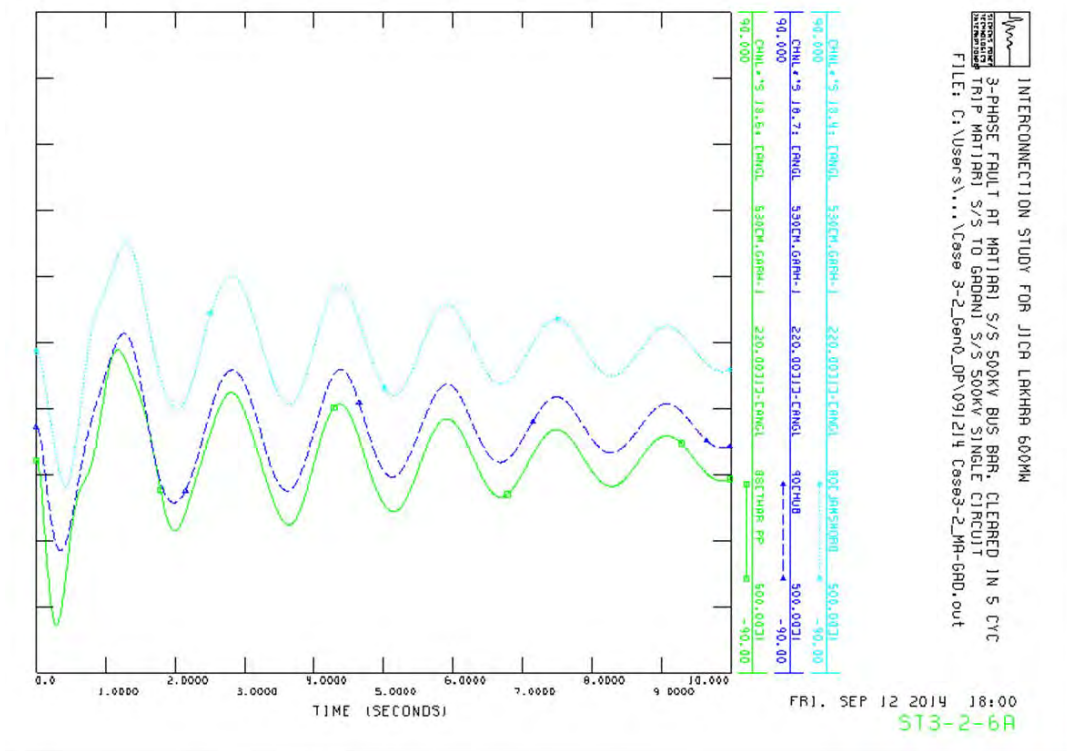
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Jamshoro S/S – Matiari S/S

Stability Analysis Result Case ST-3-2

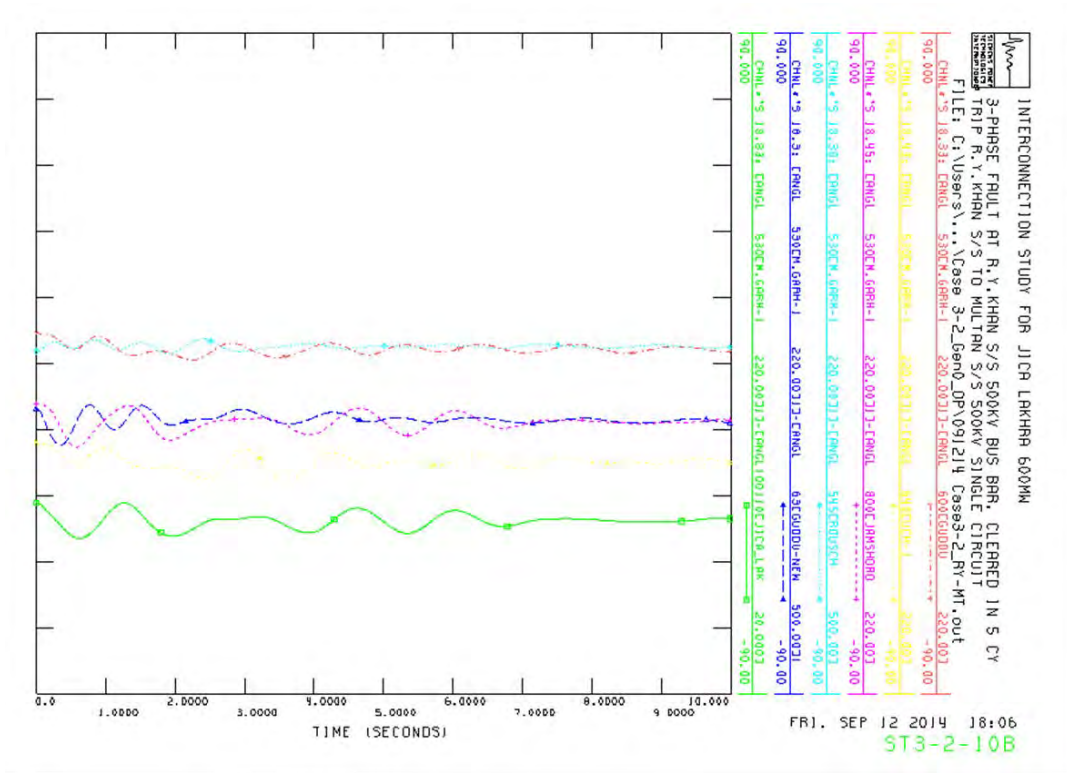
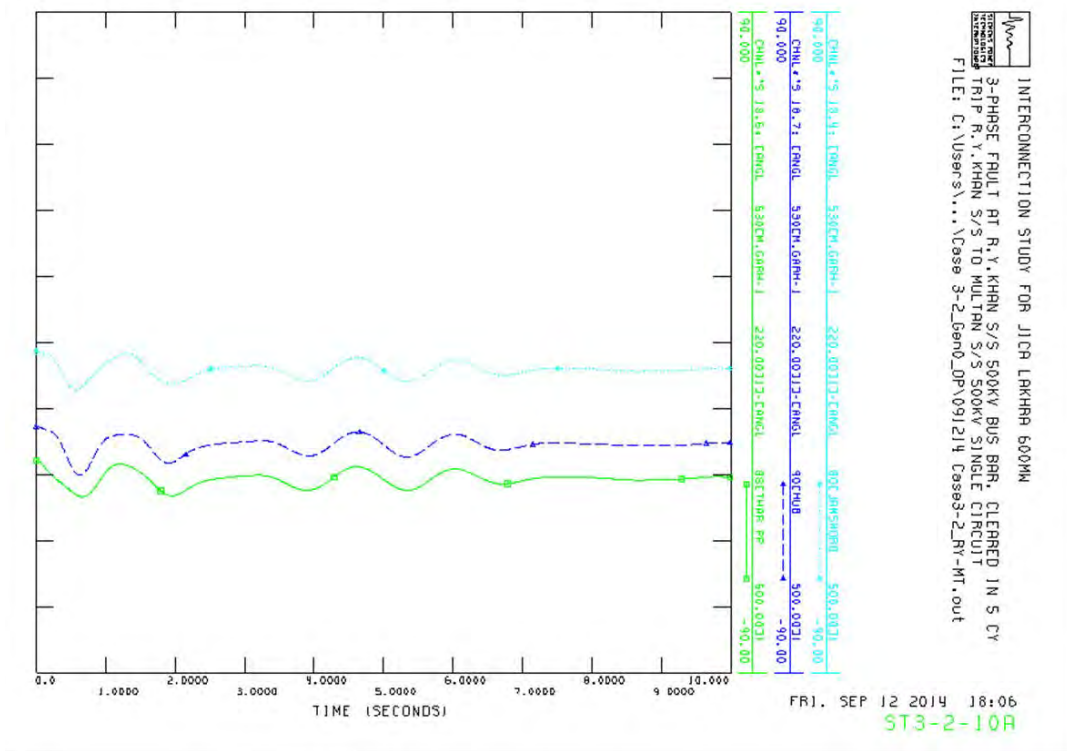
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Matiari S/S – Gadani S/S

Stability Analysis Result Case ST-3-2

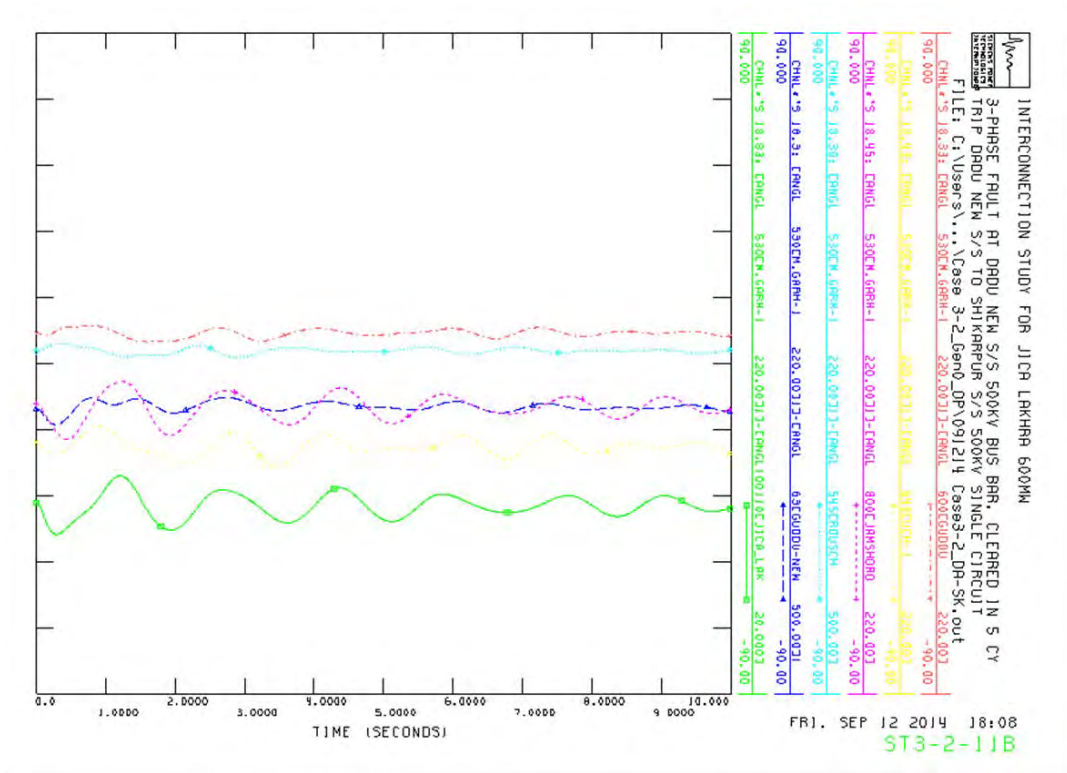
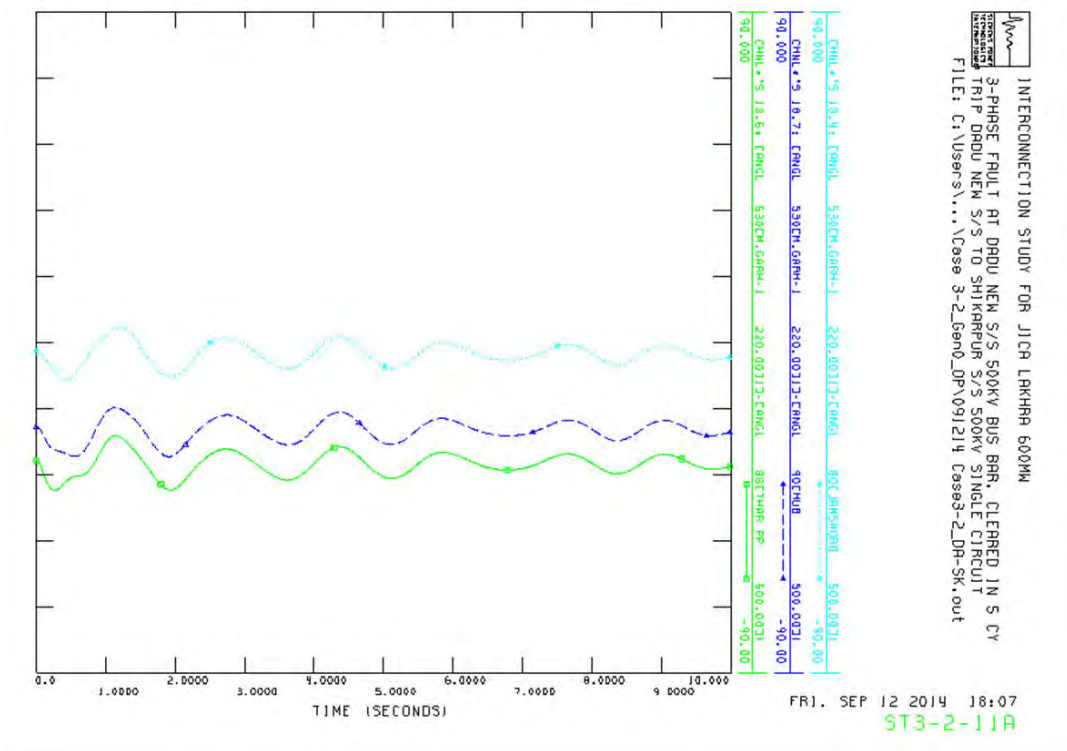
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Fault Section: R. Y. Khan PP – Multan S/S

Stability Analysis Result Case ST-3-2

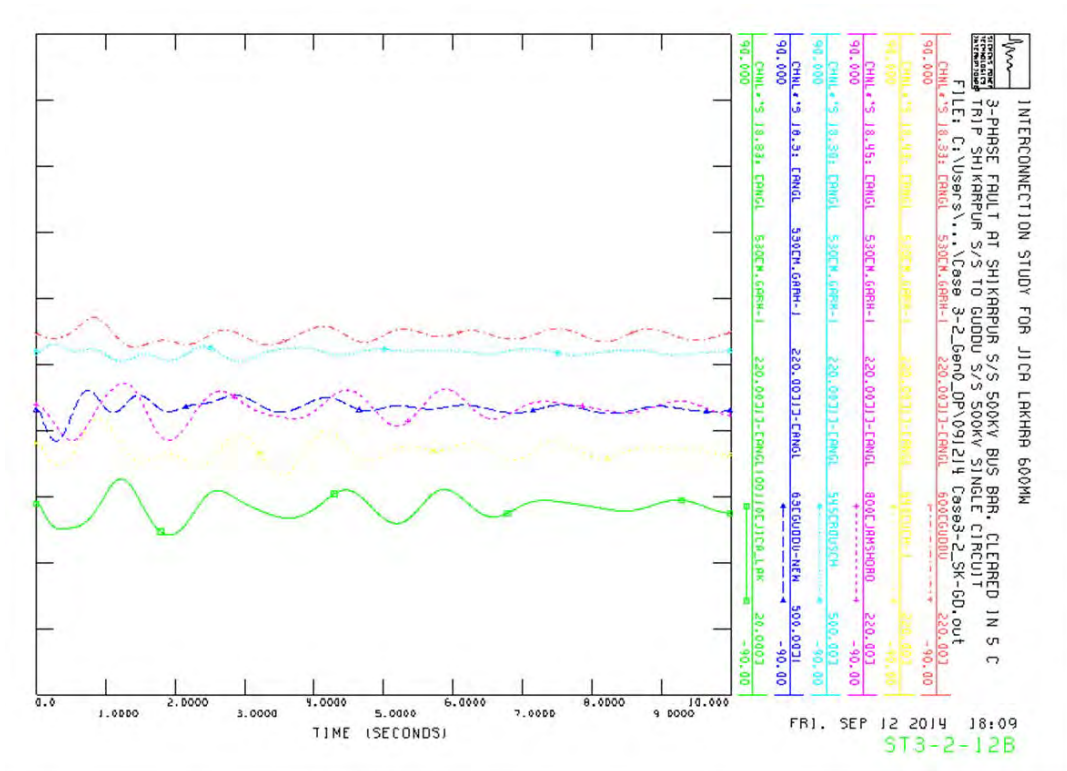
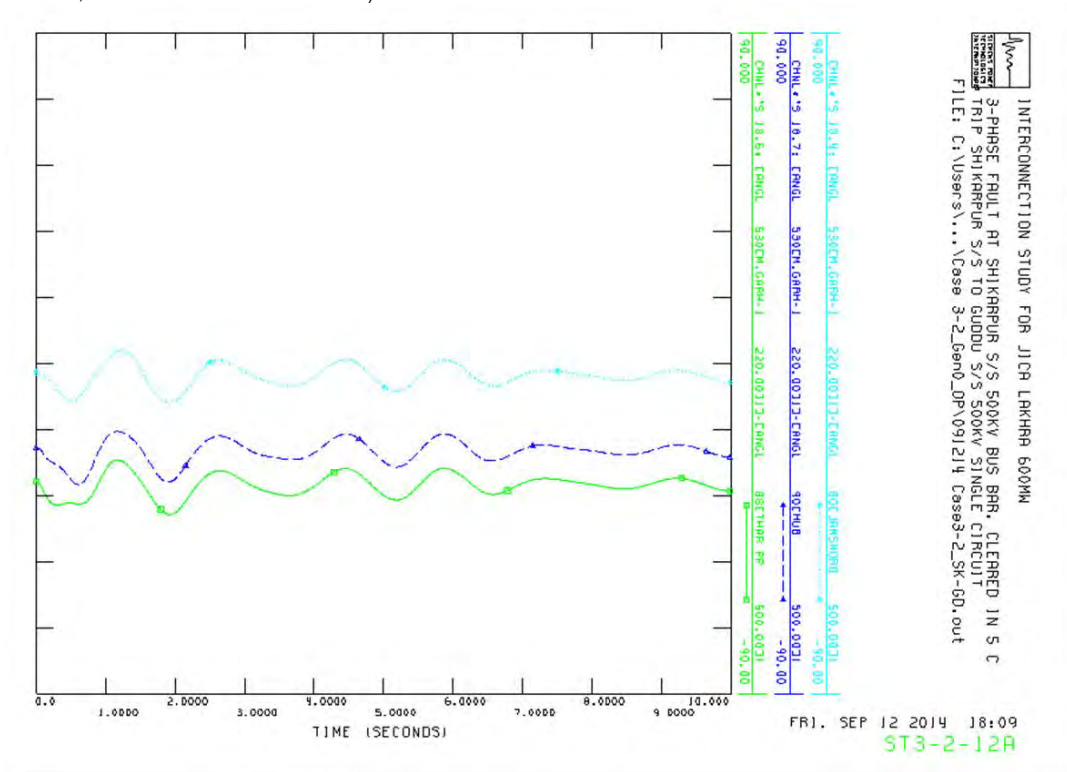
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Fault Section: Dadu New S/S – Shikarpur S/S

Stability Analysis Result Case ST-3-2

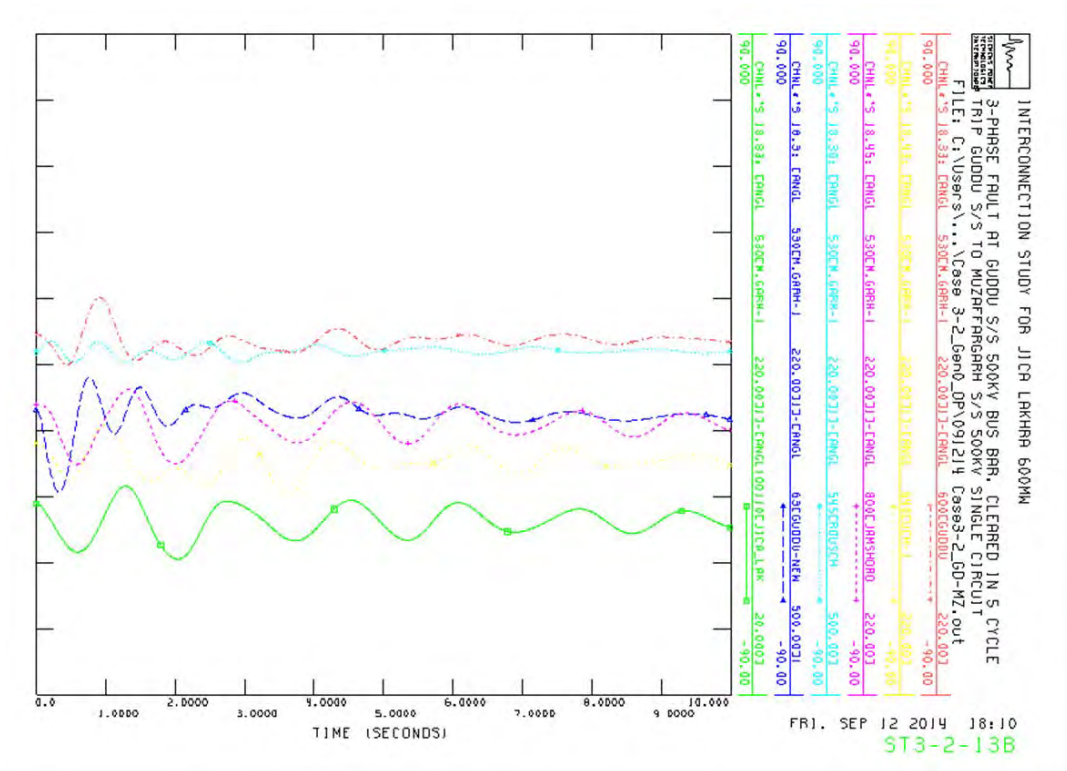
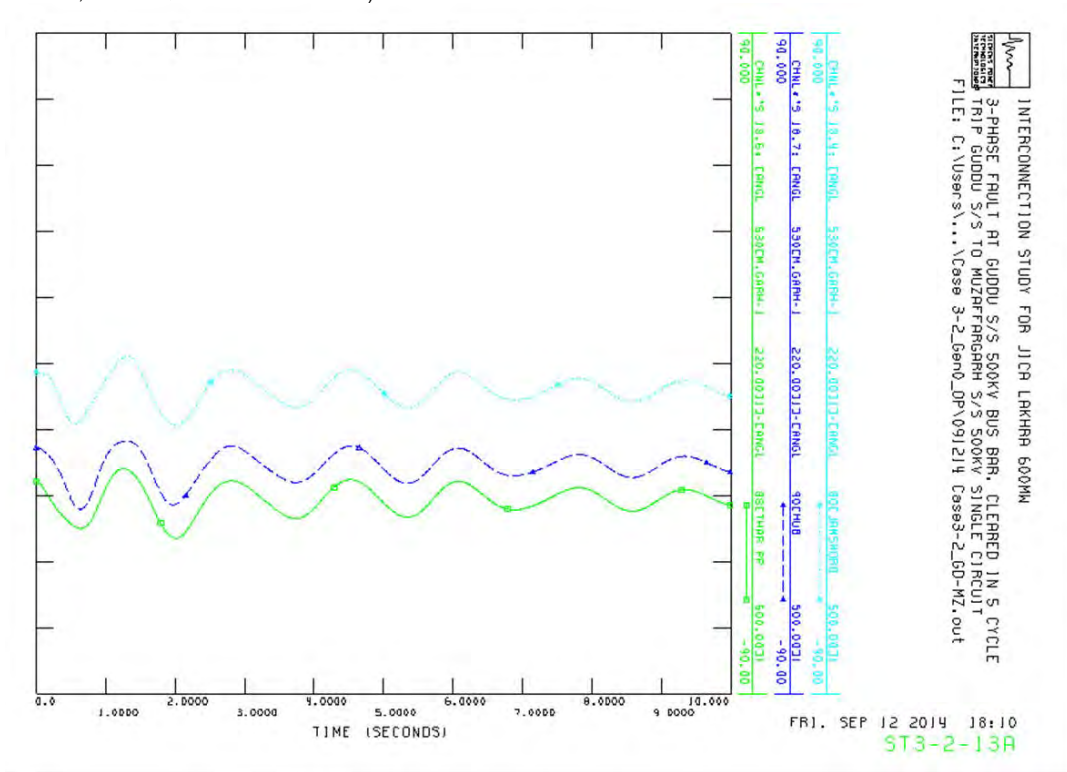
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Fault Section: Shikrapur S/S – Guddu S/S

Stability Analysis Result Case ST-3-2

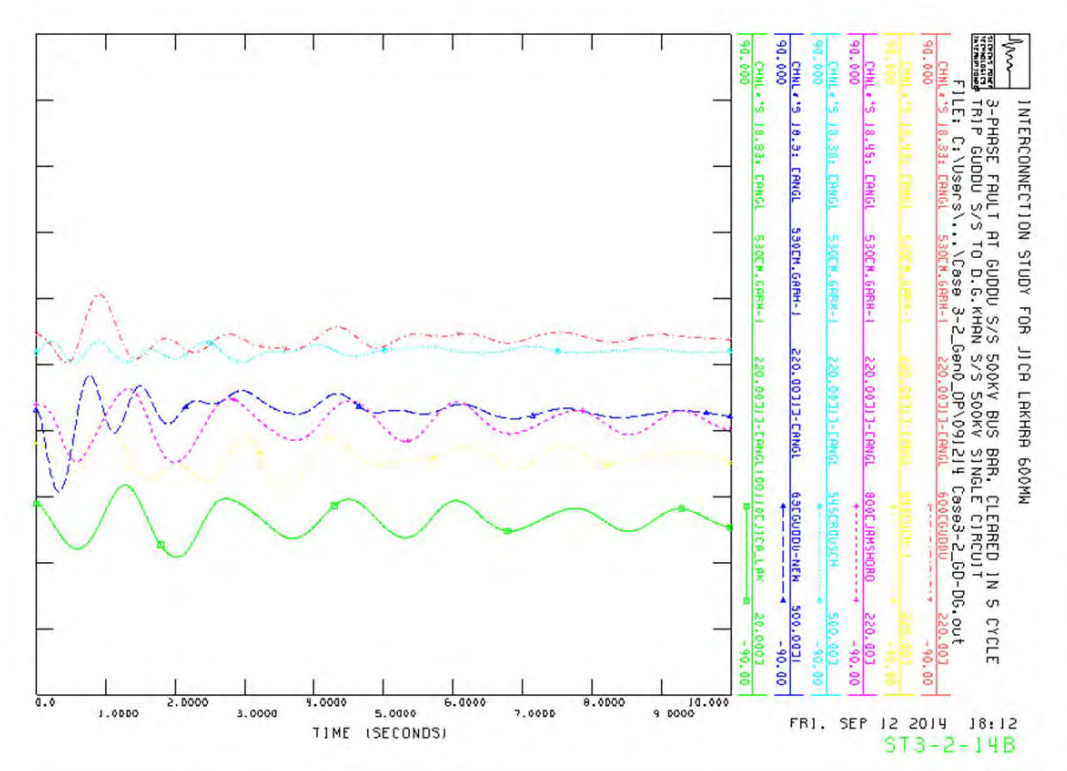
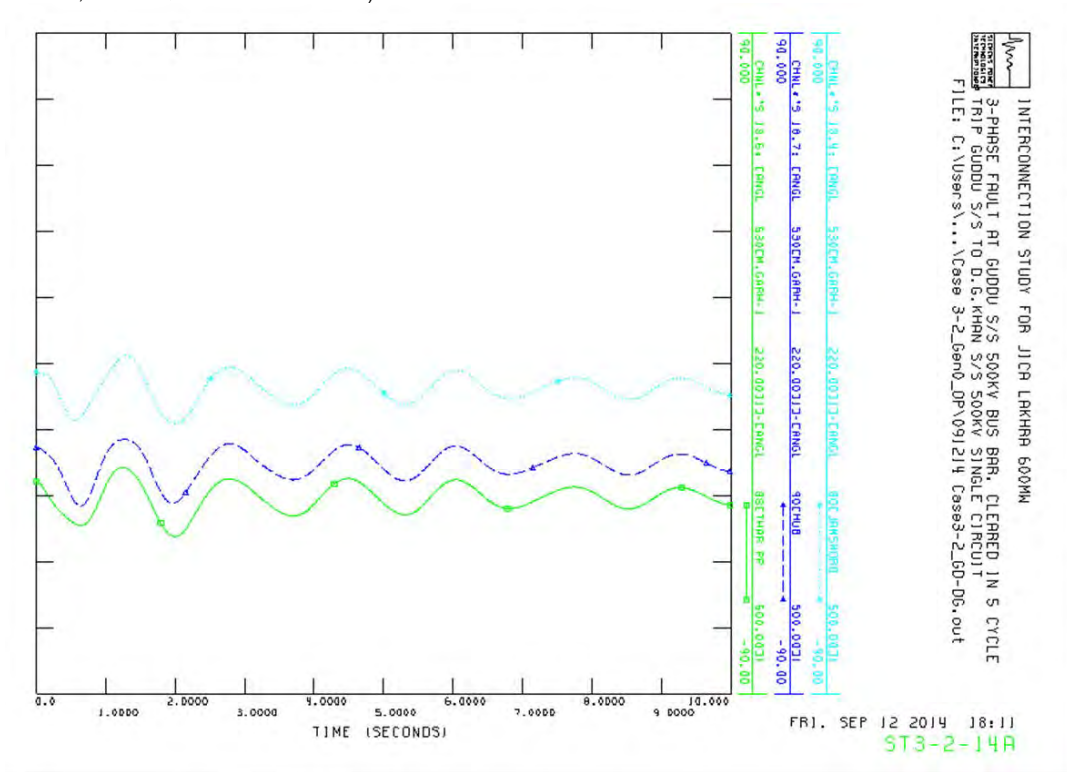
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Fault Section: Guddu S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-3-2

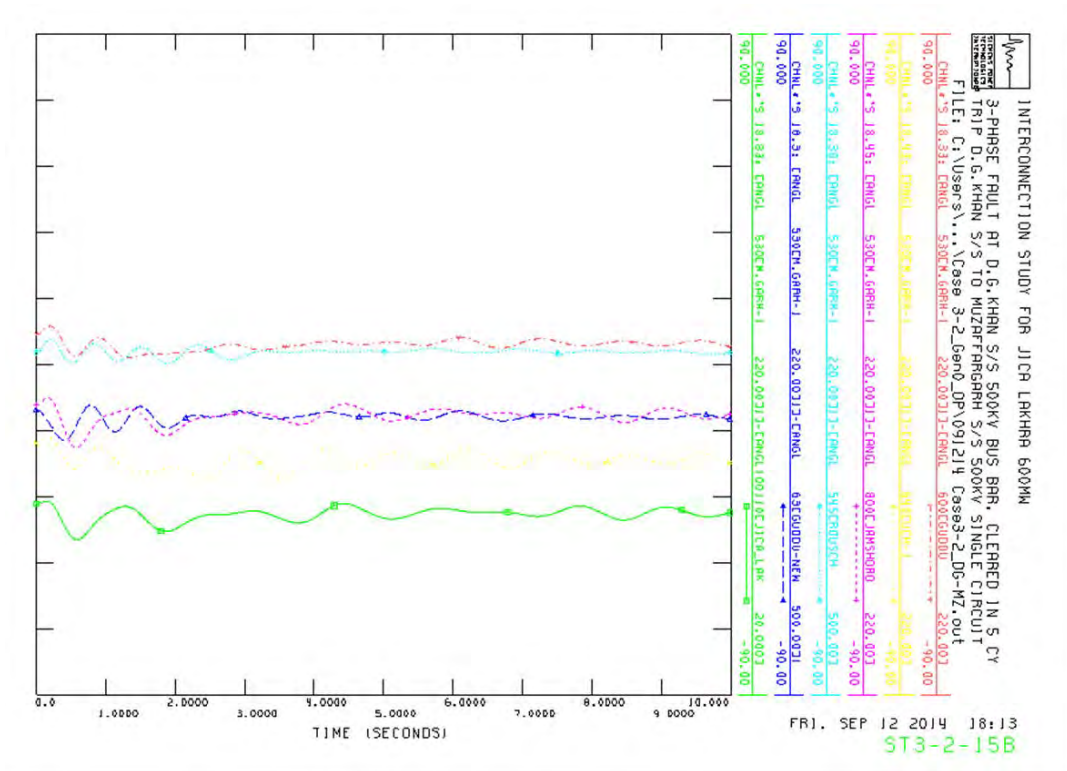
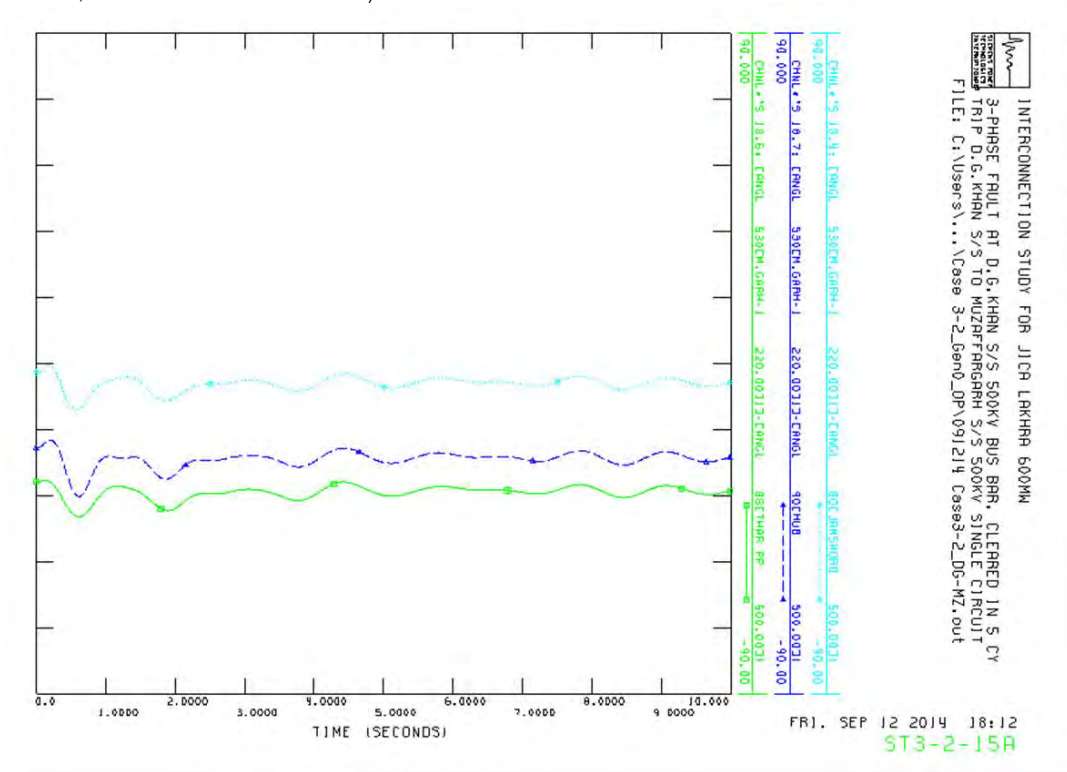
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Fault Section: Guddu S/S – D. G. Khan S/S

Stability Analysis Result Case ST-3-2

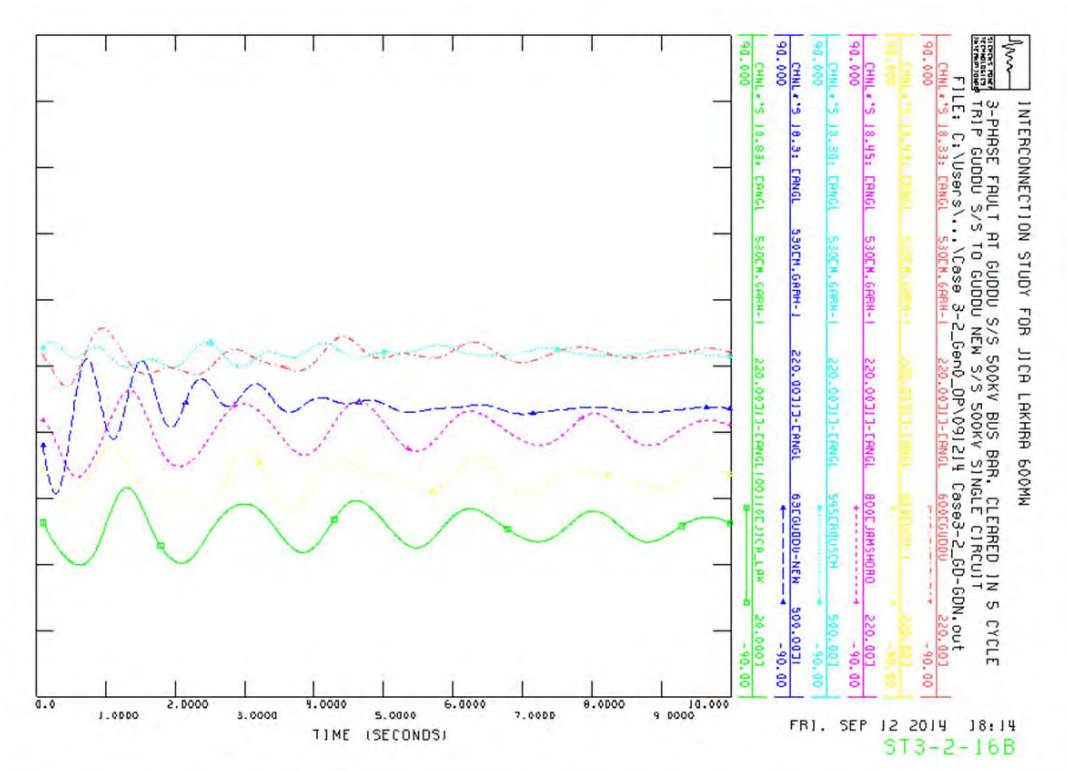
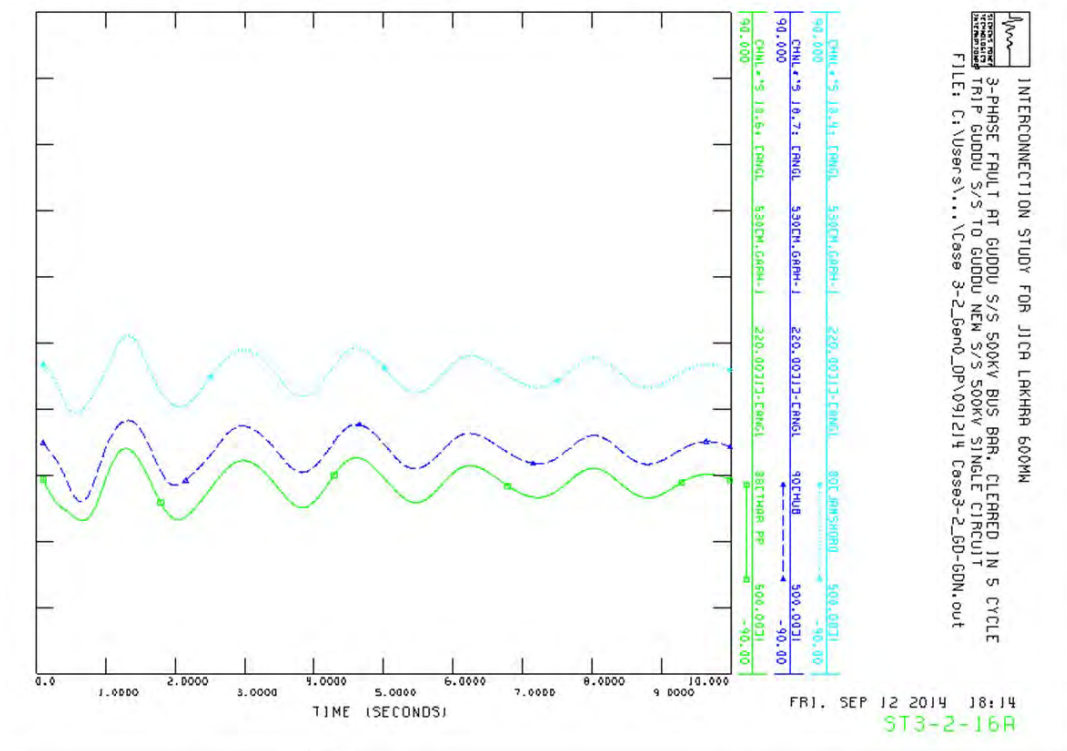
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Fault Section: D. G. Khan S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-3-2

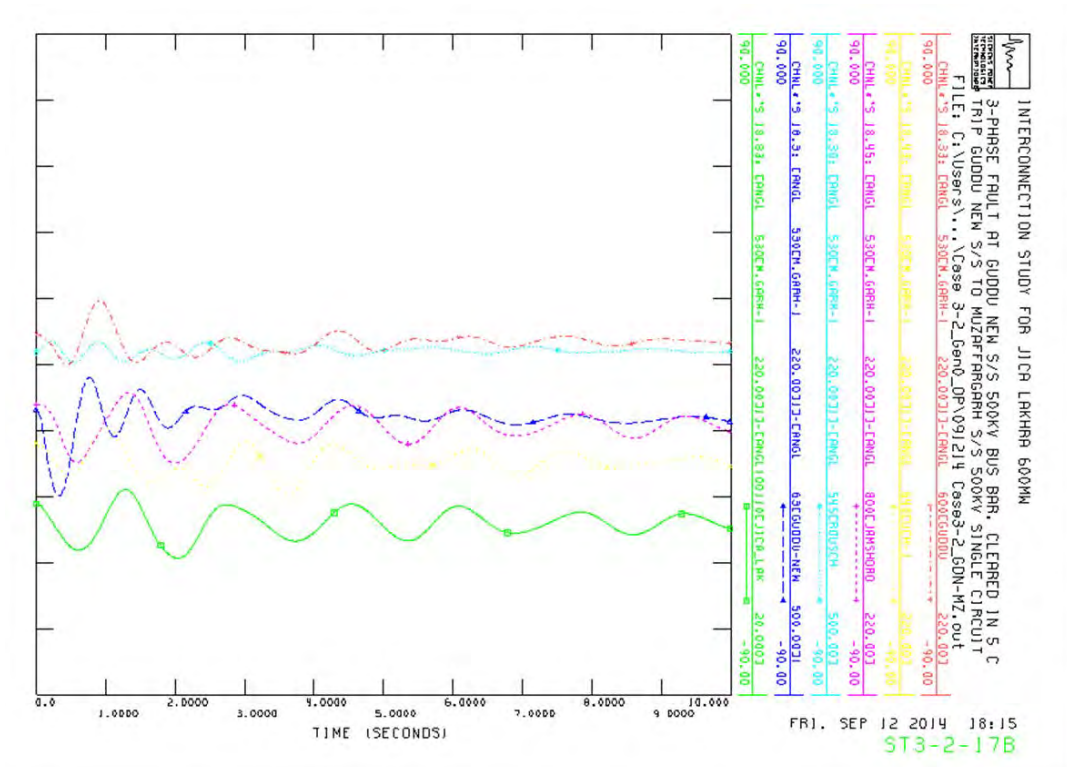
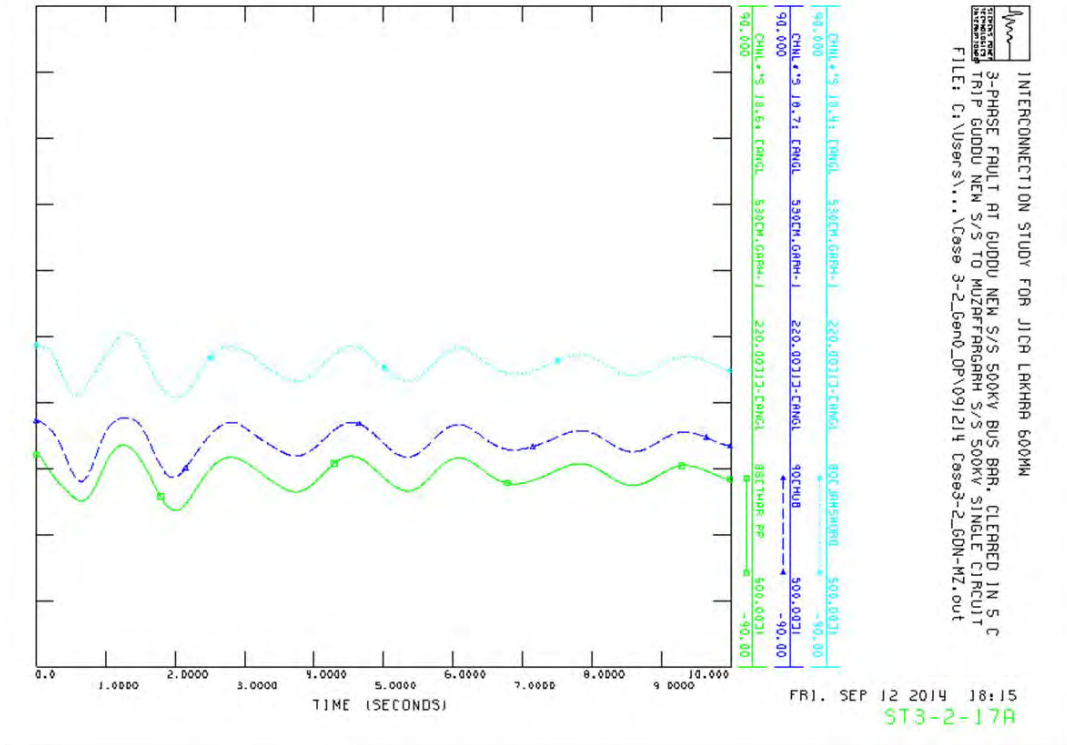
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Fault Section: Guddu S/S – Guddu New PP

Stability Analysis Result Case ST-3-2

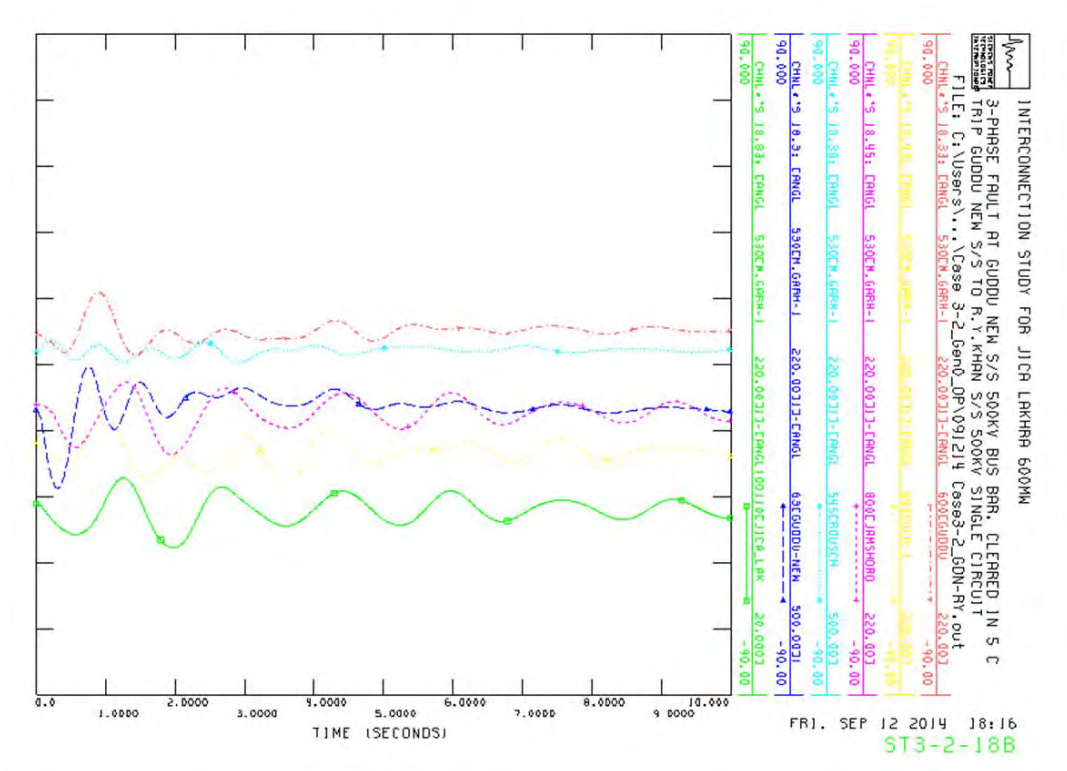
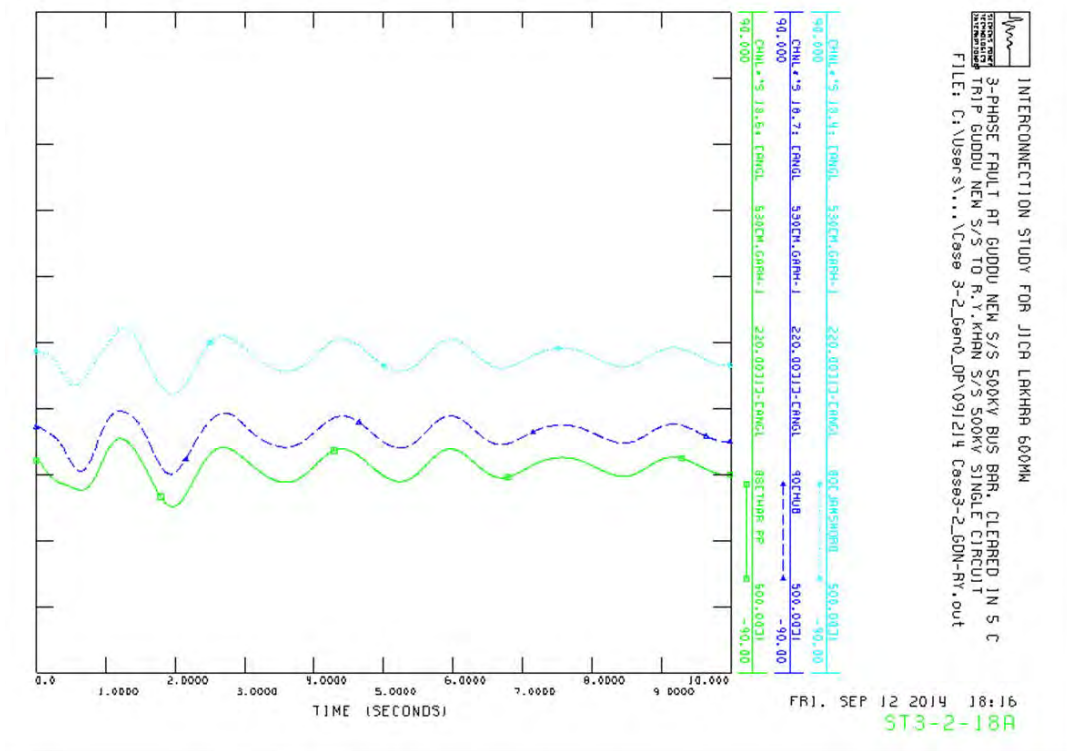
(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Guddu New PP – Muzaffargarh S/S

Stability Analysis Result Case ST-3-2

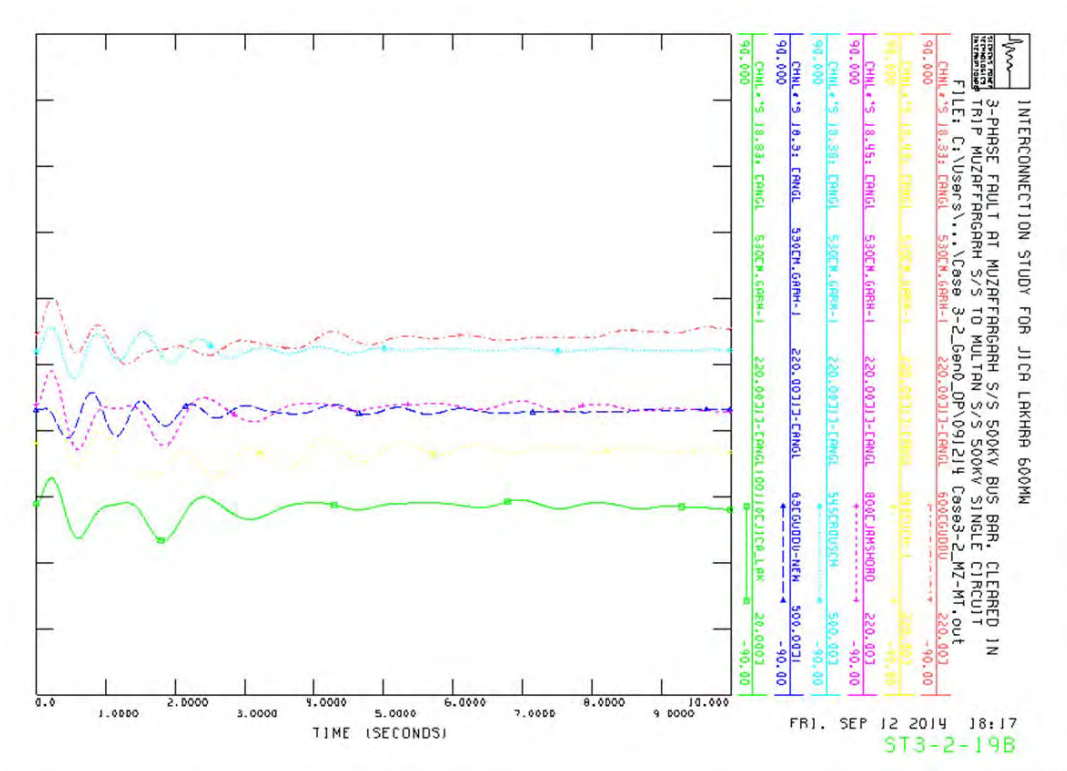
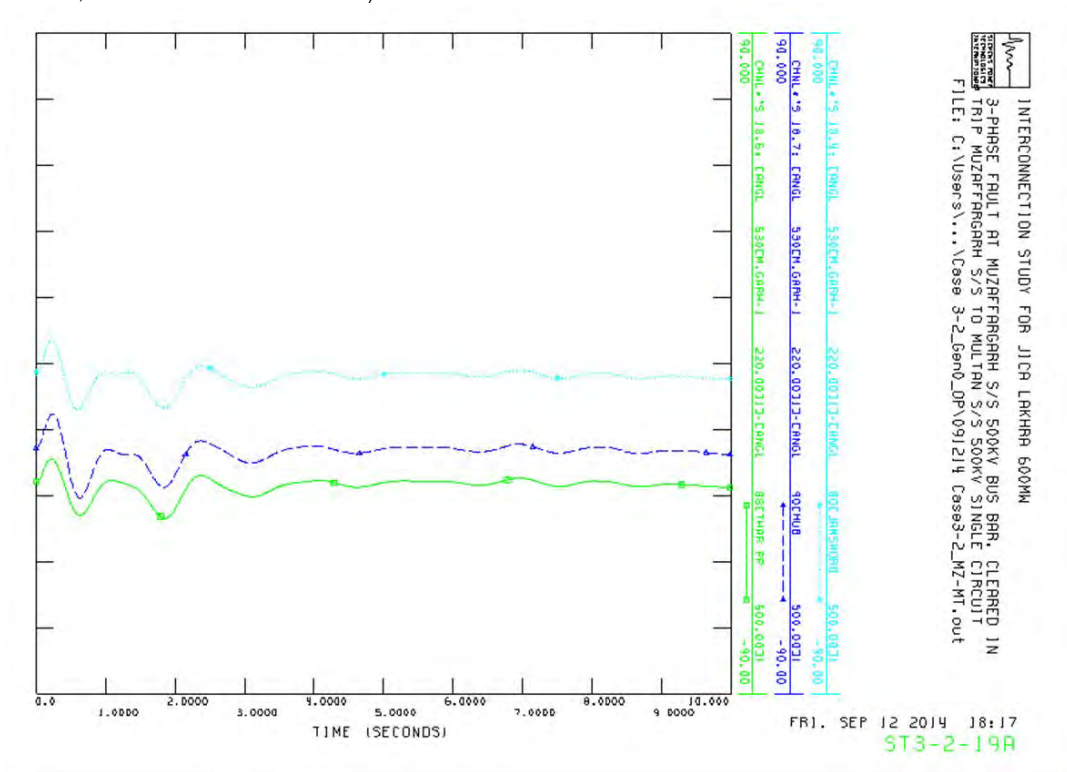
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Fault Section: Guddu New PP – R. Y. Khan S/S

Stability Analysis Result Case ST-3-2

(Lakhra PP 2 π Connection, Lakhra PP – Matiari S/S: 2cct, Lakhra PP – Dadu New S/S: 2cct Open, Matiari S/S – Moro S/S: 1cct Open, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: Out of service)



Fault Section: Muzaffargarh S/S – Multan S/S

6 - 6 STABILITY ANALYSIS CASE ST4-1

Stability Analysis Result Case ST-4-1

(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)

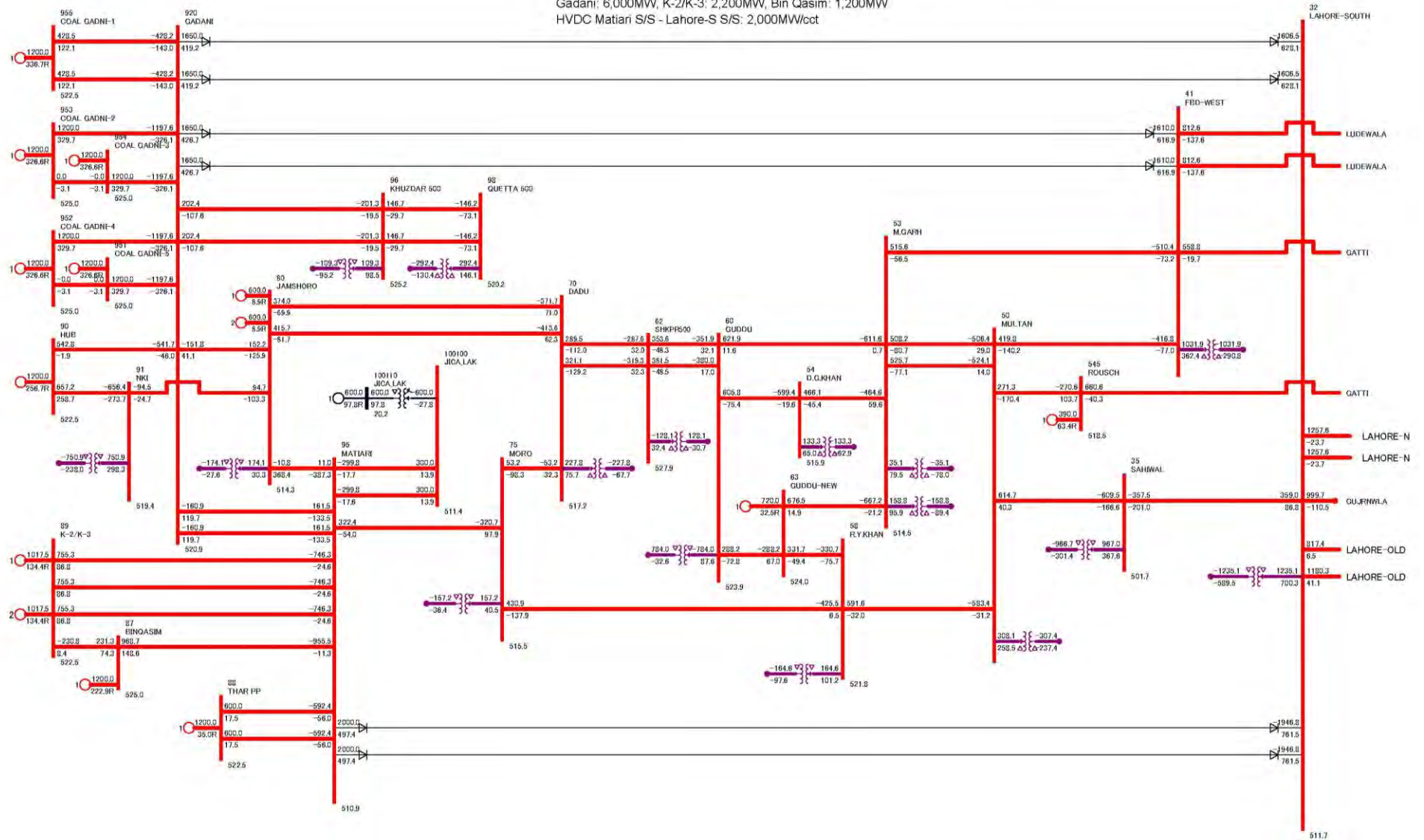
Power Flow Analysis Result: Case 4-1

Winter Case Jan-2021 (JICA Lakhra 600MW, Jamshoro 1,200MW, Thar 1,200MW)

(Matiari S/S - JICA Lakhra PP : 2cct)

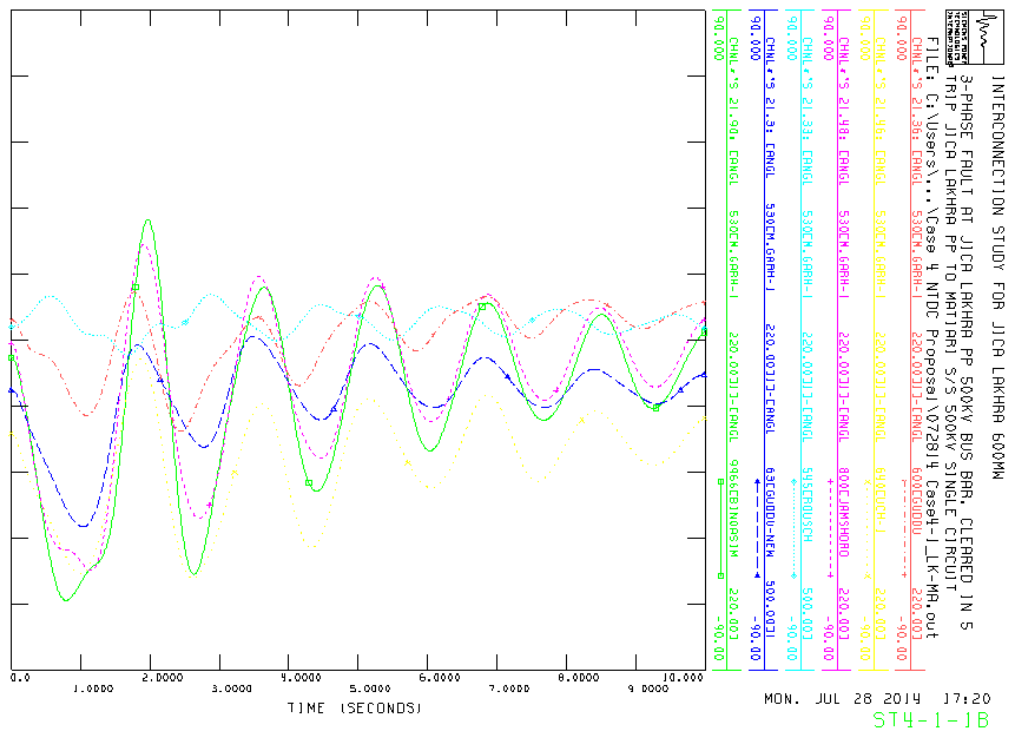
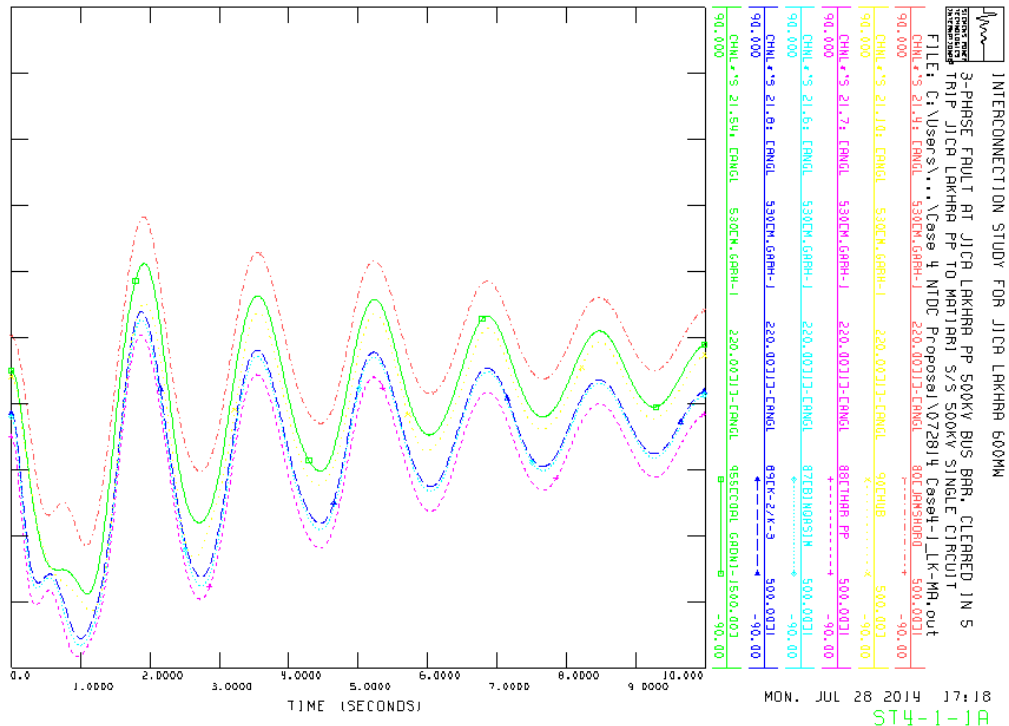
Gadani: 6,000MW, K-2/K-3: 2,200MW, Bin Qasim: 1,200MW

HVDC Matiari S/S - Lahore-S S/S: 2,000MW/cct



Stability Analysis Result Case ST-4-1

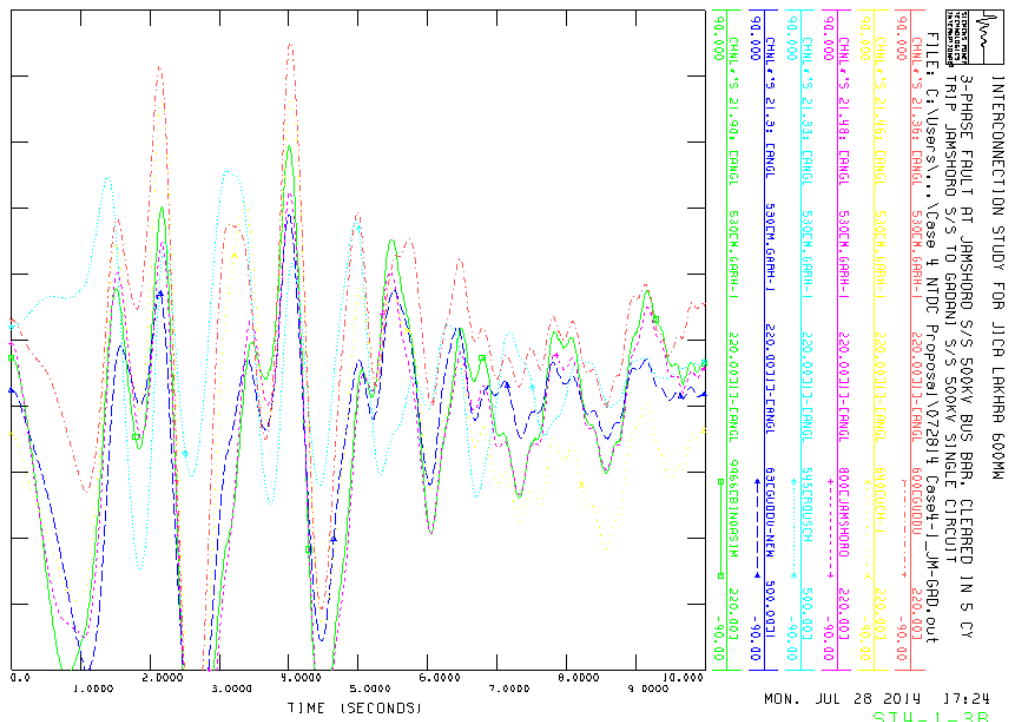
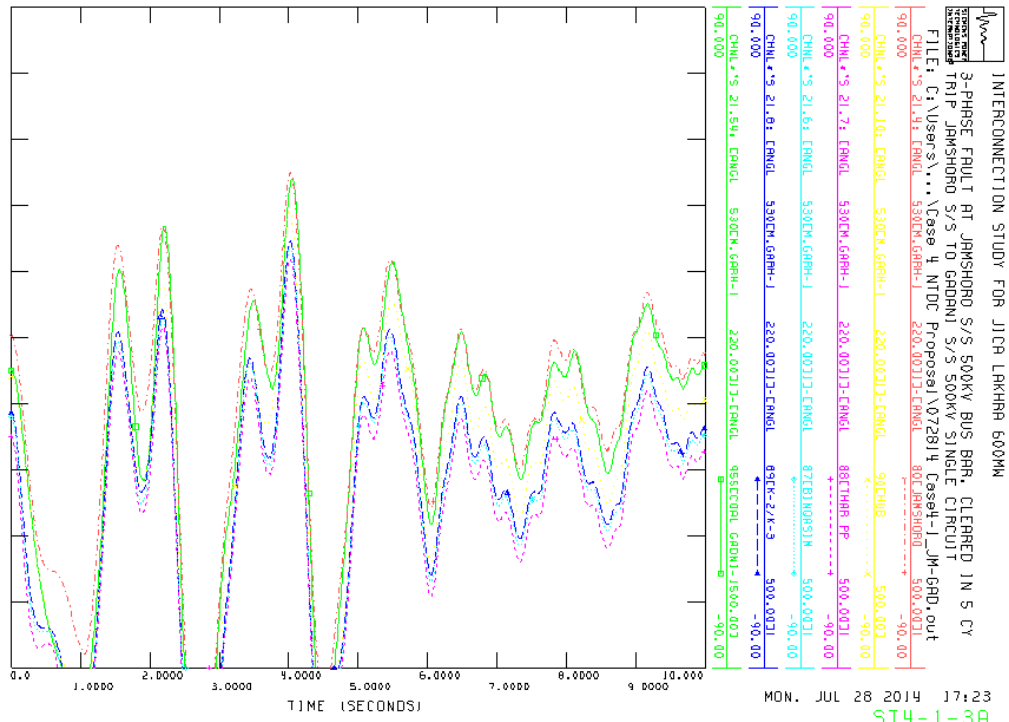
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: JICA Lakhra PP – Matiari S/S

Stability Analysis Result Case ST-4-1

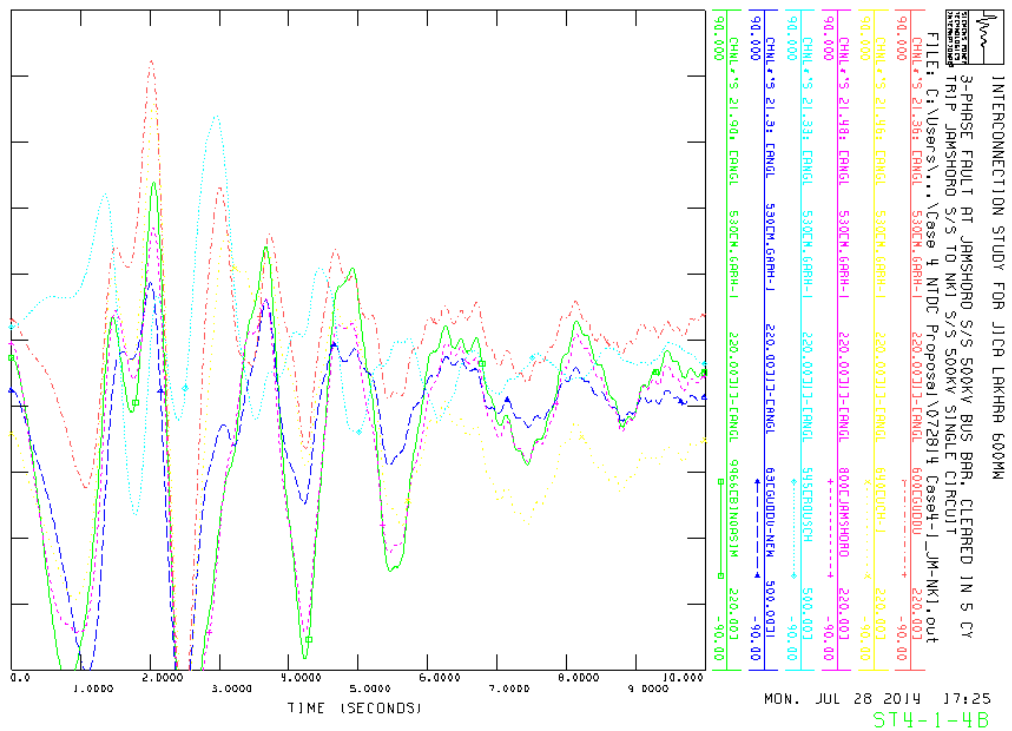
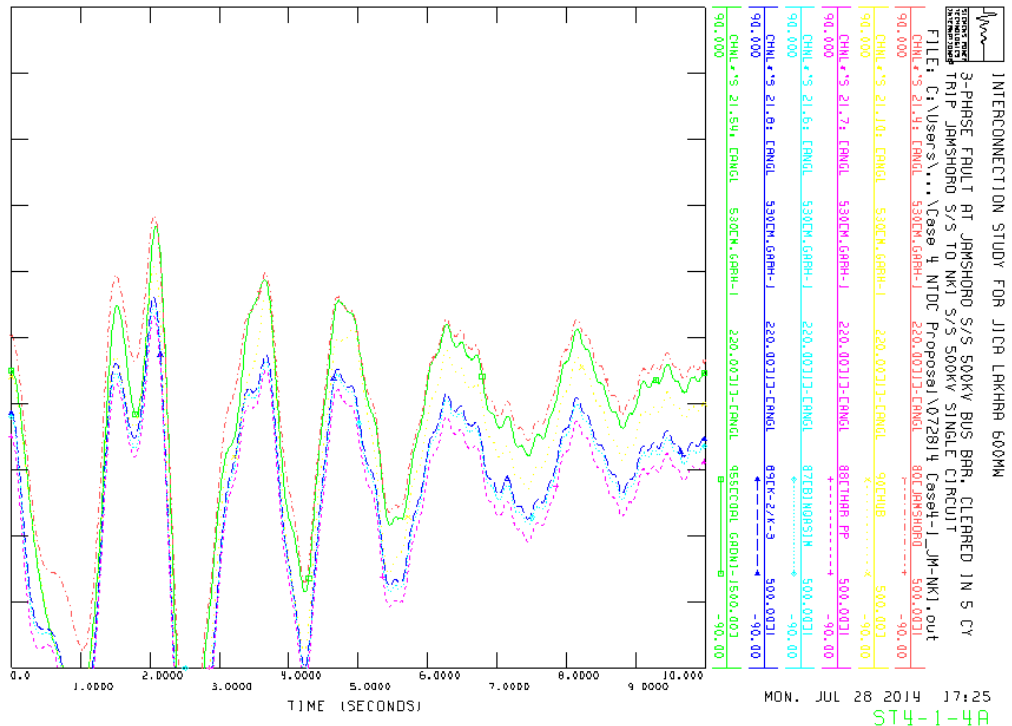
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Jamshoro S/S – Gadani S/S

Stability Analysis Result Case ST-4-1

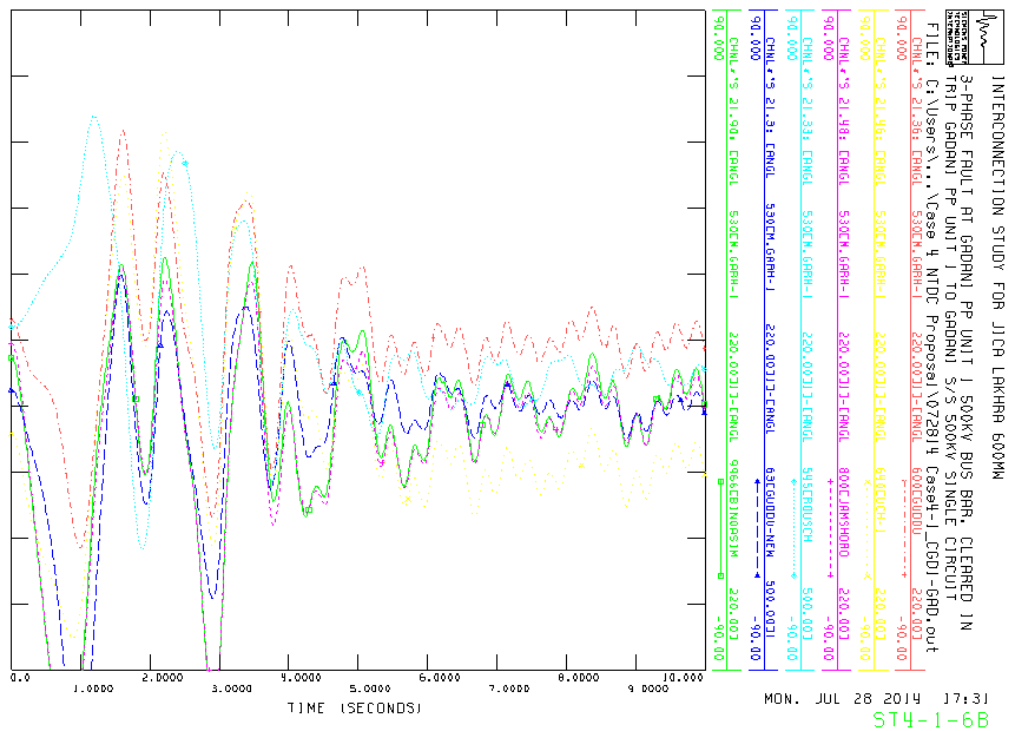
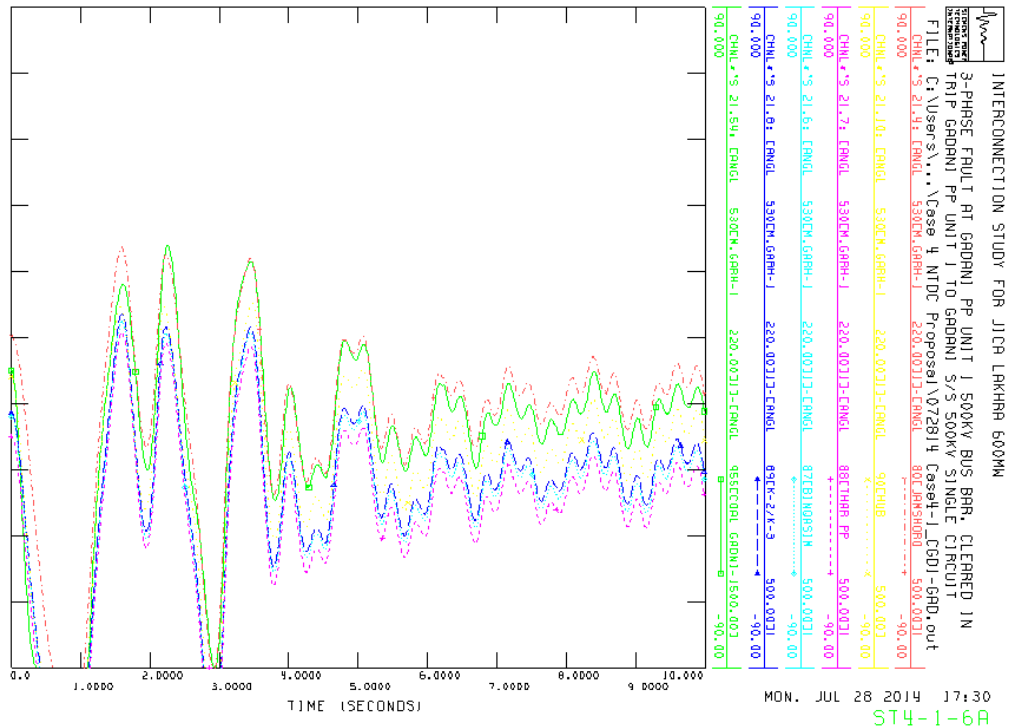
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Jamshoro S/S – NKI S/S

Stability Analysis Result Case ST-4-1

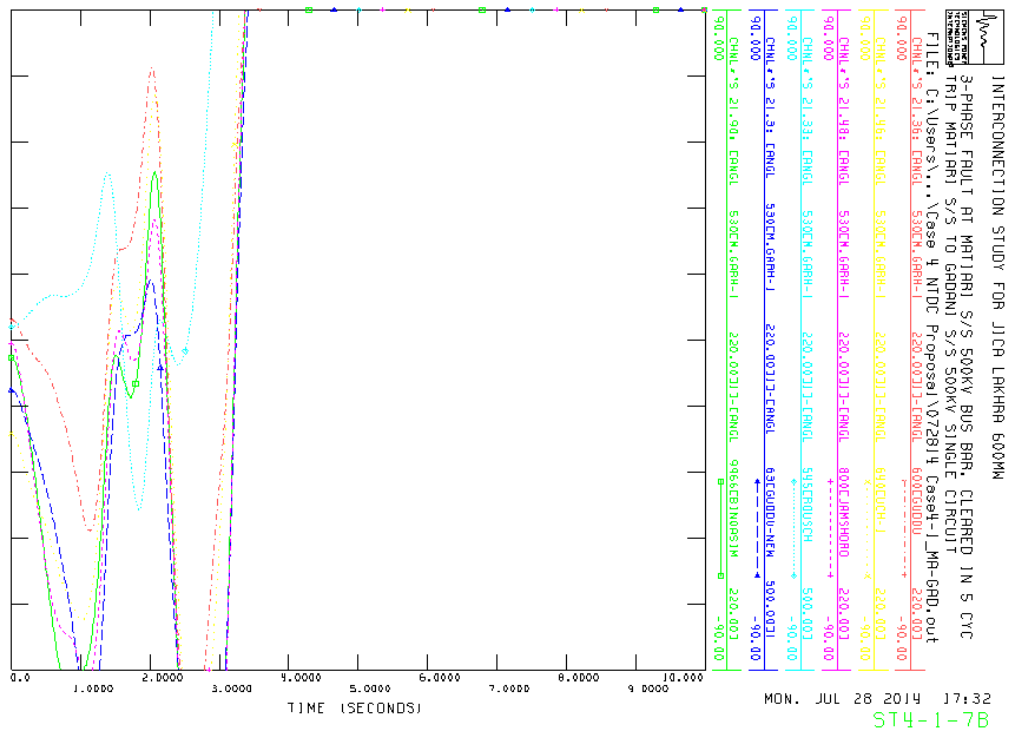
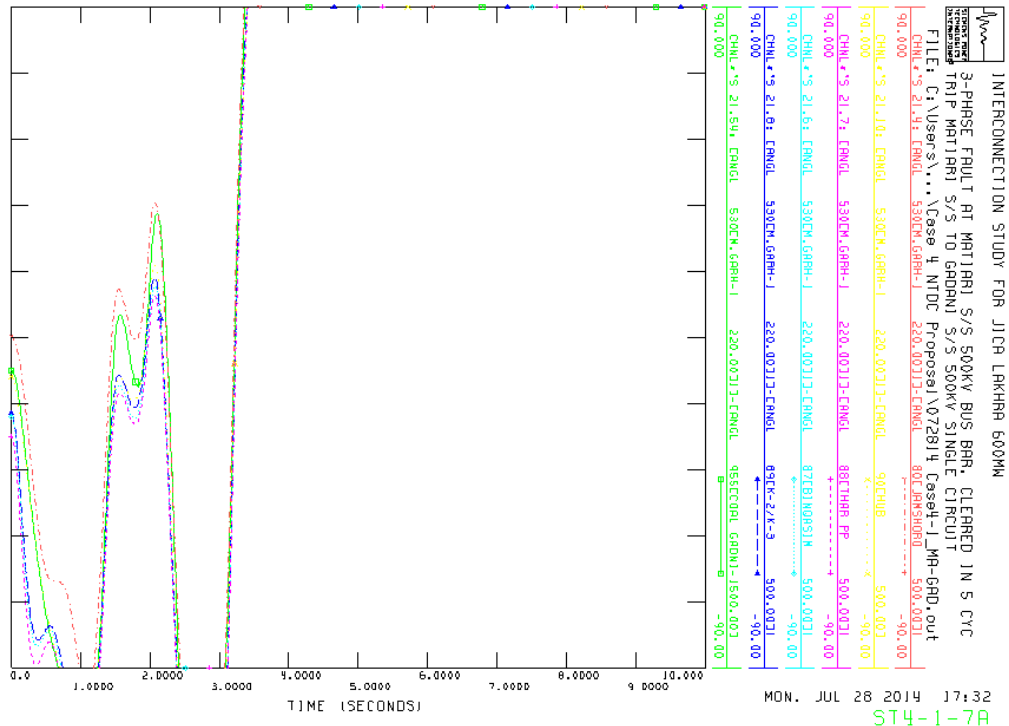
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Coal Gadani PP – Gadani S/S

Stability Analysis Result Case ST-4-1

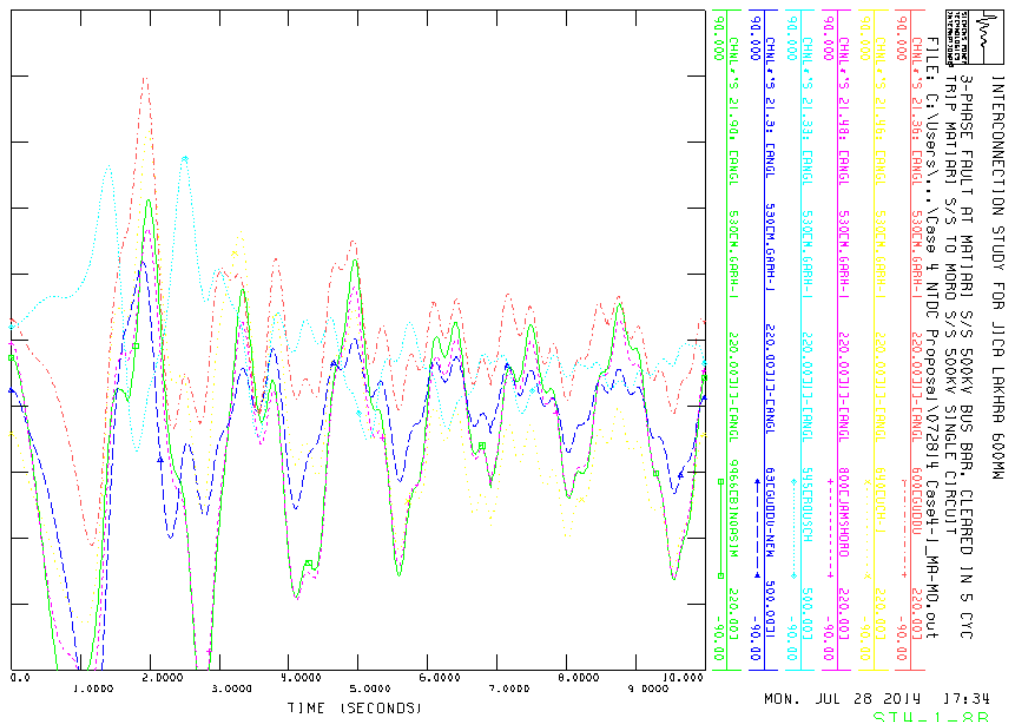
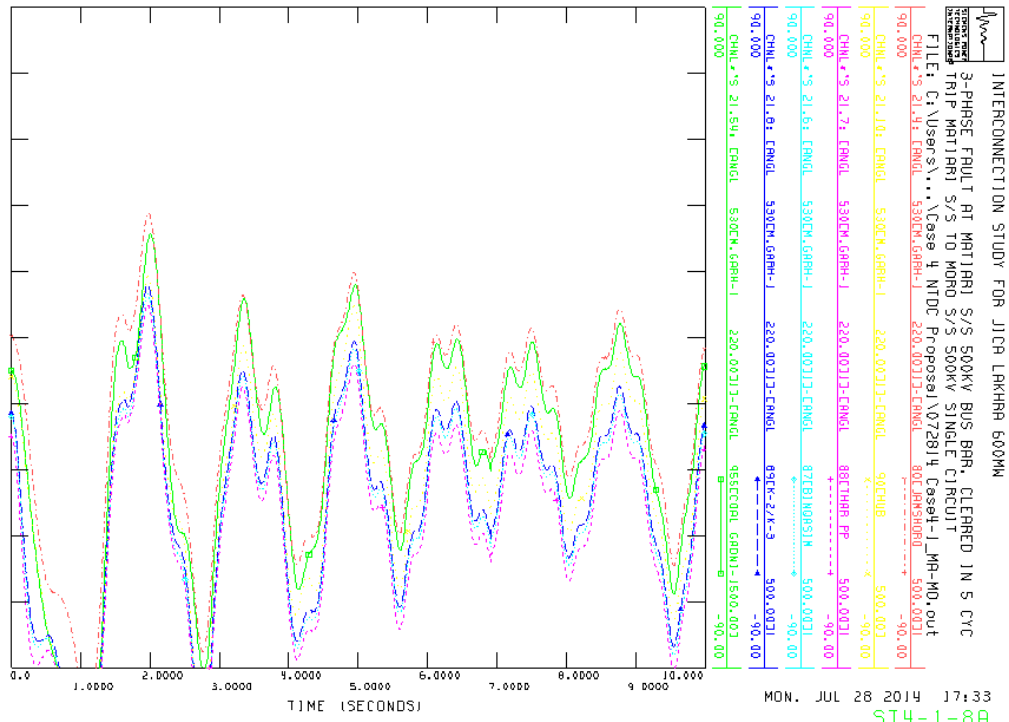
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Matiari S/S – Gadani S/S

Stability Analysis Result Case ST-4-1

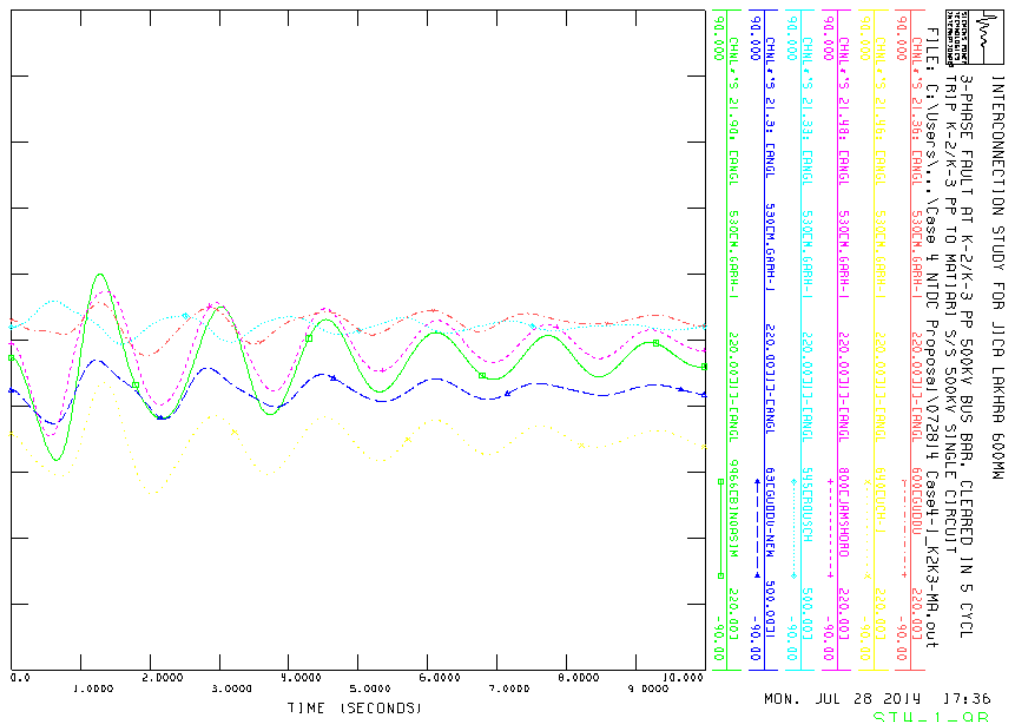
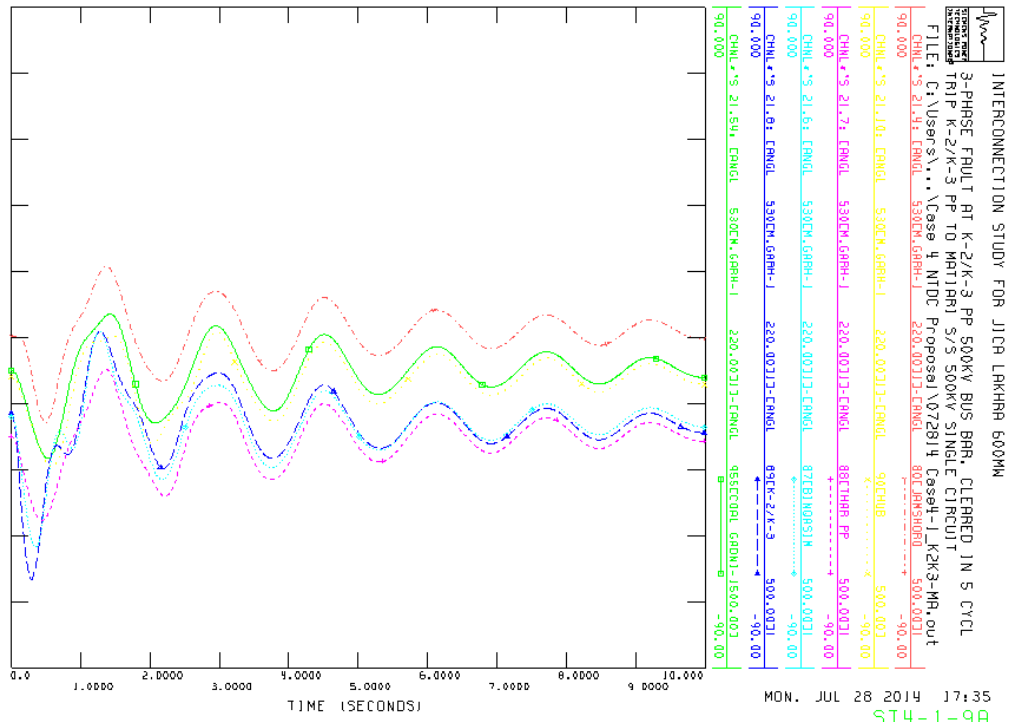
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Matiari S/S – Moro S/S

Stability Analysis Result Case ST-4-1

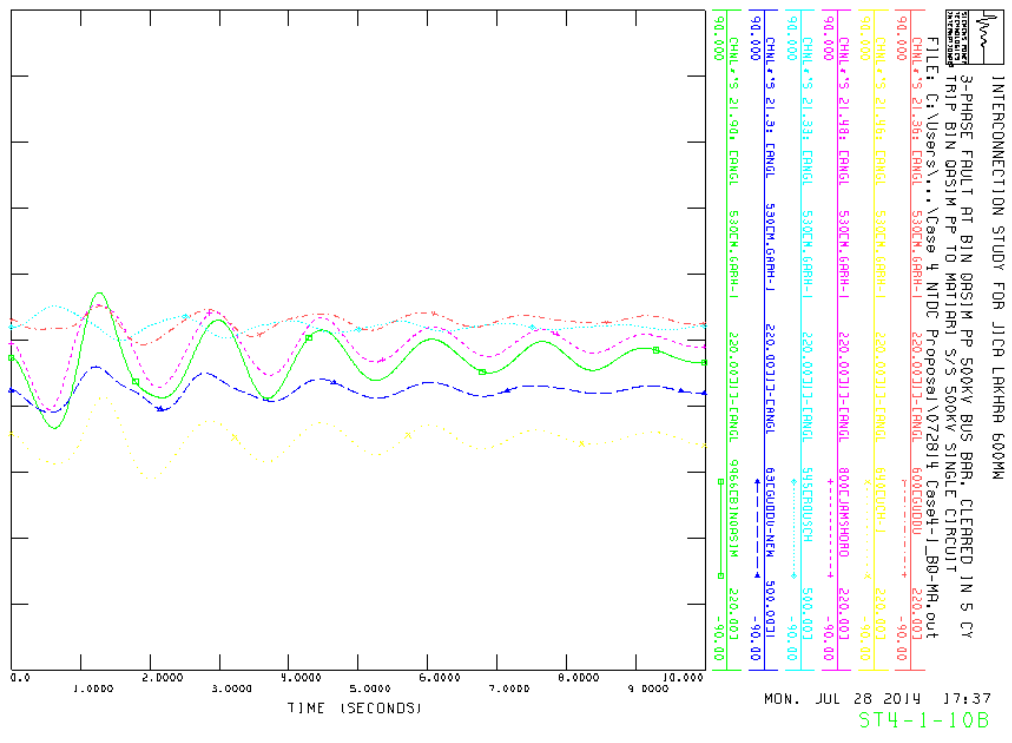
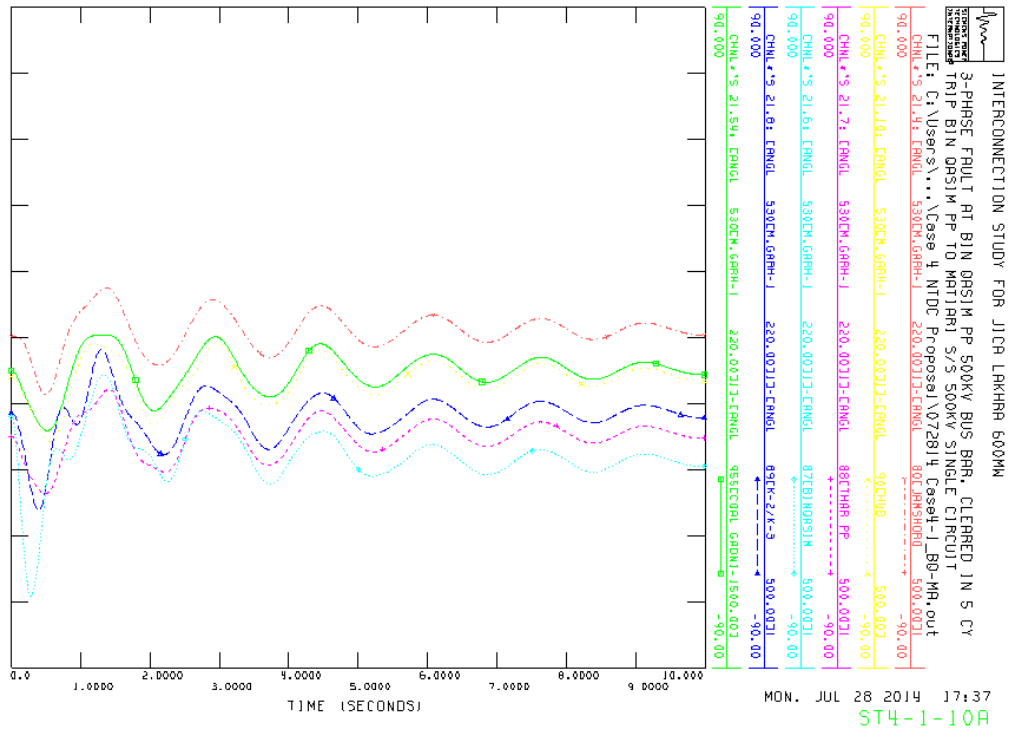
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: K-2/K-3 PP – Matiari S/S

Stability Analysis Result Case ST-4-1

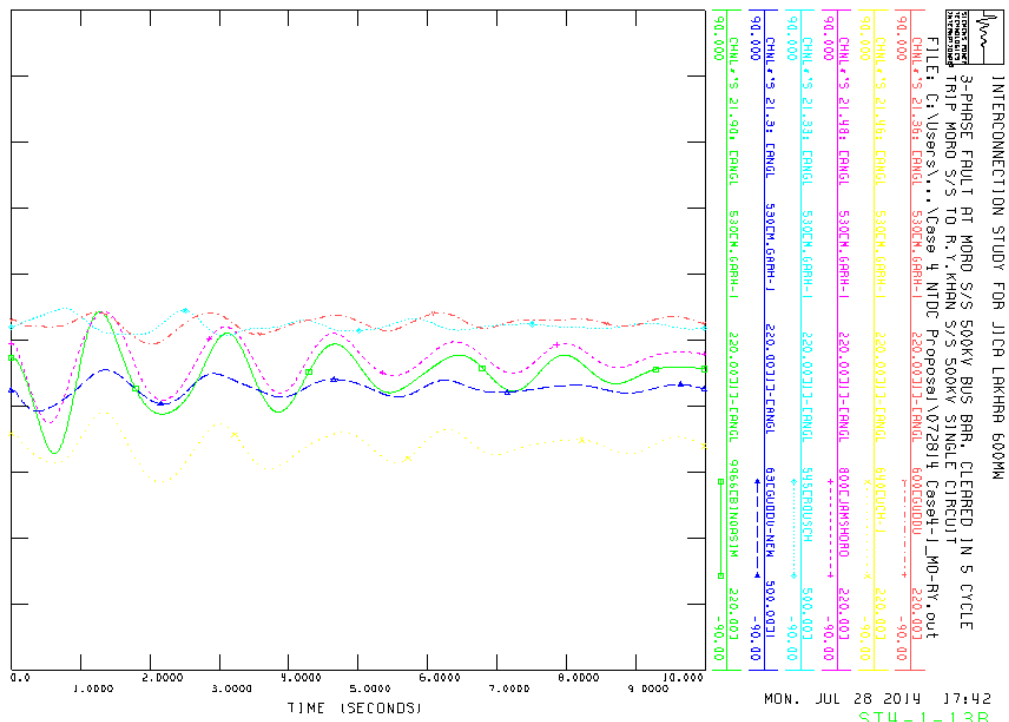
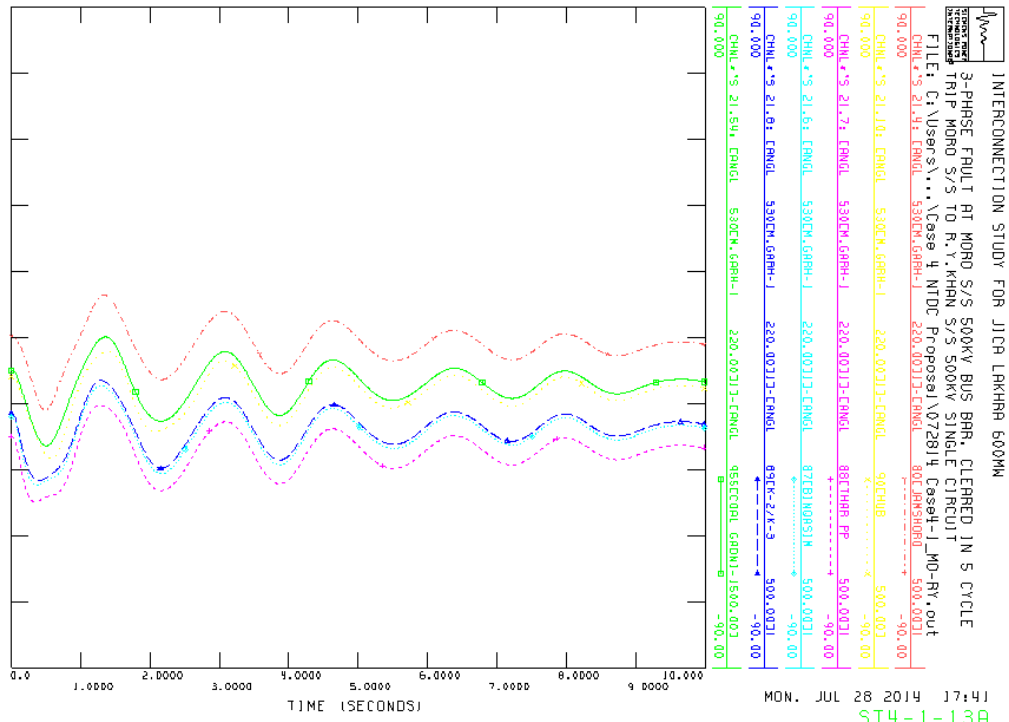
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Bin Qasim S/S – Matiari S/S

Stability Analysis Result Case ST-4-1

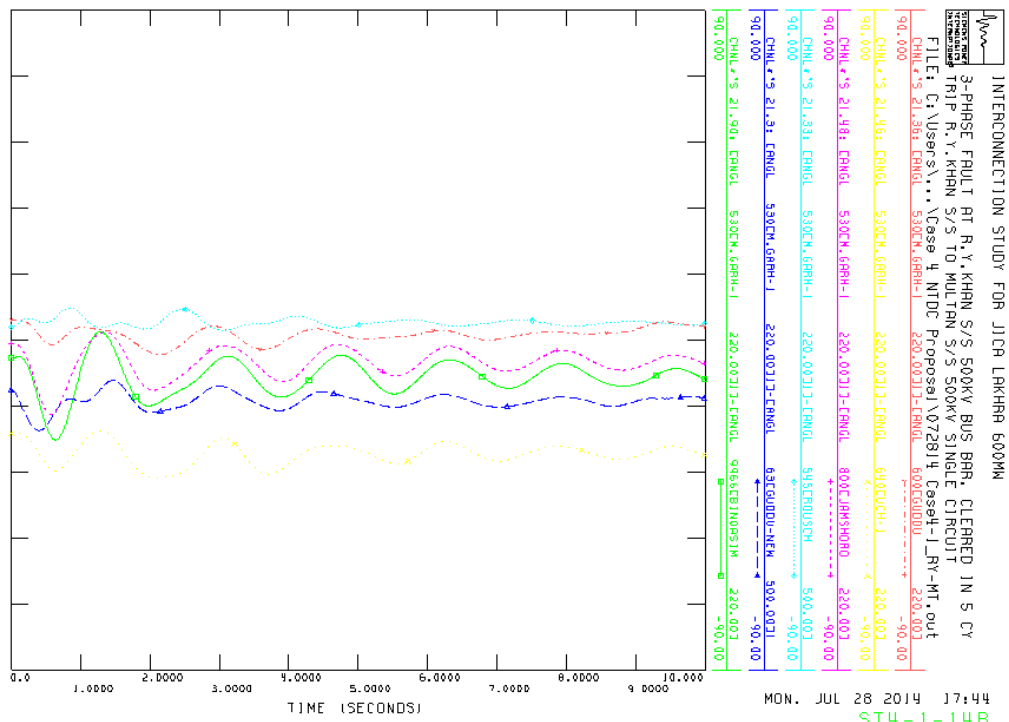
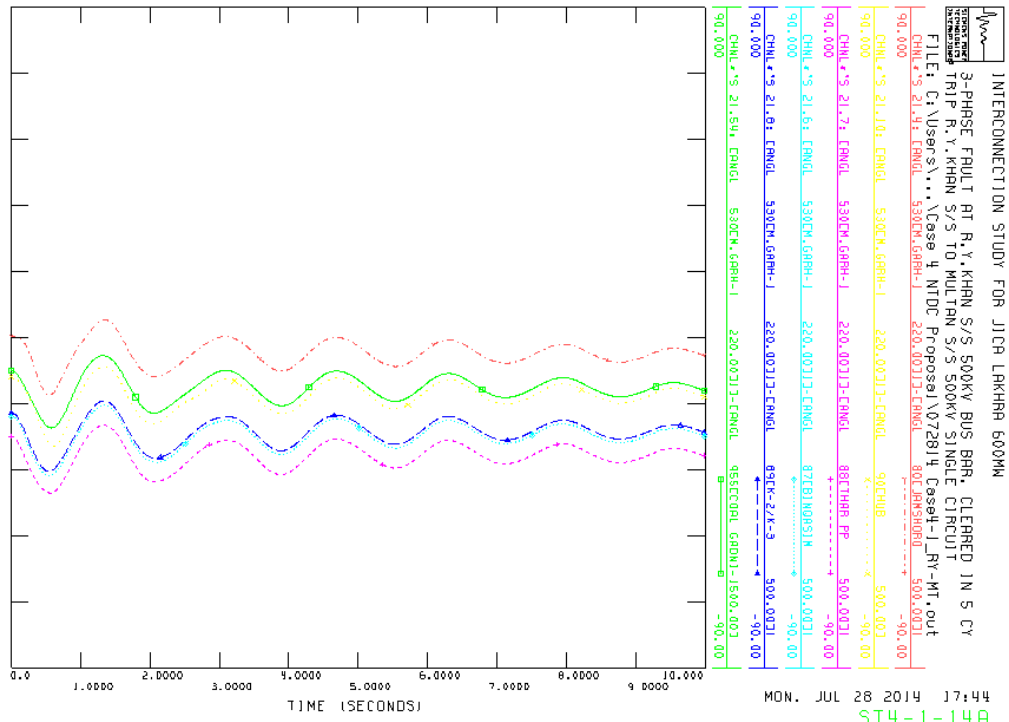
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Moro S/S – R. Y. Khan S/S

Stability Analysis Result Case ST-4-1

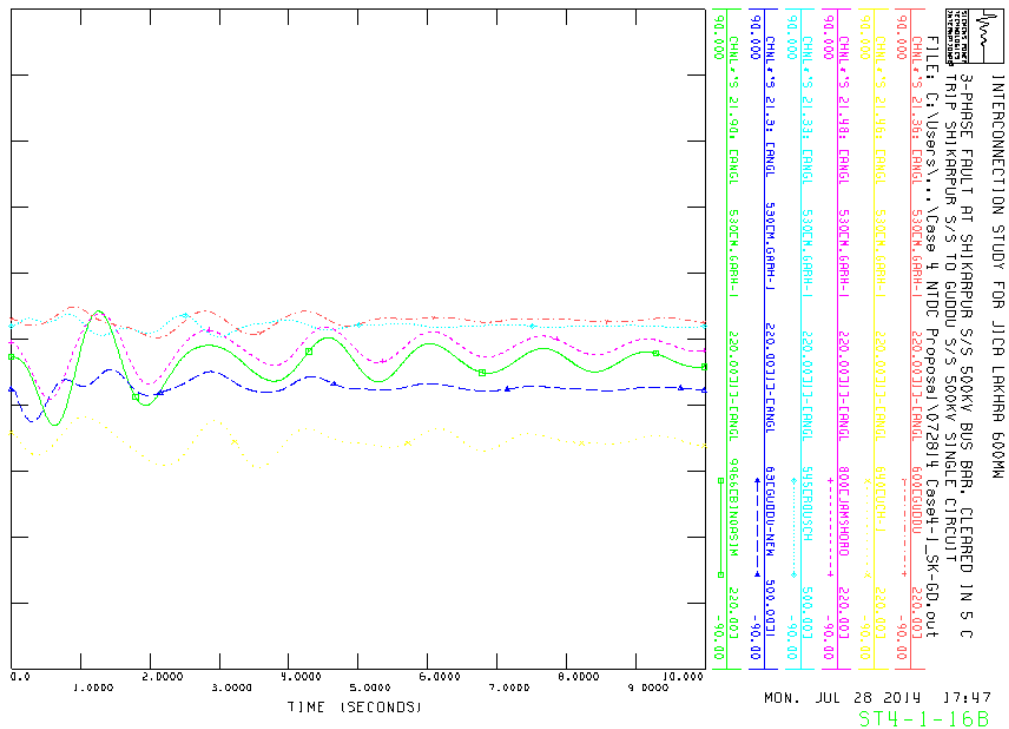
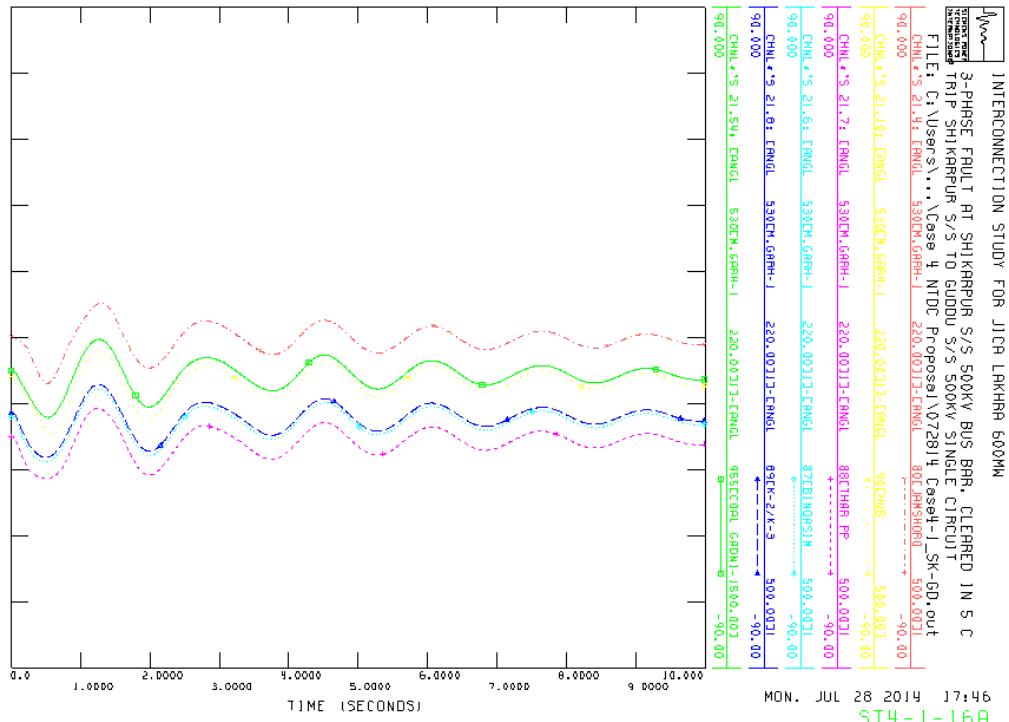
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: R. Y. Khan PP – Multan S/S

Stability Analysis Result Case ST-4-1

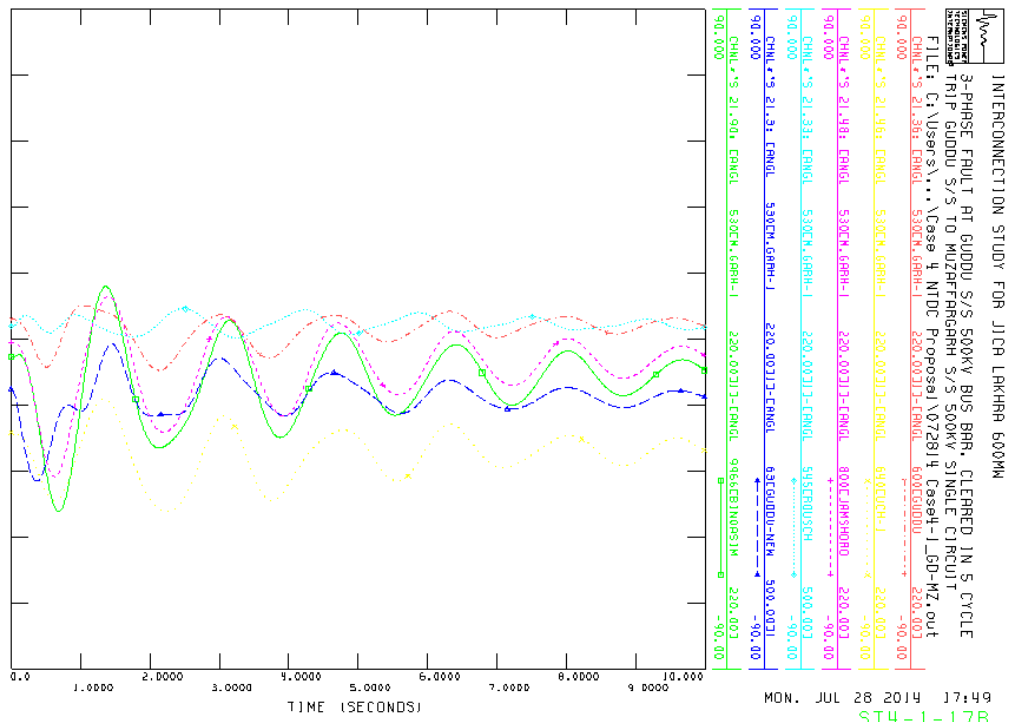
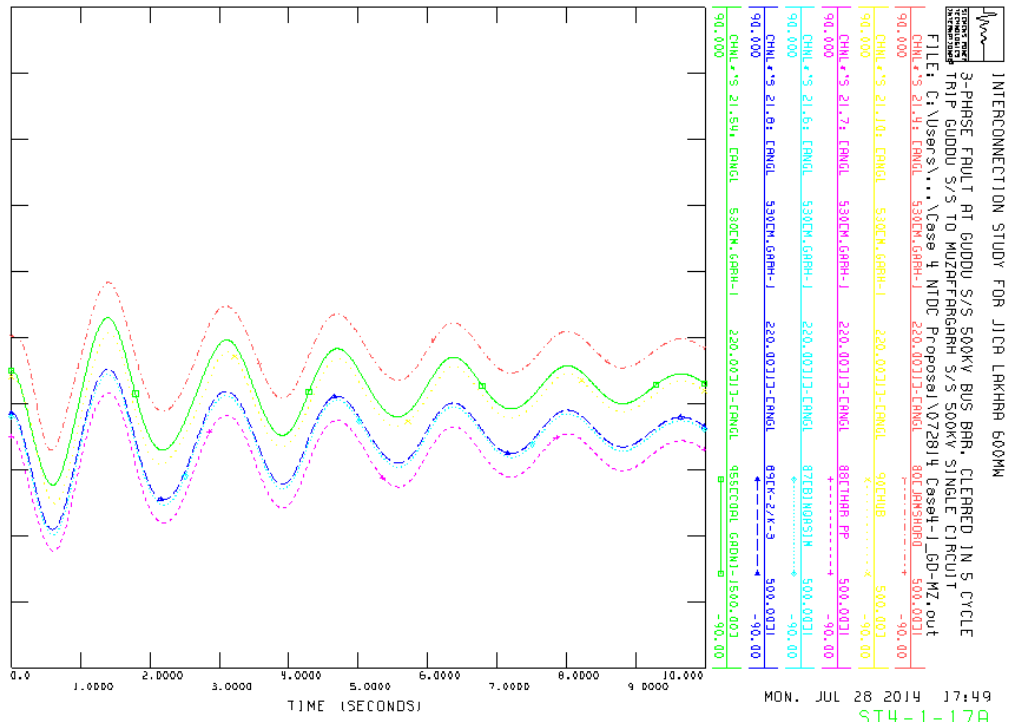
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Fault Section: Shikarpur S/S – Guddu S/S

Stability Analysis Result Case ST-4-1

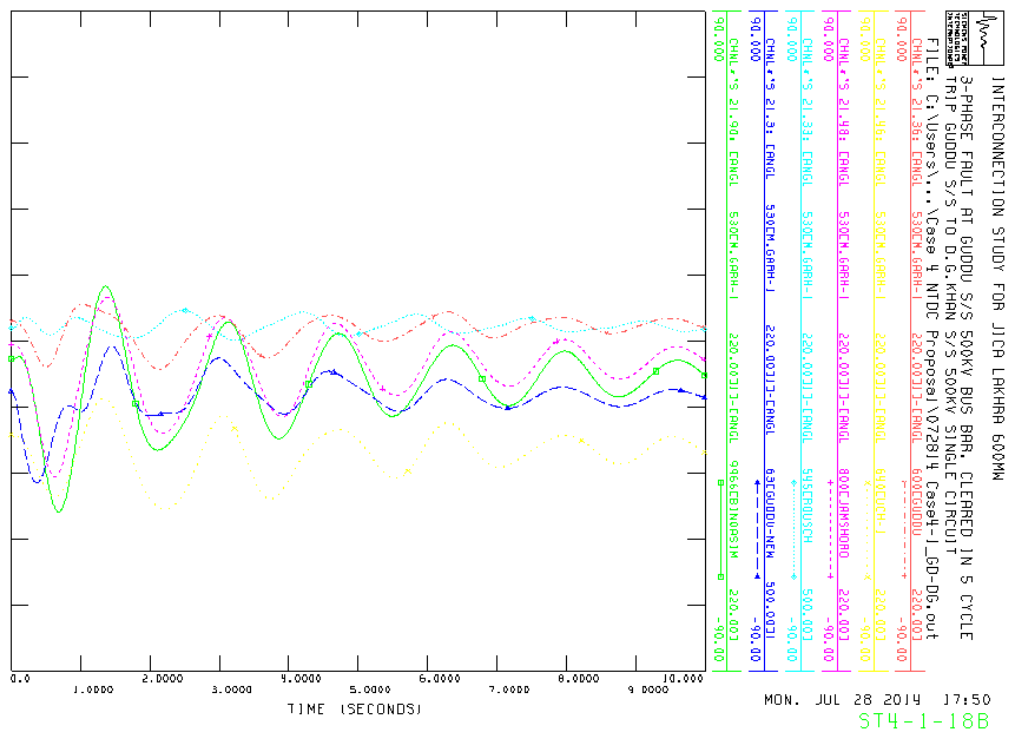
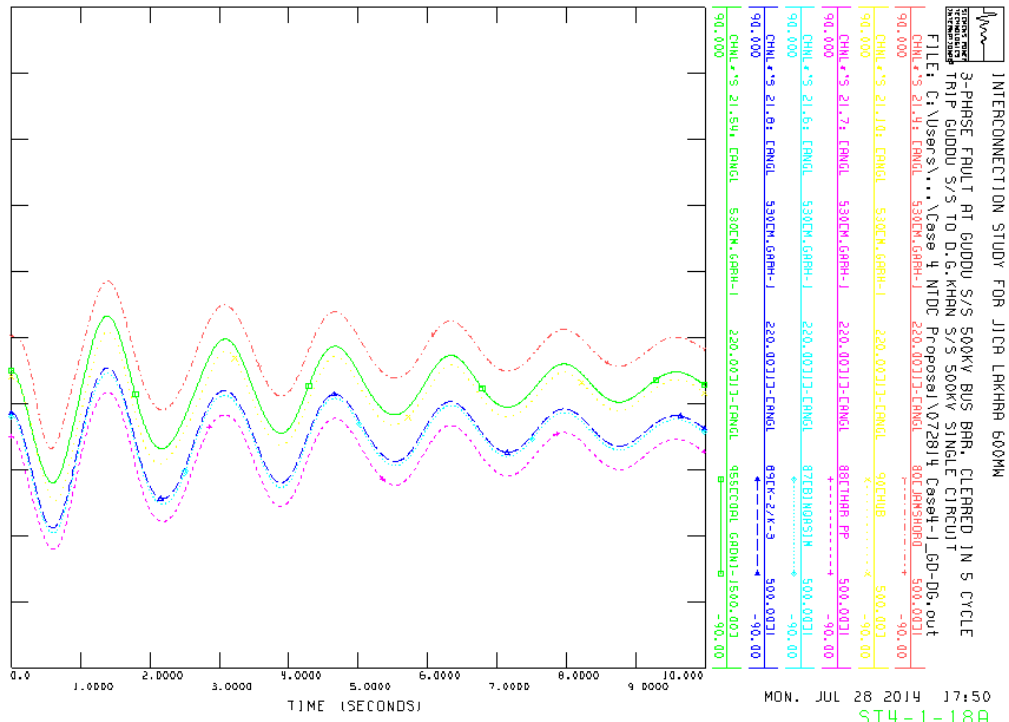
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Fault Section: Guddu S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-4-1

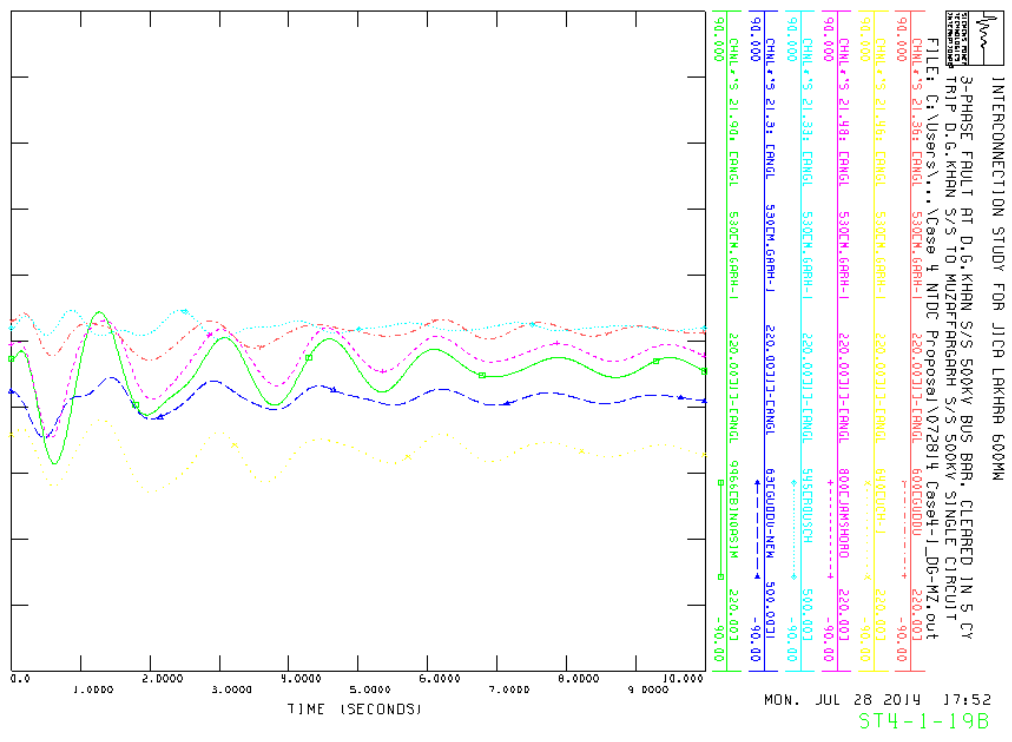
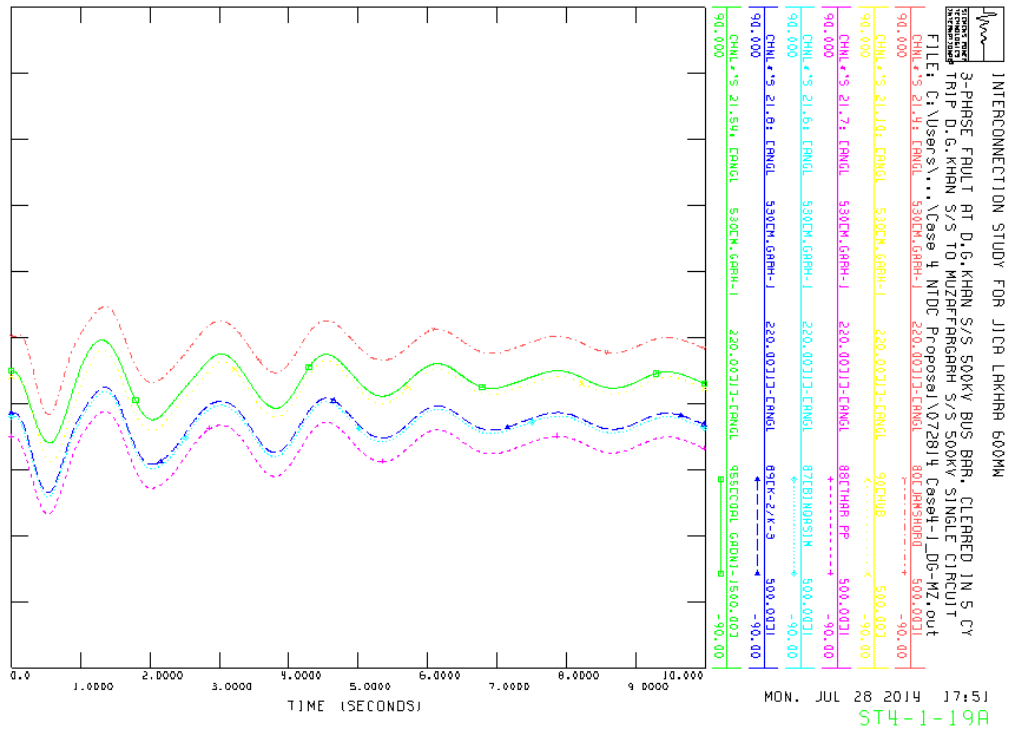
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Fault Section: Guddu S/S – D. G. Khan S/S

Stability Analysis Result Case ST-4-1

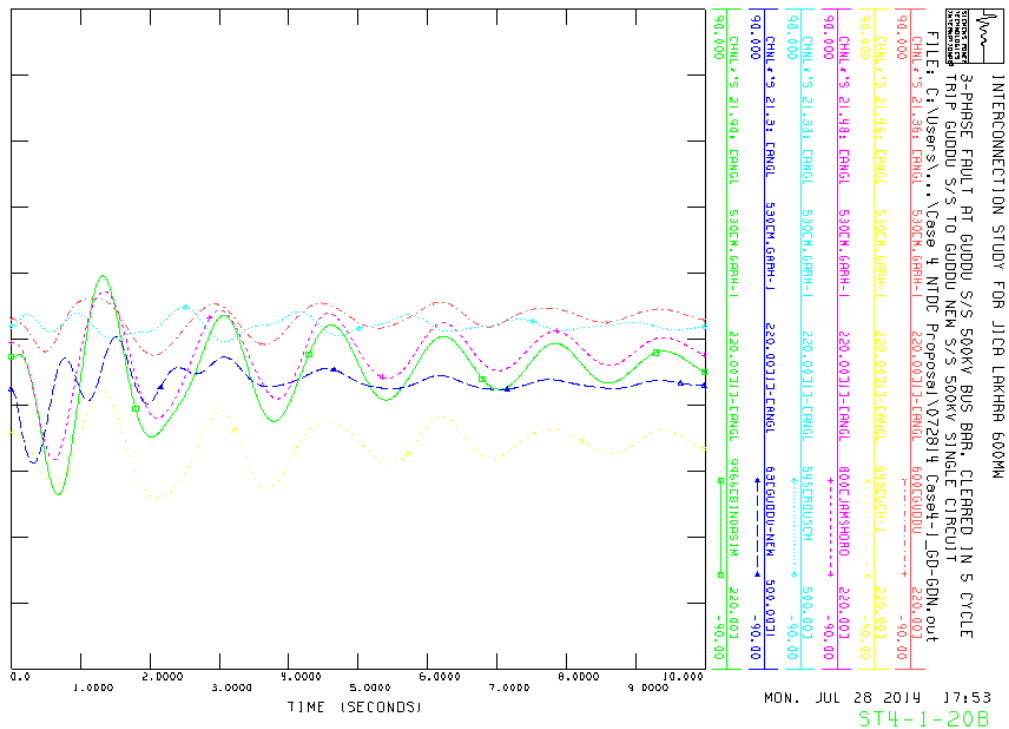
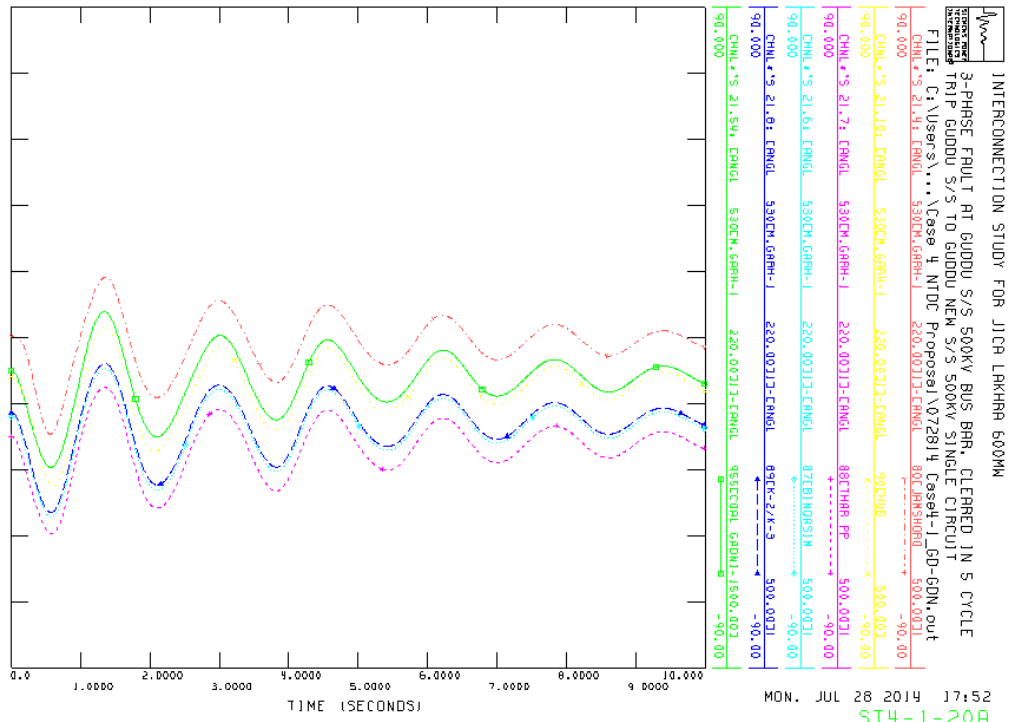
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: D. G. Khan S/S – Muzaffargarh S/S

Stability Analysis Result Case ST-4-1

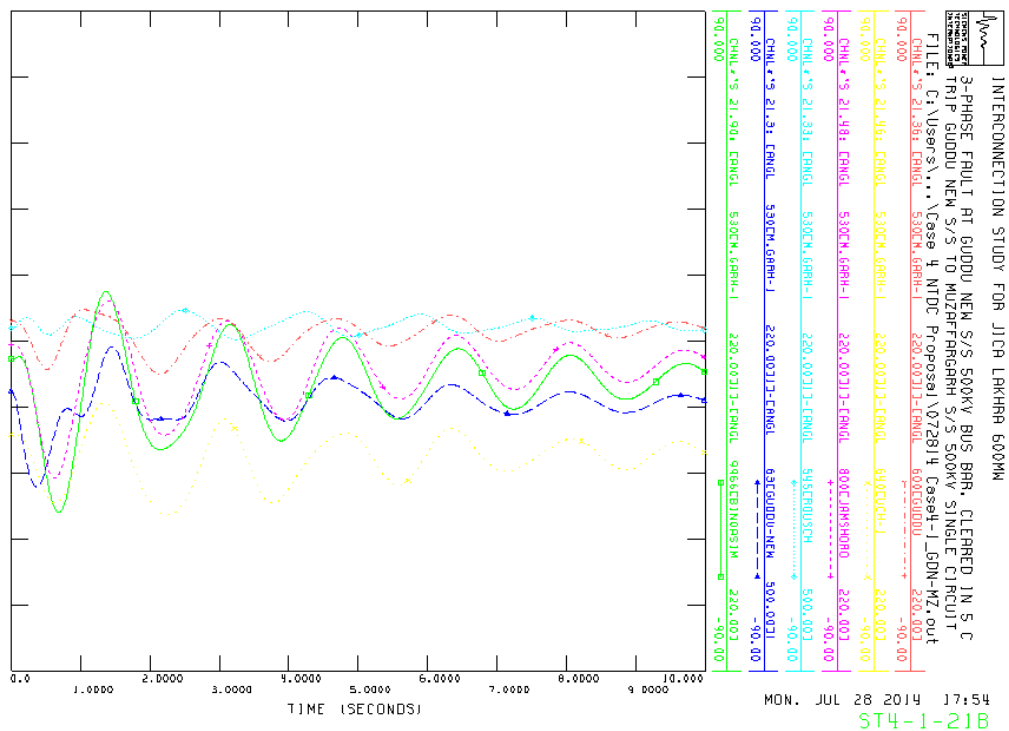
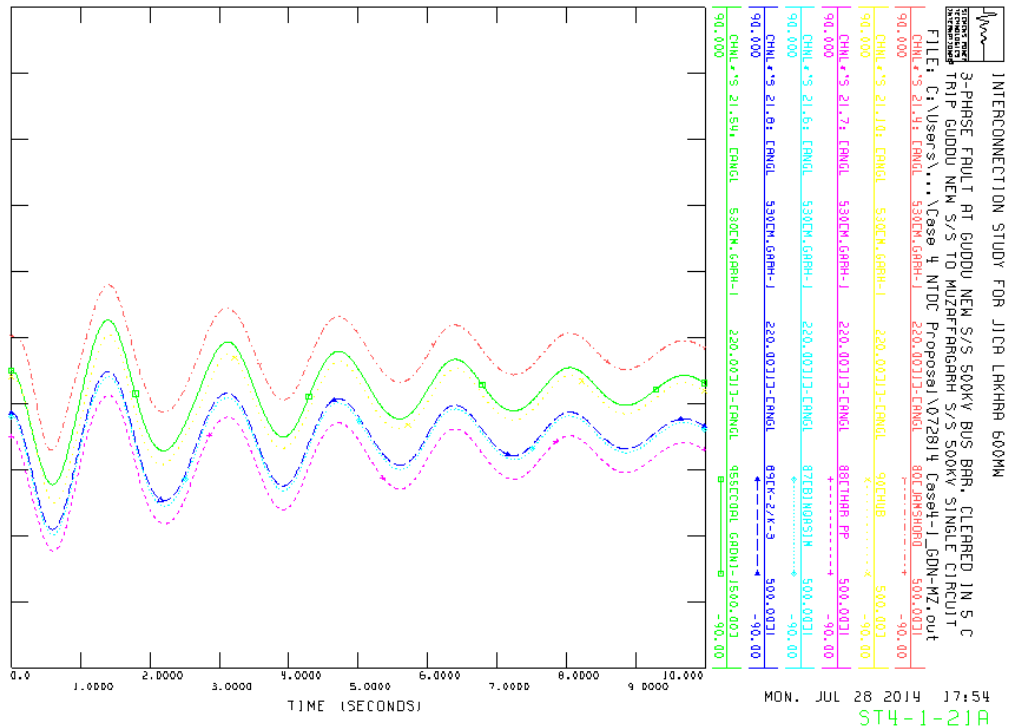
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Fault Section: Guddu S/S – Guddu New PP

Stability Analysis Result Case ST-4-1

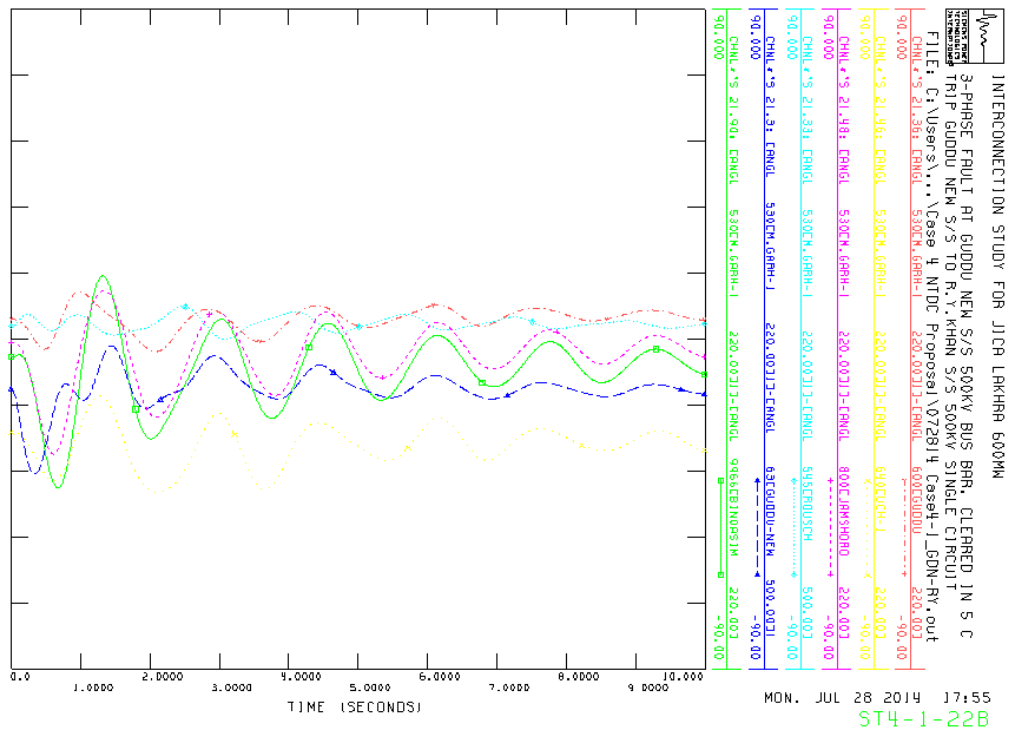
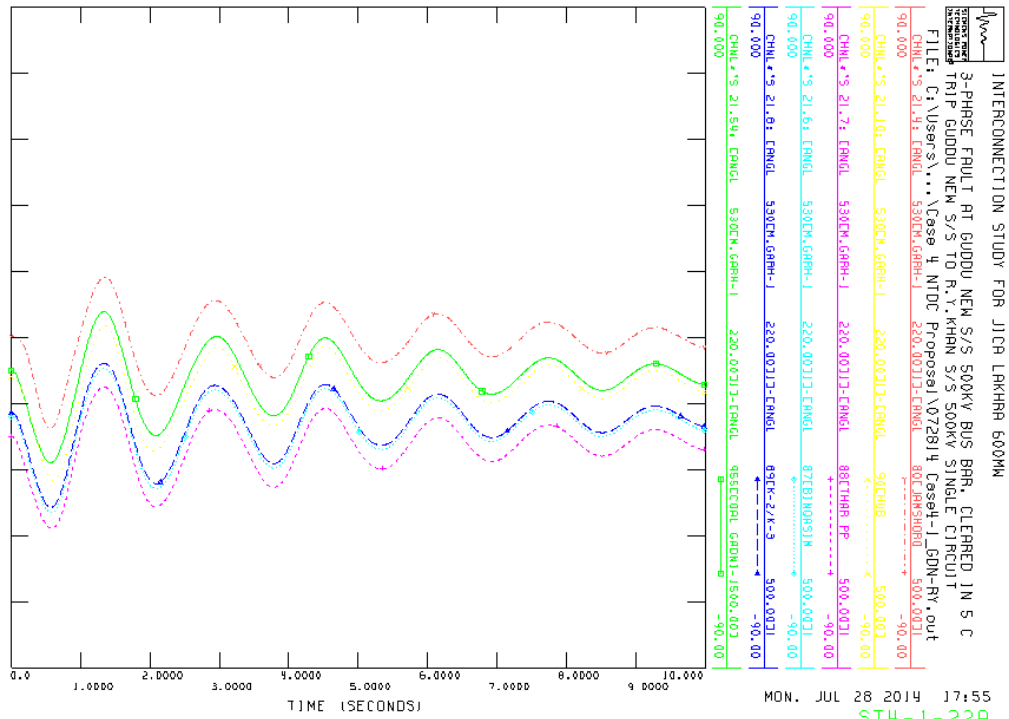
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Guddu New PP – Muzaffargarh S/S

Stability Analysis Result Case ST-4-1

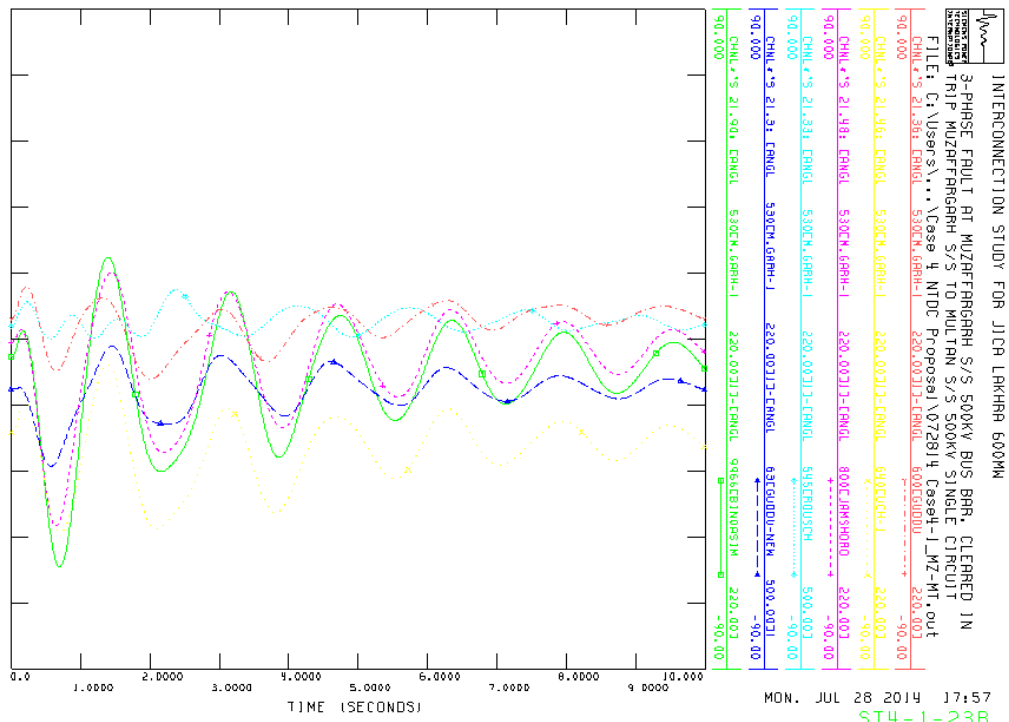
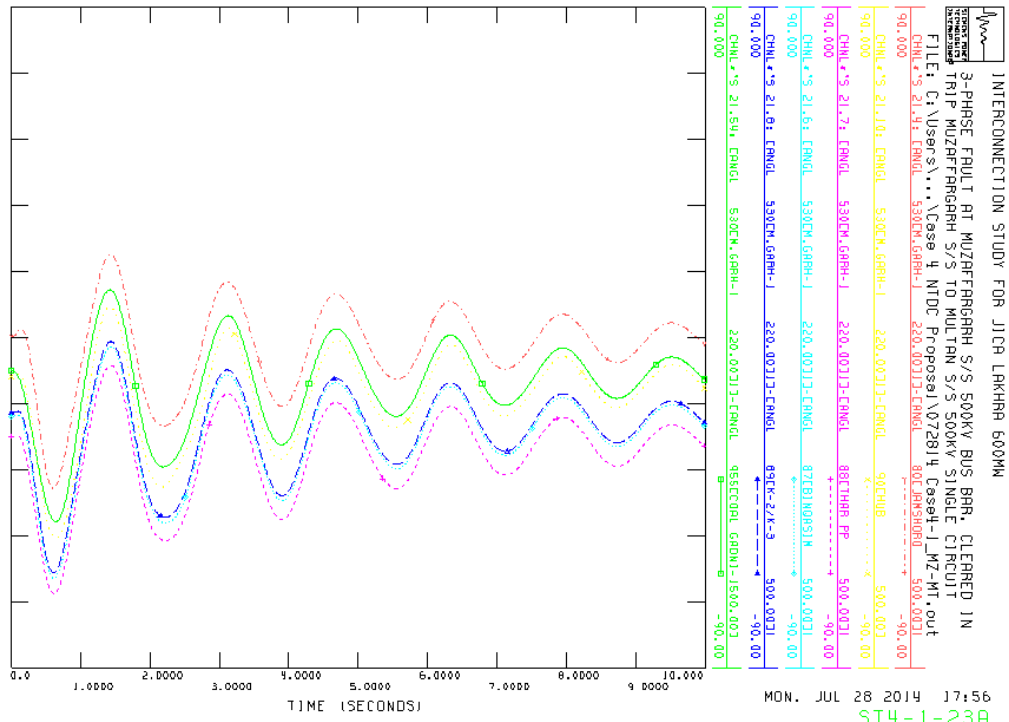
(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)



Fault Section: Guddu New PP – R. Y. Khan S/S

Stability Analysis Result Case ST-4-1

(Lakhra PP – Matiari S/S: 2cct, Gadani PP, K-2/K-3 PP, and Bin Qasim PP: In service)

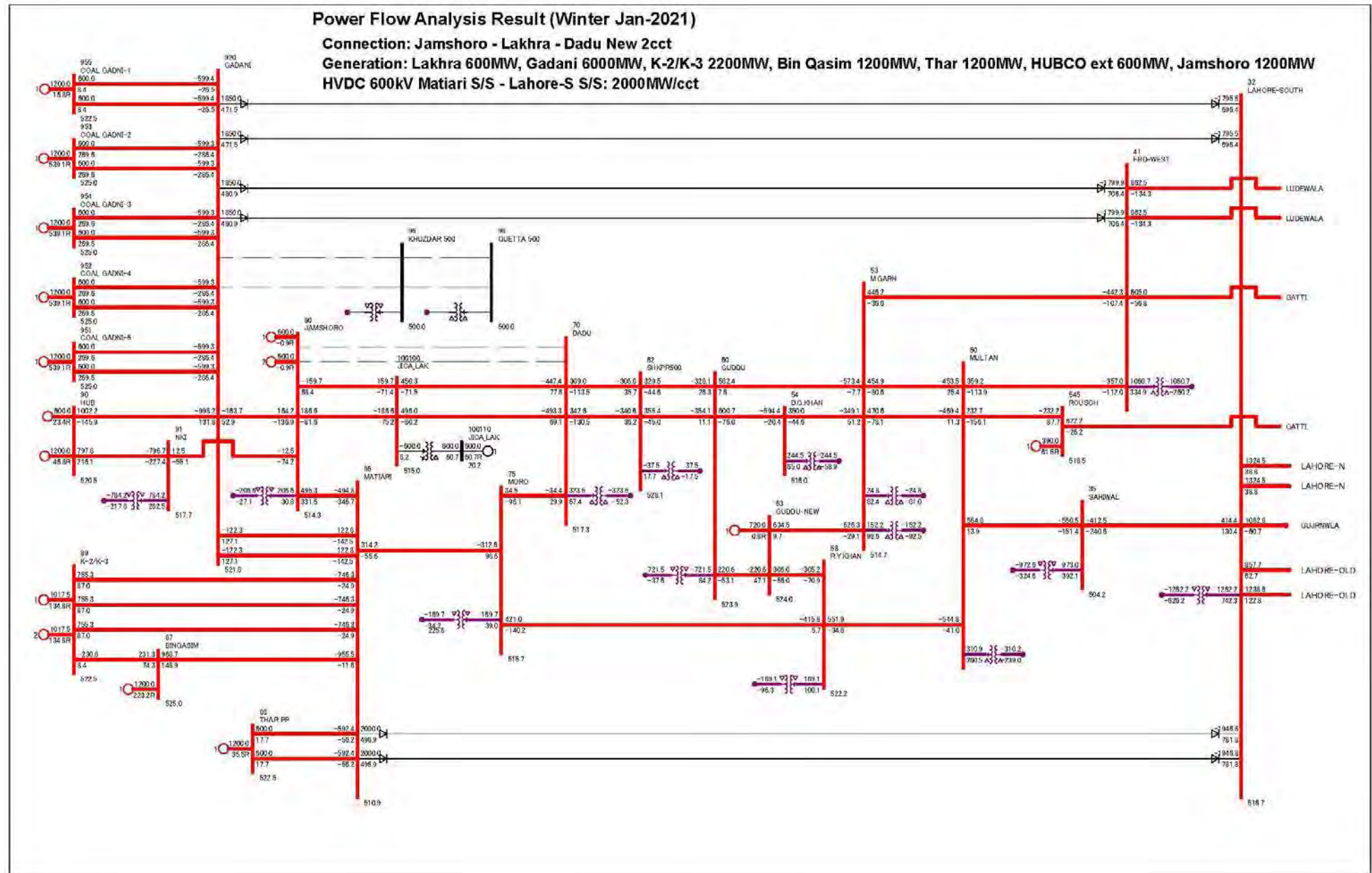


Fault Section: Muzaffargarh S/S – Multan S/S

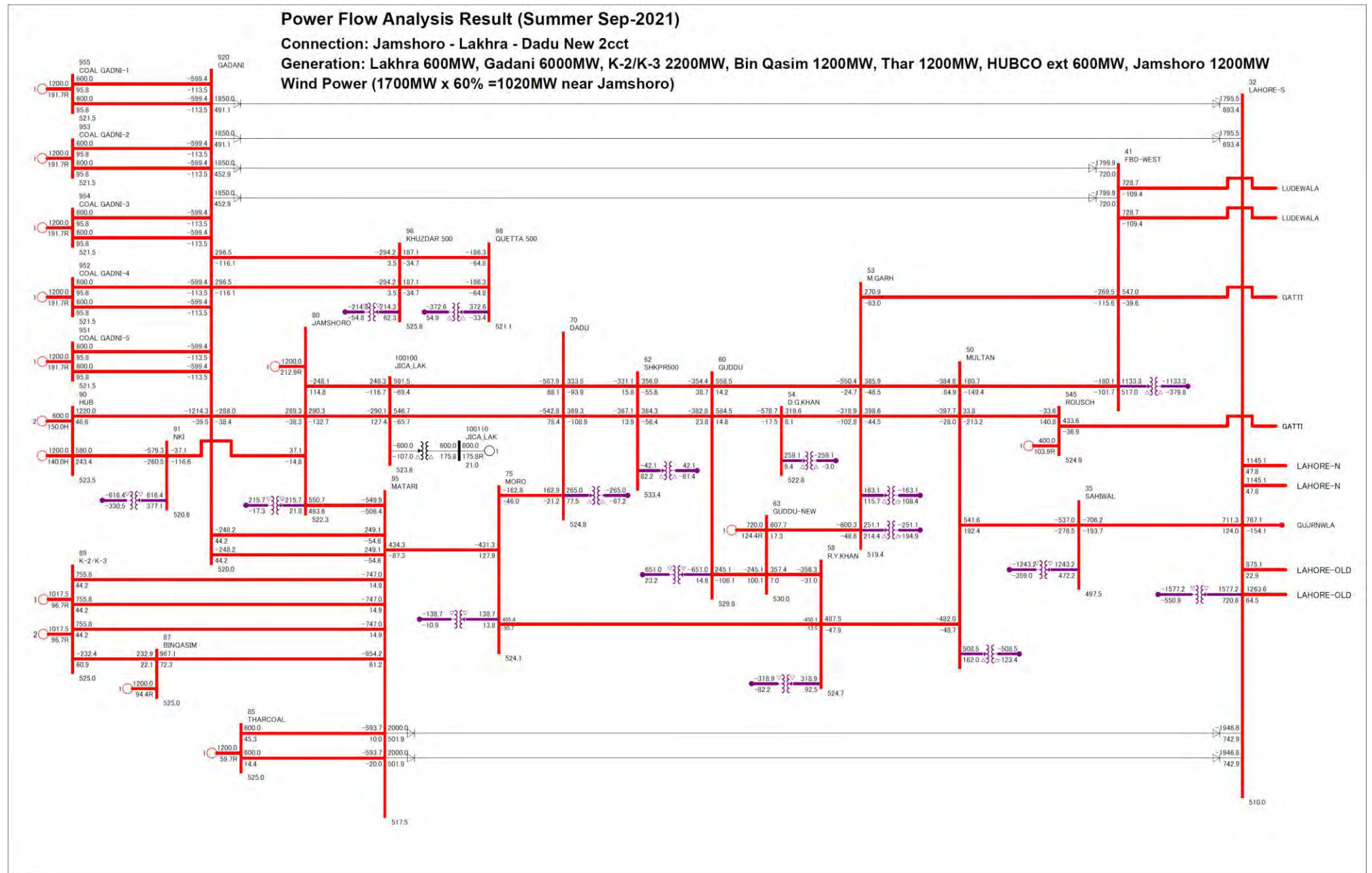
6 - 7 ADDITIONAL STUDY FOR THE SELECTED CONNECTION

SCHEME

Additional Study for the Selected Connection Scheme



Additional Study for the Selected Connection Scheme



Additional Study for the Selected Connection Scheme

a6.7 Additional Study for the Selected Connection Scheme

Additional study for case 1 selected as the connection method was carried out using the updated PSS/E analysis model files provided by NTDC in April 2014.

The planned power plants assumed in the analysis model for both power flow and transient stability studies are shown in Table a6.7-1. The light blue cells show the information additionally provided by NTDC in April 2014. According to NTDC, HUBCO extension unit will start operation in 2019, and the wind power plants to be located near Jamshoro area will start operation in 2016.

Table a6.7-1 Power Plants Assumed in PSS/E Analysis Model

Name of Power Plant	Total Output	Unit Capacity and Number of Units
Lakhra	600MW	600MW x 1 unit
Gadani	6,000MW	600MW x 10 units
K-2/K-3	2,200MW	1,100MW x 2 units
Bin Qasim	1,200MW	600MW x 2 units
Thar	1,200MW	600MW x 2 units
Jamshoro	1,200MW	600MW x 2 units
HUBCO (Extension)	600MW	600MW x 1 unit
Wind Power	1,020MW	60% of 1,700MW in total

Source: JICA Survey Team

a6.7.1 Power Flow Analysis

Power flow analysis for both winter and summer peak conditions were conducted under normal operation and N-1 contingency conditions.

There was neither overloaded 500kV transmission section nor 500kV buses with voltages out of allowable range.

a6.7.2 Fault Current Analysis

Fault current of the 500kV buses in the south system was carried out depending on the difference in the connection schemes. The PSS/E analysis model for the fault current analysis was provided by NTDC in April 2014. Both the 3-phase short-circuit (3LS) fault current and the single-line-to-ground fault (1LG) current were calculated.

The standard IEC909 technique which is embedded in PSS/E Ver. 33.4.0 was used to calculate the maximum 3LS currents and those of 1LG fault conditions at all the bus bars of the 500 kV power system in the southern area.

The calculation results are summarized in Table a6.7-2. The maximum fault current was approximately 48.0kA at Gadani switching station under 1LG condition. Therefore, it may be necessary to adopt the circuit breaker with the standard breaking capacity rating of 50kA or 63kA at Gadani switching station. For other substations or switching stations, the required standard breaking capacity rating of the circuit breakers may be 40kA or 50kA.

Additional Study for the Selected Connection Scheme

Table a6.7-2 Fault Current Summary

Bus Name	Voltage (kV)	Fault Current (A)					
		Without Lakhra PP		With Lakhra PP		Increase	
		3LS	1LG	3LS	1LG	3LS	1LG
Lahore South	500	23,970	17,472	23,972	17,472	2	1
Shahiwal	500	14,377	9,750	14,378	9,750	2	1
Multan	500	24,155	19,650	24,171	19,658	16	7
Muzaffargarh	500	23,715	19,689	23,737	19,700	21	10
D. G. Khan	500	11,999	7,715	12,008	7,718	9	3
R. Y. Khan	500	12,001	9,102	12,030	9,117	29	14
Guddu	500	21,551	20,582	21,620	20,631	69	49
Shikarpur	500	16,540	12,909	16,649	12,990	110	81
Guddu-New	500	21,047	20,126	21,112	20,171	64	45
Dadu New	500	18,996	13,650	19,459	14,106	463	456
Moro	500	14,631	9,950	14,856	10,136	225	186
Jamshoro	500	35,153	31,776	37,243	34,908	2,090	3,132
Thar Coal	500	12,033	12,519	12,101	12,573	67	54
Bin Qasim	500	15,163	14,829	15,256	14,893	93	64
K-2/K-3	500	21,594	21,925	21,808	22,087	214	162
HUBCO	500	26,812	26,118	26,985	26,234	173	117
NKI	500	22,572	18,042	22,731	18,125	159	84
Matiari	500	35,187	28,572	36,448	29,696	1,262	1,123
Rousch	500	14,524	12,676	14,528	12,677	3	2
Gadani	500	42,881	47,644	43,290	47,988	408	344
Gadani-U#9-10	500	33,728	34,261	33,958	34,421	230	160
Gadani-U#7-8	500	33,728	34,261	33,958	34,421	230	160
Gadani-U#3-4	500	33,728	34,261	33,958	34,421	230	160
Gadani-U#5-6	500	33,700	34,251	33,929	34,411	230	160
Gadani-U#1-2	500	33,728	34,261	33,958	34,421	230	160
JICA Lakhra PP	500	N/A	N/A	30,561	26,801	N/A	N/A

Source: JICA Survey Team

a6.7.3 Transient Stability Analysis

Transient Stability analysis was not conducted due to lack of dynamic data of 600 kV HVDC transmission line. The dynamic data was processed to be modified by other consultant employed by NTDC.

a6.7.4 Conclusion

In addition, it was confirmed no overloading occurred to the system under both normal operation and N-1 contingency condition with the selected connection method for Lakhra CFPP in case additional Power Plants requested by NTDC such as HUBCO extension and wind power generation were included. Also, no voltage violation occurred to the 500kV bus bars. The fault currents at all 500kV bus bars in the power system in southern area are below the standard rating of the breaking capacity of the circuit breakers even after connection of Lakhra CFPP to the power system. The transient stability analysis was not conducted with incorporation of the all planned power plants requested by NTDC since the updated dynamic data was on the modification process by NTDC, so that NTDC accepted the power system analysis with the assumed power system case in case 1.