SPEED POST

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
पश्चिम क्षेत्रीय विद्युत समिति
Western Regional Power Committee
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ISO : 9001-2008

सं ःपक्षेविस /35वी पक्षेविस वैठक/ सहा सचिव/ 2018- 2076-77
No. WRPC/35th /WRPC Mtg./AS/2018/ Date : 01 MAR 2018

सेवा में, /To,

(संलग्न सूची के अनुसार)
(As per enclosed list)

विषय ः पश्चिम क्षेत्रीय विद्युत समिति की **35** वीं वैठक की कार्यवृत
Sub.: Minutes of the 35th meeting of Western Regional Power Committee

महोदय/Sir,

इस पत्र के साथ **20** दिसम्वर **2017, 10:00** वजे को जवलपुर में आयोजित पश्चिम क्षेत्रीय विद्युत समिति की **35** वीं वैठक एवं इससे पहले **19** दिसम्वर **2017, 10:00** वजे को आयोजित तकनिकी समन्वयन समिति की वैठक की कार्य वृत संलग्न है।

Please find enclosed herewith the Minutes of the 35th meeting of Western Regional Power Committee held on 20th December 2017 preceded by TCC meeting on 19th December 2017 at Jabalpur for information and further needful.

भवदीय/Yours faithfully,

संलग्न ःउपरोक्तानुसार

Encl: As Above

(ए. वालन/ A. Balan)
सदस्य सचिव /Member Secretary

List of members of WRPC	2017-18 FAX NUMBERS
1 Chairman,WRPC/MD,GUVNL, Vadodara.	0265-2354715
2 Member (GO&D), CEA, New Delhi	011-26108834
3 Managing Director, CSPTCL,Raipur	0771-2262141
4 Managing Director, CSPDCL, Raipur.	0771-4066566
5 Managing Director, CSPGCL, Raipur.	0771-2262741
6 Chief Engineer (LD), SLDC, Raipur.	0771-2574174
7 Chairman,GUVNL,Vadodara.	0265-2340220
8 Managin Director, GSECL, Vadodara	0265-2344734
9 Managing Director, GSECL,Vadodara.	0265-2338152 Gen.2337918
10 C.E (R&C),Paschim Guj.Vij.Co.Ltd,Rajkot,Gujarat	0281-2380428
11 Chief Engineer (LD), SLDC, GETCO, Vadodara.	0265-2352019, 2356469
12 Managing Director, MPPTCL, Jabalpur	0761-2664141
13 Managing Director, MPPGCL, Jabalpur.	0761-2665661
14 Managing Director, M.P.Poorva Kshetra V V C L.,Jabalpur	0761-2666070
15 CE(LD), SLDC, MPPTCL, Jabalpur.	0761-2670119, 2664343
16 Chairman & Managing Director, MSETCL, Mumbai.	26598595
17 Chairman & Managing Director, MSPGCL, Mumbai.	26471060, 26581400
18 Chairman & Managing Director, MSEDCL, Mumbai.	26478672
19 Chief Engineer (LD), SLDC, MSETCL, Kalwa.	27601769
20 Chief Electrical Engineer, Electricity Dept., Goa	0832-2426986
21 Secretary(P), UT of Daman & Diu, Moti Daman.	0260-2230771,2230088
22 Secretary(P), UT of DNH, Silvassa.	0260-2630220
23 Director (Comml.), NTPC Ltd., New Delhi.	011-24368417
24 Director (Finance), NPCIL, Mumbai.	022-25993332
25 Director (Operation), PGCIL, Gurgaon.	0124-2571922
26 Chief Executive Officer, NLDC, New Delhi.	011-26536901
27 General Manager, POSOCO, WRLDC, Mumbai.	28202630
28 COO & Executive Director (O), Tata Power Com.L. Mumbai	66657966
29 Managing Director, RGPPL, Noida	0120-4148911, 13, 14
30 Chief Executive Director&MD, NHDC Ltd, Bhopal.	0755-4030003
31 Executive Director, Torrent Power Generation, Surat	02621-661151
32 COO(O&M), Adani Power Ltd, Ahmedabad	079-25557155
33 Dy.CEO&WTDir. LANCO Amarkantak Power Pvt.Ltd.Korba,	07759-279970
34 CEO, NTPC Vidyut Vyapar Nigam Ltd,New Delhi.	
35 ED, Torrent Power Ltd, Ahmedabad.	079-26764159
36 Director & CEO, JSW Energy Ltd.,New Delhi.	011-48178740
37 Managing Director &CEO,Jindal Power Ltd.,Gurgaon.	011-26739151
38 Excutive Director & CEO,CGPL Ltd,Kutch.	02838-661181
39 Sr.Vice President (O),RattanIndia Power Ltd,Gurgaon	0124-6695868
40 President & Plant Head, Jaypee Nigrie STPP,Sigrauli,MP	
41 Project Head, D.B.Power Ltd, Raigarrh, Chhattisgarh.	
42 COO(O&M), Adani Power Maharashtra Ltd, Ahmedabad	079-25557155
43 Project Head, KSK Mahanadi Power Co.Ltd.,Bilaspur, C.G.	
44 President-Thermal,MB Power(M.P.) Ltd,New Delhi.	011-47624229
45 Project Head,Sasan UMPP,Sasan Power Ltd,Waidhan,M.P	

List of members of TCC	2017-18
1 Chairman,TCC/ Managing Director I/c.GETCO,Vadodara.	0265-2338152
2 Chief Engineer (GM), CEA, New Delhi.	011-26109750
3 Executive Director (Comml.), CSPDCL, Raipur	0771-2574442
4 Executive Director(O&M:Gen), CSPGCL, Raipur	0771-2574425
5 Executive Director(Gen.), GSECL, Vadodara	0265- 2344537
6 Superintending Engineer (R & C), GETCO, Vadodara.	0265-2353086 / 2337918
7 Addl. C.E.(R&C),Paschim Gujarat Vij.Co.Ltd,Rajkot, Gujarat	0281-2380428
8 Executive Director (O&M-Gen), MPPGCL, Jabalpur.	0761-2664572
9 CGM (Coml.)M.P.Poorv Kshetra Vidyut Vitaran Co.Ltd,Jabalpur.	0761-2660182
10 Director (Operation), MSETCL,Mumbai	022-26590383, 26591254
11 Director (Operation), MSPGCL, Mumbai.	26478852
12 Director (Operation), MSEDCL, Mumbai.	26581465
13 Executive Engineer, DD, Nani Daman	0260-2250889
14 Executive Engineer, DNH, Silvassa	0260-2642338
15 Regional ED, NTPC Ltd., WRHQ-I, Mumbai.	28259364
16 Regional ED, NTPC Ltd., WRHQ-II, Raipur	0771- 2544550 / 2544513
17 Associated Director (Trans), NPCIL, Mumbai.	25993664
18 Executive Director, WRTS-I, PGCIL, Nagpur.	0712-2641471
19 Executive Director, WRTS-II, PGCIL, Vadodara.	0265-2488564
20 Head, Tata Power Company Ltd, Chembur, Mumbai	67175385
21 General Manager (Power), RGPPL, Ratnagiri	02359-241071
22 Chief Engineer(Elect.), NHDC, Bhopal, M.P.	0755-4030130
23 Executive Director (O&M), Torrent Power, Surat	02621-661151
24 Associate Vice President (Protection &Metering) , Adani Power Ltd, Ahmedabad.	079-25557155
25 Director(O&M)LANCO Amarkantak Power Pvt.Ltd,Korba,C.G	07759-279970
26 G.M. NTPC Vidyut Vyapar Nigam Ltd,New Delhi.	
27 Vice President (EHV),Torrent Power Ltd, Ahmedabad.	079-26764159
28 Director (Technical), JSW Energy Ltd., Bandra(E),Mumbai	022-42863000
29 President, Jindal Power Ltd., Chhattisgarh.	07767-281995.
30 Chief (O&M),Coastal Gujarat Power Ltd,Kutch. & Dy,CEO,Coastal Gujarat Power Ltd., Kutch.	02838-661181
31 General Manager, Jaypee Nigrie STPP,Sigrauli,MP	
32 Project Head, D.B.Power Ltd, Raigarh, Chhattisgarh.	
33 Associate Vice President (Protection &Metering) , Adani Power Maharashtra Ltd., Ahmedabad	079-25557155
34 Project Head, KSK Mahanadi Power Co.Ltd.,Bilaspur, C.G.	
35 GM-Business Development, MB Power (M.P.)Ltd,New Delhi.	
36 Project Head,Sasan UMPP,Sasan Power Ltd,Waidhan,M.P	
37 Sr.Vice President (O),RattanIndia Power Ltd,Gurgaon	0124-6695868
38 Member Secretary, NPC, New Delhi	011-26868528, 26865206
SPECIAL INVITEE	
1 CMD, MPPMCL Jabalpur.	0761-2664749, 2661245
2 Member (Power), NCA, Indore.	0731-2559888
3 CEE, Central Railway HQ , Mumbai.	
4 CEE, Western Railway HQ , Mumbai.	
5 COO, KWPCL, Raigarh, Chhattisgarh.	
6 President, SKS Energy Ltd., Raigarh.	
Copy to	
1 Chief Engineer ,NPC, New Delhi.	011-26865206,26526361
2 Member Secretary, ERPC, Kolkata	033-24239652, 24239653
3 Member Secretary, SRPC, Bengaluru	080-22259343
4 Member Secretary, NERPC, Shillong	0364-2534040
5 Member Secretary, NRPC, New Delhi	011-26868528, 26865206

भारत सरकार

Government of India

केन्द्रीय विद्युत प्राधिकरण

Central Electricity Authority

पश्चिम क्षेत्रीय विद्युत समिति मुंबई

Western Regional Power Committee

Mumbai

19 एवं 20 दिसम्बर 2017 को जबलपुर में आयोजित 35 वीं बैठक की कार्यवृत्त

Minutes of 35th Meeting of TCC/WRPC held on 19th & 20th December 2017 at Jabalpur

Hosted by

MPPTCL, Jabalpur

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ANNEXURES

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35th Western Regional Power Committee (WRPC) meeting was held on 20th December, 2017 at Jabalpur. It was preceded by Technical Coordination Committee (TCC) meeting held on 19th December, 2017. The lists of participants are attached at **Annexure – A & B**. The WRPC meeting was hosted by Madhya Pradesh Power Transmission Company Ltd. (MPPTCL.) The TCC meeting was chaired by Shri B. B. Chauhan, Chairman TCC & MD, GETCO. The WRPC meeting was chaired by Shri Pankaj Joshi, IAS, Chairman, WRPC & MD, GUVNL.

On the onset of TCC meeting on 19th December, Shri Sanjay Kumar Shukla, IAS, MD Madhya Pradesh Power Management Co. Ltd. (MPPMCL), welcomed Shri B.B. Chauhan, TCC Chairman & MD GETCO, Shri A. Balan, MS WRPC, Shri P.A.R. Bhende, MD MPPPTCL, Shri A.P. Bhairave, MD MPGENCO and all members, representatives from Gujarat, Maharashtra, Chhattisgarh, Goa and all the esteemed members of all other utilities of WR. Excerpts from his inaugural address: *"There was discriminatory supply of electricity divide between Cities and rural areas during the early 1980s. Power supply was a big challenge in 90s. The situation has changed from the last 10-12 years. The scenario has now changed significantly and the Power deficient States are becoming power sufficient or even surplus States. On the other hand, growth of renewable, grid integration, development of robust national grid is posing challenges. To sum up, we should put our efforts for making this sector transparent and efficient, address the pricing concerns, and compete with other better performing sectors. The issues such as T & D Loss, transmission cost, generation cost, coal shortages, overpricing of material, delays in execution are required to be addressed since addition of all these factors contribute to in increase the cost by Rs. 1/- to 1.5/- per unit. Engineers should put their efforts in reducing the T & D losses through advanced technological tools. There is no improvement in meters for decades together, we should adopt smart meters which are more customer friendly. Engineers in this field should desire to adopt new technology instead of opposing it. Matter comes to TCC regarding transmission capacity expansion and we should be careful about proper spending and judiciously decide the level of redundancy and avoid over sizing of the transmission system. We have to be more responsive to the questions discussed by common public and various public forums. We should educate the common people and tell the components of electricity charges. Whatever mistakes we did in the past should also be corrected as & when we come across them so that we can supply the power to all 24x7 and at right price. In order to achieve these objectives, we need to ensure that the decisions taken by us should be convincing to others."* At the end of the speech he again extended a very warm welcome to all the participants and a very comfortable stay at Jabalpur.

While chairing the 35th TCC meeting, Shri B.B. Chauhan Chairman TCC & MD GETCO welcomed the distinguished guests on the dais and the representatives of all the constituents of WR, participating in the 35th TCC meeting. He appreciated the encouraging opening remarks made by Shri Sanjay Kumar Shukla, IAS and thanked MPPTCL for making excellent arrangement for this meeting and comfortable stay of the participants. He suggested that a time slot of 45 minutes be kept for technical presentations from the constituent members so that the senior positions would be appraised of what is going on in the sector. He said *"we are missing adaptability to new technologies and equipments; lot of things are deliberated at various forums of WRPC such as Commercial, Protection and Operation Committee Meetings; these deliberations should be brought to the knowledge of senior level officers of WRPC and appraise them about the developments in these sectors".* He urged all the constituents to have a fair and very detailed deliberations for arriving at conclusion, so that the issues can be settled amicably, should it be technical, commercial or regulatory issues. He stated that the power scenario in WR is more stable compared with the other regions of the country; though WR has a good load generation balance, still WR is struggling with some issues such as reactive power management, over voltage issues, coal linkages, etc.. He stressed that forum should discuss deficiencies and with available resources, should come out with solutions.

While inaugurating WRPC meeting on 20th December 2017 Shri I.C.P. Keshri, IAS, Principal Secretary (Energy), Govt. of MP, welcomed Chairman WRPC Shri Pankaj Joshi, MD MPPMCL Shri Sanjay Shukla, officer of MPPTCL & MP GENCO on dais and all participants to Jabalpur. Excerpts from his inaugural address: "*On behalf of MP Govt., MPPTCL, MPPMCL I hope travel of all the participants to Jabalpur and their stay was comfortable. I was informed that yesterday's TCC meeting-was fruitful. Whenever we discussed in MoP, it transpired that WR was the most disciplined region. Any new policy was required to be implemented in India, we used to choose WR as we were confident that WR would accomplish the task. Whenever the WR overdrawl used to go above limit, they would bring it back within two time blocks, if not in one time block. No line of WR constituent was ever opened to reduce their overdrawl. I compliment all the WR constituents for this and they should continue to maintain the lead in maintaining system security and manage the system in a better way. WR is a leader and let us continue to be leader in that. I hope that whatever TCC discussed and recommended we will discuss it in depth and take valid and mutually beneficial decisions. I again extend my warm welcome to all on behalf of MP Govt. and look forward to meet again in future for sharing good things. We are closely followed by SR as far as the innovations, good practices and good decisions are concerned. All of you have to play a very major and proactive role in keeping the leadership. Reaching the top is not an issue, but maintaining the*

top position requires lots of hard work and all our colleges in WR will leave no stone unturned and lead the country as far as the power sector goes".

While chairing the 35th WRPC meeting, Shri Pankaj Joshi IAS, WRPC Chairman & MD GUVNL welcomed Principal Secretary Energy, Govt. of MP Shri Keshriji, MD MPPMCL Shri Shuklaji, MD East DISCOM MP Shri Mukhwesh Chandra Guptaji, MD GETCO & Chairman TCC Shri Chauhan, MS WRPC Shri A.Balan, MD MPPTCL Shri Bhende, MD MPGENCO Shri Bhairaveji and other dignitaries present for the meeting. On behalf of WRPC, he welcomed members of WRPC, heads and representatives of various agencies and power utilities of WR and participants of 35th meeting of WRPC, which is being hosted by MPPTCL in the beautiful city of Jabalpur which is home to the world famous Bheda ghat and Dhuadhar waterfalls. He expressed his gratitude to MPPTCL for willingly agreeing to host 35th TCC & WRPC meeting at Jabalpur. He thanked Shri Keshriji, Shri Shuklaji & Shri Bhendeji and his team for making excellent arrangements of meeting, transport and stay of the WRPC and TCC members and participants attending the meeting. During his address, he briefly gave the WR power supply position. He further listed out the issues that need to be resolved like response of RGMO/FGMO by generators, over voltage problem, coal shortage, tripping of lines in foggy areas during the winter season. He further informed that yesterday in the TCC meeting most of the issues have been resolved and common consensus has been arrived at. He said *"there are some issues which need more deliberations today, like pump mode operation of different hydro plants such as Bhira, Kadana & SSP, installation of new interface energy meters /AMR- system concern agency should take lead role, the preparedness of downstream network"*. He noted with concern that participation in TRM was very poor in the recent past and requested all constituents to actively attend the TRMs, so that ongoing projects are completed within the scheduled time. He once again placed on record his appreciation for the nice arrangement made by MPPTCL as host of this meeting and making participants stay comfortable. He expressed special thanks to MD TRANSCO (MP), members of the committee and representative present and hoped that their contribution and valuable support during course of the proceeding would be helpful in taking the decision.

	A. Confirmation
1	**Confirmation of the Minutes of 34th Meeting of WRP Committee**
	Agenda Background:
	The minutes of 34th meeting of WRP Committee held on 28th July 2017 at Mumbai were forwarded to the members vide letter No. WRPC/34th WRPC Mtg. /AS/2017/13484 dated 11.09.2017. In regard to item no.6 "Establishing pump mode operation at SSP" of MoM of 34th WRPC/TCC, Chief General Manager (Regulatory), MPPMCL, Jabalpur vide letter dated 29.09.2017 requested the following comment to be included in the minutes as it was stated by them during the discussion: Quote: *"MP stated there are unresolved issues related to UI cost, operation cost, and power and water sharing, MPPTCL opined that they expect their government's decision on this issue within 3 months of time."* Unquote: In the said letter, it was further informed by MPPMCL that subsequently the matter was also discussed under agenda item no. 217.03 in 217th Meeting of Narmada Valley Development Authority held on 31.08.2017, wherein the GoMP has recorded its disagreement on participation in any pumping mode operation of SSP.
	Meeting Discussion:
	Item no. 6 of 34th WRPC: (i) MPPMCL was informed that the requested paragraph for inclusion given under quote and unquote is already there as first paragraph under the heading "WRPC Discussion" of item no. 6 of 34th WRPC MoM. (ii) However, MPPMCL furnished information *"matter was also discussed under agenda item no. 217.03 in 217th Meeting of Narmada Valley Development Authority held on 31.08.2017, wherein the GoMP has recorded its disagreement on participation in any pumping mode operation of SSP*" would be treated as a follow up matter on the issue as it happened after the WRPC meeting, and recorded accordingly hereby.

(iii) TCC Chairman, stated that there is a need to balance the variability on account of renewable penetration; MoP, CEA and others are now focussing on hydro power plants to convert into pumping mode, as far as possible which is having that feature; SSP with 1200 MW capacity can be put into the pumping mode with a meagre value of expenditure and that was also agreed to fund through PSDF; Now the issue, raised by concerned department, regarding the water allocation, power sharing, cost sharing would be recorded in the MoM. He informed that in the last TCC meeting itself requests were made to all the participating states including Gujarat, Madhya Pradesh, Maharashtra and Rajasthan to have a meeting and resolve whatever the issues amicably and noted that the meeting did not take place yet; the issue would be further discussed in the listed regular agenda item in this meeting. The concern of MPPMCL would be recorded in the minutes of the meeting.

(iv) MP Representative however registered his disagreement on this issue and saying that without consensus, decision cannot be arrived at.

(v) MD, MPPMCL said "*I think an outsider can help in this. The basic question is of jurisdiction. In MP, there is a dedicated department called NVDD. They are the nodal department who interact with NCA and SSA and other relevant authorities made by GoI including water commission. So the whole concern could not be quoted in the compete context, but the whole context is that we are not authorised to say anything on this. Our request is that share the plan with us so that we can give it to NVDD and they will take a competent approval of the state govt and then we can convey it to you. There is no opposition or there is no support, nothing like that. Whether any water reservoir has to be used in multiple ways and whether it is a pumping mode which is a necessity of the sector, is a good thing. These are not the issues. The issue is simple that the competent department of the government can only take a call on this, so we cannot say anything on the matter, because we are not authorised to comment. Our request is that share your plan with us for submitting to the state govt. Let the govt take a call and convey it. Money is not a problem".*

(vi) On a query from TCC, Chairman, MP replied that details for sharing on the issue could be sent to energy department of MP.

- The additional information regarding NVDA meeting is treated as follow up matter and accordingly recorded in this minutes.

No other comments were received from members. TCC/WRPC confirmed the minutes without any modification.

	B. Follow-up / Status update of previous issues
2	**LILO of 220 KV S/C Haldarva – Jhagadia line at NTPC Jhanor PS – regarding extending necessary support by Jhanor to GETCO**
	Agenda background:
	• CE, SLDC Gujarat vide letter dated 03.07.2017 informed that in 36th Standing Committee meeting of CEA on Power System Planning in WR held on 29th August 2013 at NRPC, Katwaria Sarai, New Delhi, the LILO of 220 KV S/C Haldarva – Jhagadia line at NTPC Jhanor PS was proposed by GETCO. NTPC stated that no space was available within the fenced area of present switchyard. However, Space for extension of the switchyard was available for two no. 220 kV bays for LILO of Haldarva – Jhagadia220 kV S/C line at Jhanor TPS. • After further discussion, LILO of Haldarva – Jhagadia220 kV S/C line at Jhanor TPS by GETCO was agreed. The line work of LILO is completed. For extension of 220 KV bus and for construction work of bays, the necessary drawings and documents are submitted by GETCO to NTPC based on various site visits and inputs from NTPC Jhanor. • During peak conditions, at least two machines of Jhanor remains on bar. The loading on each 220 KV D/C Jhanor - Haldarva line (existing) always remains on higher side around 180 to 225 MW. Many times, generation at Jhanor have been restricted due to higher loading on 220 KV D/C Jhanor –Haldarva line. In addition, it is very difficult to permit outages on 220 KV D/C Jhanor – Haldarva line. • Therefore, it is utmost necessary that joint efforts by NTPC Jhanor & GETCO shall have to be made for extension of 220 KV bus and construction work of bays for LILO of 220 KV Haldarva – Jhagadia line at Jhanor to improve system reliability. <u>34th TCC Discussion (27th July, 2017):</u> • CE, SLDC Gujarat briefed the issue. He requested NTPC to cooperate in the matter. • NTPC representative ensured that by 10th August, 2017 NTPC shall give clearance for all the drawings required to execute the bay work at NTPC Jhanor. Representative from NTPC further ensured that

	they will extend all support / cooperation to expedite the matter including field integration issues related to execution of work. NTPC stated that they would carry out the O&M work of the bus and bays of the said LILO. • As per recent feedback from GETCO, drawing approval is accorded by NTPC. However, approval for some civil related query need to be expedited by NTPC Jhanor. • WRPC agreed as above. Follow up: DE (STU) GETCO vide email dated 17.10.2017 informed that NTPC vide their email dated 20.09.2017 have given clearance to GETCO and accordingly GETCO is in the process of tenderization. Tender will be uploaded shortly. Issue**:** To decide the time line for completion of work.
	Meeting Discussion:
	TCC Discussion: GETCO informed that no clearance is pending from NTPC; civil tender is finalised and electrical tender is to be retendered and with the target date of Sept, 2018, two feeders would be commissioned. It was noted that lines are already completed. **WRPC Discussion:** WRPC was informed that the issue was only for follow up. It was noted that GETCO has confirmed that nothing is pending from NTPC and approval such as drawing approval, or layout approval have been received; GETCO has finalised civil tendering and gone for electrical retendering as single tender received; the work would be completed by September, 2018. **TCC/WRPC noted the same.**
3	**Increase in GETCO Transmission loss due to high power flow on + 500 KV Mundra-Mohindergarh Bi-Pole HVDC line**
	Agenda Background:
	a) 493rd OCC (10.03.2017) meeting decision: The issue was discussed in detailed in 493rd OCC meeting and it was suggested that WRLDC in consultation with Gujarat shall study the quantum of power that circulated though the loop.

b) Issue raised by GETCO in 34th WRPC meeting under item No. 4:

Managing Director, GETCO vide letter No. MD/STU-ISTS/505/572/08 dated 05.07.2017(Copy enclosed) took up the issue of Increase in GETCO Transmission loss due to high power flow on ± 500 KV Mundra-Mohindergarh Bi-Pole HVDC line to 34th WRPC. The following concern was raised by Managing Director, GETCO vide above referred letter:

1. *± 500 KV Mundra – Mohindergarh Bi-Pole HVDC line was established by M/s. Adani as a dedicated line to provide power supply to Haryana from Unit No. 7, 8 and 9 each having capacity of 660 MW located at Mundra, Gujarat. Initially, power flow on above HVDC line was restricted within 1250-1500 MW by NLDC to handle N-1 contingency criteria as per CEA transmission planning criteria.*

2. *Subsequently, M/s. Adani was issued an ISTS transmission license by CERC for its dedicated transmission system associated with Mundra and Mohindergarh complex. Later on, to balance regional power flow through other tie-lines between WR-NR & ER-NR corridors, NLDC is allowing high power flow of the order of 2500 MW on ± 500 KV Mundra – Mohindergarh Bi-Pole HVDC line.*

3. *It is observed that power flow on ± 500 KV Mundra – Mohindergarh HVDC line is maintained high as compared to generation from Unit No 7, 8 & 9 of APL, Mundra TPS. This is resulting into additional Inter-State power flow through GETCO network thereby increased current flow and higher I^2R losses for the State network.*

4. *The implementing agency i.e. NLDC is already requested to look into the matter vide our letters dated 31/01/2017 & 03.05.2017. However, response from NLDC is awaited.*

Managing Director, GETCO requested that *any commercial impact viz. increase in Intra-State transmission losses and sharing of ISTS transmission charges & losses under PoC mechanism may be compensated to GUVNL.*

c) 34th TCC/WRPC (27/28 July, 2017) Discussion:

TCC decision:

It was agreed that GETCO & RLDC would carry out studies for different scenarios of dispatch through HVDC lines to ascertain the losses occurring in GETCO network. The studies shall be completed by 31st August 2017 and reported in next WRPC meeting.

34th WRPC discussion:

TCC, Chairman stated that the main concern raised by the SLDC Gujarat is that because of increase in power flow in 500 kV Mundra _Mohindargarh Bi-Pole HVDC line, there is increase in GETCo. Transmission losses. He also appraised that Mundra_Mohindargarh being an ISTS HVDC line which is more useful to control the power flow from WR to NR and also control to restrict the power flow in other AC elements which is resource full for power from other region to NR. He further stated that during the discussion in TCC it was decided that GETCo and WRLDC would once again carryout further study in different scenario and dispatches through HVDC line to ascertain and quantify the losses occurred in GETCo network by taking the data of 15 minutes block and this study would be completed by 31st August 2017 and the report of the same should be put up to next WRPC meeting.

GM, WRLDC clarified that once this line has become an ISTS, it becomes a part of TTC/ATC of WR to NR and therefore it is a national asset. Nevertheless we respect issue raised by Gujarat but our study shows that there is no co relation between losses occurred in Gujarat system and quantum of flow in HVDC line. He further added that if it is the case, then WRLDC can discuss with GETCo and once again study the entire issue.

34th WRPC decision:

- *GETCO and RLDCs shall carry out further studies with regard to increasing transmission losses in GETCO network owing to increased flow in HVDC line.*
- *GETCO and RLDCs shall consider different scenarios and dispatches by taking into account the data of 15 minutes time block.*
- *The study shall be completed by 31st August 2017 and report of the same shall be put up before next WRPC meeting.*

Update on follow up after 34th WRPC meeting:

In line with the decision taken in 34th WRPC, there was a series of communication between WRPC, WRLDC and SLDC, Gujarat for expediting the issue. In this context, AGM, WRLDC Vide email dated 11.10.2017 informed that WRLDC had proposed dates for joint studies and requested SLDC, GETCO to nominate their executives with the required data. From the reply received from SE(OP), SLDC, GETCO, it was understood that SLDC study team is working on the various cases. In above referred email WRLDC stated that *".....As sufficient time has passed after the WRPC meeting (July 28-29, 2017) and SLDC team has not proposed any date for joint study, it is assumed that the issue is solved and SLDC GETCO is agreeing with the results circulated by WRLDC earlier....."*.

	Issue: Whether GETCO agree with the statement of WRLDC "*it is assumed that the issue is solved and SLDC GETCO is agreeing with the results circulated by WRLDC earlier"* or still look forward for joint study.
	Meeting Discussion:
	TCC Discussion: (i) Chief Engineer, SLDC Gujarat stated that he fully endorsed the study done by WRLDC. He further added that the study was done for a base case scenario only when there is full generation at Adani bus; but in case of less generation at Adani bus, which has been a regular practice since last two to three months i.e. there has been almost 40% less availability of generation at Adani bus, chances are that there is more outflow than the schedule for Haryana, there may be the chances of increase in losses in Gujarat network. He requested TCC to allow SLDC, Gujarat more time to sit together with WRLDC for joint study, so that WRLDC and SLDC, Gujarat might come to a new conclusion. (ii) E.D., WRLDC stated that they were clear during that day in last WRPC meeting that there is no such case of extra loss in Gujarat network. He further informed that WRLDC has been inviting SLDC, Gujarat for joint study since last WRPC meeting but due to some reasons Gujarat could not participate in joint study. He further stated that we welcome SLDC, Gujarat once again for joint study. (iii)TCC Chairman suggested granting time till 15th January, 2018 for joint study. He further added that if the result of the joint study remains inconclusive then in that case the reply given by WRLDC shall be considered to be in order. **WRPC Discussion:** (i) TCC, Chairman explained the agenda point and he also informed about the recommendation of 35th TCC. (ii) Chairman, WRPC inquired whether deadline of 15th January, 2018 is agreeable to GETCO. In reply Chief Engineer, SLDC Gujarat stated that they are comfortable with the deadline. **WRPC Decision:** **TCC/WRPC agreed that WRLDC and GETCO would sit together for joint study and come up with the final finding by 15th January, 2018 and if the result of the joint study remains inconclusive then in that case the reply given by WRLDC shall be considered to be in order.**

4	**Interconnection between CGPL UMPP and Adani Mundra STPS in Gujarat – provision of 400/220 KV ICT at CGPL Mundra and compensation mechanism for 220 KV S/C CGPL Mundra – Nanikhakhar line & bays**
	Agenda Background:
	a) Background: *In the 33rd WRPC meeting, WRPC recommended that since this ICT is being brought for system benefit, it should be under PSDF funding. Therefore it was recommended that GETCO shall apply for the project with PSDF authorities and WRPC approval for the same is accorded.* Managing Director, GETCO vide letter no MD/STU/505/07 dated 05.07.2017(Copy enclosed) took up the above issue for discussion in 34th TCC/WRPC. The following points were raised by Managing Director, GETCO vide above referred letter. (1) Technical requirement of 400/220 KV ICT at CGPL Mundra is already agreed in SCM as well as 33rd TCC / WRPC forums. (2) In this regard this is to clarify that the generation switchyard belongs to a private party (CGPL) and entire evacuation scheme is developed by PGCIL under ISTS scheme. GETCO being a STU for Gujarat State has no direct role in entire project. Therefore, if GETCO will apply for PSDF funding then there will be issues related to implementation / execution, ownership and operation & maintenance of the said asset at CGPL switchyard. (3) At this juncture, it is pertinent to note that 2 Nos. of 400 KV feeder bays at CGPL Mundra switchyard is under implementation by PGCIL for accommodation of 400 KV D/C CGPL Mundra – Bhuj Pool line identified as a strengthening scheme after implementation of planned evacuation scheme. Therefore, looking to the above mentioned issues and PGCIL presence in CGPL switchyard, it is suggested that PGCIL shall apply for PSDF funding for 400/220 KV ICT at CGPL Mundra and implement the same. Also, 220 KV S/C CGPL Mundra – Nanikhakhar line & associated 220 KV bay at Nanikhakhar is to be maintained by GETCO, suitable commercial mechanism may be developed for compensation. b) Discussion on issue in 34th TCC/WRPC (27/28 July, 2017) 34th TCC Discussion: PGCIL stated that the interlinking ICT work between CGPL UMPP and Adani Mundra STPS has to go through SCM for acceptance. It was

opined that generators can also carryout such ICT work. Further, it was informed that the ICT work cannot be done under PSDF scheme by PGCIL, but it could be done under "cost plus" basis. PGCIL also opined that if it is part of an ISTS work, then it can be done.

MP stated that before starting the ICT work, commercial issues (i.e. fixed cost, O&M cost, etc.) are to be addressed first. Further it was stated by MP that cost of such ICT work has to be borne by the Generators' (CGPL) beneficiaries only and not others.

CE, NPC/CEA clarified that if ICT work as part of ISTS asset, then it may not be eligible for PSDF scheme.

After detailed discussion, TCC suggested that the opinions of the TCC members for funding through PSDF to be appraised to Standing Committee for WR planning.

It was also proposed by TCC that installation of the ICT shall be carried out by PGCIL after completing the formalities by moving the proposal through Empowered Committee (on Transmission) constituted by Ministry of Power.

34th WRPC Discussion:

MD, GETCO informed that the provision of ICT at CGPL is for facilitating the black-start to Mundra complex & it is certainly for system requirements. He further informed that the matter has already been decided in 33rd WRPC meeting to be funded through PSDF. He stated that entire CGPL evacuation system is done by PGCIL& also commissioning of two feeder bays for Bhuj pooling station has been done by them. Therefore he requested PGCIL, having expertise and well conversant with system, to carry out the project through PSDF after completing all formalities.

Director, PGCIL stated that the proposal is not qualified for PSDF. He also stated that if WRPC want this work to be carried out by PGCIL then a letter from WRPC is required to be communicated to Ministry and CEA. He also stated that 100% PSDF funding involves ownership and O&M charges issue. He asked CEA representative (CE, NPC) to throw more light on the matter of PSDF funding. CEA representative stated that this work can be given by WRPC to PGCIL on nomination basis. The representative of MP stated that it is a having lot of commercial implication and if POC mechanism is to be applied then the POC charges should only be borne by beneficiaries of the project not all the beneficiaries of WR. In response, Director, PGCIL stated that the project is for black start facility and therefore it is a project for system requirement. He further added that the cost of project could be

around Rs. 20 to 30 Crores and therefore for this meagre expenditure the commercial implication would be very small.

WRPC Decision:

After detailed discussion, WRPC agreed for independent funding and work to be executed by PGCIL.

Follow up after 34th WRPC:

MS, WRPC vide letter No. WRPC/Protection/ CGPL 1316, 17/10/2017 intimated the decision of 34th WRPC to Chief Engineer (PSP & P-I), CEA and requested him to expedite the matter as per the decision taken in WRPC.

Issues:

In this matter, General Manager (CTU-Plg.) vide letter No. C/CTU-Plg/W/01/CGPL-APL, dated 27/10/2017 (copy enclosed) sought clarification on decision taken in 34th WRPC. He stated in his letter that Powergrid generally implements elements with its own funding /borrowings and the investment is recovered by realisation of transmission charges through PoC mechanism. He added in his letter that the term 'Independent Funding' mentioned in 34th WRPC Mom needs to be clarified.

In this regard it is noted that the term used as referred above had actually been used several times by various members during the actual deliberation in 34th WRPC meeting and therefore it was mentioned in final decision.

Meeting Discussion:

TCC Discussion:

(i) M.S., WRPC briefly explained the issue. ED, PGCIL asked about the clarification on word "*independent funding*" used in the MoM of 34th WRPC. During the discussion, a representative from MPPMCL stated that CGPL project is a competitive bidding tariff based project, therefore the cost of the ICT and bays should be shared by the beneficiaries of the project only. He further informed that if the similar situation arises at Sasan or any other station whether the similar treatment will be given for such additional equipments. ED, WRLDC informed that the requirement of ICT and bays at CGPL was agreed in previous WRPC meetings. However, the funding mechanism was to be finalized. He further informed that the term *"independent funding"* needs to be clarified.

(ii) M.D., MPPMCL enquired whether the agenda is to seek clarification

on the term *"independent funding"* or the discussion is on requirement of equipment at the CGPL Complex. TCC, Chairman clarified that the technical requirement of ICT and bays was agreed in last WRPC that the work of installation of ICT shall be made by PGCIL and the cost will be recovered from POC mechanism. He further stated that let maintenance work be done by PGCIL and operation of the equipments be done by CGPL.

(iii) TCC Chairman stated that the issue related to funding mechanism will also be discussed tomorrow and Chairman, WRPC will take a decision in this regard.

WRPC Discussion:

(i) M.P. maintained the stand taken in TCC and added that the expenditure, even if it is a paisa, of this project has to be borne by generator or beneficiaries of the project.

(ii) G.M., GUVNL informed that under POC mechanism, the flow decides who will be charged and how much amount and therefore the implication of POC charges due to ICT at CGPL will be very meagre on other states of WR except Gujarat.

(iii) M.D. , MPPMCL stated that we are not negotiating amount whether it is 10 Rupees or 10 Crores Rupees. It is an issue of principle & precedence.

(iv) Principal Secretary (Energy), Govt. of M.P. stated that whatever is said by the representative of M.P. is absolutely right; if, it is a question of CGPL in instant case, it may be some other unit in future; so if we are so concerned about the system, this concern of WRLDC as well as all constituents of WRPC should continue for the future cases also; they should not be changing their stand or utterances in future; this should be recorded in the minutes of meeting and go ahead. He further stated that WRPC/WRLDC will be repository of this consensus in future, because these two are permanent body of this forum.

WRPC Decision:

WRPC agreed that the work of installation of ICT and associated bays at CGPL Complex shall be carried out by PGCIL and the cost of the same shall be recovered through POC mechanism. WRPC also agreed to take the similar stand in similar cases in future.

5	**Operation of Kadana and Bhira in Pumping Mode**
	Agenda Background:
	WRLDC vide email dated 11.07.2017 intimated that out of the installed generation capacity of 109 GW in Western Region, 78 % capacity is coal/gas fired, 15.4 % (16.8 GW) is RES and only 6.7% (7.4 GW) is hydro. Even with limited hydro capacity, the power generation from hydro stations is often constrained due to scarcity of water or other social obligations with respect to water releases (e.g. constant schedule). In view of the above, efforts need to be urgently made to rejuvenate the available pumping facility at Kadana (4x60 MW) and Bhira (1x150 MW) HEP that are not being utilized due to various commercial and technical constraints. The matter has already been discussed in several OCC meetings. TCC/WRPC may like to deliberate on the measures to be taken to expedite: 1. Utilization of 1x150 MW capacity at Bhira PSP in Maharashtra 2. Utilization of 4x60 MW capacity at Kadana PSP in Gujarat 34th TCC/WRPC Discussion: It was informed by Gujarat that in case of Kadana, there was a meeting on 17.07.2017 among BHEL, CEA & GSECL wherein it was agreed to test either machine 3 or 4 in pump mode after carrying out alignment of bearings. Further it was also informed that for unit 1 & 2 in pump mode operation, the further decision shall be conveyed by GSECL. In case of Bhira, it was informed that the TATA power is pursuing with irrigation department for providing gates for Bhira since last 3 years with Maharashtra irrigation dept. However response is still awaited from Maharashtra irrigation dept. TCC suggested TATA to take up with Member (Hydro), CEA for further needful under intimation to WRPC, Secretariat to enable them to take up the issue further. WRPC agreed as above. Follow up after 34th WRPC: (i) KADANA: Chief Engineer (Gen.), GSECL, vide letter No. CEG/ EE(Hydro)/ KHEP/O&M/1852, Date 16.10.2017 informed the followings:

	• It is to inform that a high level meeting between the representatives from GSECL, GETCO, CEA, BHEL & OEM M/s CKD Blansko, Czech Republic regarding Pump Mode Operation of 4x60 MW KHEP of GSECL was held on 17.07.2017 at 12:00 PM at GSECL Co, Vadodara. • M/s CKD Blansko, Czech Republic made presentation on the observations made by their team during visit of KHEP from 13.07.2017 to 16.07.2017 and modification / retrofits required to operate 4 x 60 MW KHEP Units under Pump Mode Operation. • M/s CKD Blansko has submitted their offers for refurbishment of KHEP unit no. 1 and all the four units on 12.09.2017. The offers are under scrutiny process. Other Indian agencies involved for such work are being explored. • Order is placed for alignment, balancing and checking healthiness of KHEP units for the pump mode operation to M/s. Fitwell Power Projects Pvt. Ltd., Vadodara on 23.08.2017. It is planned to carry out the work in November 2017. (ii) <u>BHIRA:</u> Head - Grid Operations, TATA Power vide email dated 25.10.2017 informed that Tata Power is in process of communication with Member (Hydro), CEA and will forward the copy of letter to you as soon as send it to Member (Hydro), CEA.
	Meeting Discussion:
	TCC Discussion: (i) M.S., WRPC explained the agenda points and requested C.E., SLDC, Gujarat and TATA Power to give updates in respect of Pump Mode Operation at Kadana & Bhira. (ii) C.E., SLDC, Gujarat stated that for Kadana Unit-3, an agency has been hired to settle the issues. The agency has already taken the approval of Irrigation Department of Govt of Gujarat. He further elaborated that ABC analysis on BHEL unit has also been started and would probably be completed by end of December, 2017. He further informed that trial run of Kadana Unit for Pump Mode Operation would probably be carried out by 15th of January, 2018. (iii) Representative from TATA Power intimated that they have written a letter to Member (Hydro), CEA, New Delhi on 13th Nov., 2017. Bhira Power Station can operate in Pumping Mode, however, sufficient

	water is not available at the pickup point, therefore gate are required to be provided. They have taken up this issue with Water Resources Deptt. Govt. of Maharashtra. However, reply is still awaited. **WRPC Discussion:** (i) TCC Chairman informed that everything is ready with Tata power, but because of some gate issue on the downstream, pumping mode is not possible. The gate is under the control of WRD, Maharashtra. (ii) Tata Power stated that on the direction from irrigation department, gate design has been made and submitted for verification by Central Design Organisation, Nasik. Cost is being estimated and after which the approval would be given. We are pursuing with WRD and written letter to CEA also. (iii) WRPC suggested that follow-up activity in regard to Bhira is to be taken up by WRPC with Maharashtra and CEA. **WRPC Decision:** **WRPC to follow up with Maharashtra and CEA in regard to Bhira pumping mode operation.**
6	**Status of pump mode operation of SSP**
	Agenda Background:
	<u>Background from 496th OCC:</u> The matter for establishment of pumped mode operation at SSP was discussed in 496th OCC meeting. In the meeting following was informed. 1. Construction of Garudeswar weir (will take at least one year) 2. Up-gradation of RBPH Units. (will take at least one and half years) The construction work of weir is awarded in May – 2012. Presently, approx. 35% of Construction work of Garudeshwar Dam is completed. For pumping mode operation of 6 x 200 MW RBPH Units, the supply, installation and commissioning of isolated phase bus ducts, Static Frequency converter and phase reversal switch along with all require accessories will be required. The SSNNL has prepared estimates amounting around 68 Crore Rupee for equipment required for operating RBPH in pumping mode and submitted to CWC/CEA for their scrutiny and then same will be submitted to Planning Commission by SSNNL. In the meeting, CE, SLDC Gujarat stated that up-gradation of RBPH Units (for establishing pump mode operation) is a very needed project

and it will be helpful for sorting out the problems of all three associated states of Gujarat, MP and Maharashtra. Representative from MP informed that approval for above project has to be taken from Govt of MP. GM, WRLDC suggested that since the project will be funded from PSDF, there will not be any financial burden on any state. He also suggested that a high level meeting involving Gujarat, MP, Maharashtra and NCA can be convened and the project can be carried ahead.

CE, SLDC Gujarat vide letter dated 03.07.2017 requested WRPC secretariat to discuss the above matter once again in TCC/WRPC meeting. In the above letter subsequent development in this matter has been communicated as follows;

> "As per the information received from the Chief Engineer (D & V), SSNNL, Vadodara on 08.06.17 (letter attached), the schedule date of completion of Garudeswar weir is Nov'17. Looking to present status, it may be completed in June'18. For upgradation of RBPH units to operate in pump mode, the principal approval from SSCAC (Sardar Sarovar Construction Advisory Committee) and NCA is pending. The expected time frame for upgradation of RBPH units for operation in pump mode would be two to two and half years from date of placement of order."

34th TCC/WRPC Discussion:

TCC Discussion:

After detailed discussion, Maharashtra& Gujarat agreed for installation of electrical equipment required for pump mode operation and funding through PSDF. Further, 14 Gujarat representative requested that the PSDF proposal may be taken up by NCA through SSNNL which is being implementing agency. In response to this, MP representative stated that they are not agreeing to the proposal of pump mode of operation as this is not a forum to decide and even if it is required to be implemented it is to be got cleared by State Government / NVDA under NWDT award.Further, this matter involves issues of water sharing and sharing of charges towards pump mode operation and therefore cannot be decided in this forum.

MD GETCO / TCC Chairman clarified that establishment of pump mode machinery at SSP is not new development today, but, it is already a part of original DPR / approval. Accordingly, SSP machines are already designed for reversible mode operation. However, some electrical work and minor modification in machines are not implemented earlier for non-availability / uncertainty in implementation of Garudeshwar weir. Now, work is already ongoing for Garudeshwar weir and it is high time to carry out balance electrical work at SSP end to have complete infrastructure ready by 2018 for pump mode operation.

On a reservation by MP on various water / power / charges / operational issues for pump mode operation TCC Chairman informed that after addressing each and every concern of all the participating States, the machines will be operated into pump mode after mutual agreeable terms between States. Further, looking to the ambitious target of 175 GW RE by 2022 of GOI and huge RE potential in all three participating States, balancing requirement is very essential in WR. Also, looking to the very high ramp rate of hydro machines and huge capacity of 1200 MW (2 x 600 MW), SSP machines are best suit as balancing infrastructure against RE variations. WRLDC and WRPC strongly supported stand of Gujarat and have agreed that commercial modality may be decided subsequently. TCC Chairman clarified that, since this is not a new development today in SSP project and also looking to huge balancing requirement in WR, WRPC / TCC forum have all the rights to ask NCA to submit proposal under PSDF for implementation of already agreed infrastructure as pump hydro is best suitable to counter the effect of variability on account of high penetration of Renewable Energy and to address the issue of peak demand. With these background TCC Chairman also briefed that MoP, GOI is also exploring possibilities to have pump mode operation not only at SSP but at all other feasible hydro stations.

After long discussion, TCC suggested the following:

(1) NCA may go ahead with installation of electrical equipment through PSDF funding by making a proposal through SSNNL as per earlier resolution in 496thOCC so as to complete the balance work concurrently with completion of Garudeshwar Weir.

(2) WRPC Secretariat shall write to 3 beneficiary states viz Gujarat/ Madhya Pradesh / Maharashtra to resolve the issue of water / power sharing in pump mode operation by the time the machines are installed and ready for pump mode operation.

(3) It is also requested to come out with an operational philosophy for pump mode operation within three months by the participating states.

WRPC Discussion:

MP stated there are unresolved issues related to UI cost, operational cost, and power & water sharing. MPPTCL opined that they expect their government's decision on this issue within 3 months of time.

Chairman, WRPC stated that it is a national project and needs to be completed at the earliest. WRLDC stated that they needed this very useful project.

	Follow-up after 34th WRPC: Chief Engineer SLDC, Gujarat vide letter No. Guj-SLDC/SCH/F/12/4247, dated 26/10/2017 intimated that as per the minutes of 113 PSC of SSCAC (Item No. 113-10), it is discussed that pumping mode operation is a major decision and need to be discussed in the NCA meeting. Representative of GoG/SSNNL is asked to submit a comprehensive proposal bringing out all associated issues and list of all equipment/works with details, included under the pumping mode operation to NCA for deliberation in the next NCA meeting. It is also asked SSCAC Secretariat to forward to NCA a comprehensive note containing all proposals submitted by GoG/SSNNL and the views of other party States along with decisions taken in various meetings of PSC to SSCAC and SSCAC. Based on these inputs, a comprehensive agenda note would be prepared in NCA and circulated to all party States for their comments for focused discussion in the NCA meeting. WRPC may request NCA to clear the proposal at the earliest.
	Meeting discussion:
	TCC Discussion: (i) M.S., WRPC informed the above agenda points and also highlighted the key issues discussed during 34th WRPC meeting. (ii) During the discussion, TCC, Chairman stated that meeting of PSC of NCA was planned in October, 2017 and subsequently deferred in November, 2017. Before that meeting happened a decision was taken by PSC of NCA to take up this issue as full-fledged agenda item in NCA Secretariat meeting. He further stated that the decision was already taken in 34th WRPC meeting that NCA may go ahead with installation of electrical equipment through PSDF funding by making a proposal through SSNNL. Therefore, the issues of installation of electrical equipment should not be restricted. The issues related to power sharing / water sharing can be subsequently sorted out. (iii) M.D., MPPMCL stated that the issue should be addressed to the right forum i.e. NVDD (Narmada Valley Development Department). He further stated that the representatives of M.P. participating in this meeting are not authorized / competent to make comment or give consent on the issue being discussed. **WRPC Discussion:** (i) TCC, Chairperson informed about the discussion during TCC. He stated that the machines were purchased some 20-25 years back having features of pump mode operation. He informed the forum that in TCC, it was discussed that let the paper work of installation of electrical equipment are started and issues related to water sharing / power sharing would be discussed later on as the time required for

	calling quotation and other formalities for installation of electrical equipments is about a year. He stated that these machine are suitable for stability of grid and smooth grid operation and therefore it was decided in 34th WRPC meeting to go ahead with installation of electrical equipment. (ii) Principal Secretary (Energy), Govt. of M.P. stated that the WRPC is not right forum to discuss this issue and therefore this issue should be taken up with NVDD and then it should be taken up in this forum for further discussion. He further stated that NVDD is the competent authority for both water and power sharing and therefore this issue should be first taken up to NVDD. (iii)M.D., MPPMCL stated that we are not right forum to discuss the issue of pump mode operation of SSP. This issue should be addressed to a department which is competent to take a decision in the matter and the right department is NVDD. **WRPC Decision:** **WRPC observed that there is no consensus on the matter of pump mode operation of SSP and therefore WRPC suggested to take up this issue with NCA and NVDD.**
7	**Multiple tripping of evacuation lines at CGPL on13.07.2016 leading to tripping 5x830 MW generators and 400 kV lines at 400 kV Bachhau S/S**
	Agenda Background:
	A complete blackout at CGPL took place on 13.07.2016. A group comprising of CGPL, GETCO, Powergrid WR-II, WRLDC and WRPC representatives met at Vadodara on 18.07.2016 to discuss the blackout. A Committee comprising of representative from CGPL, GETCO, WRLDC was formed to study the power swing phenomenon observed in the CGPL system. Based on the discussions and details received, a report is prepared by WRPC and it is available in WRPC website under PCM Minutes. Subsequently the issue was discussed in the 128th, 129th PCM & 33rd & 34th WRPC meetings. 34th TCC/WRPC Decision (27th & 28th July 2017): TCC Discussions: Chairperson TCC suggested that a group of experts shall look into this issue afresh and give its recommendations. It was decided that:

- A group of experts from WRLDC, CTU, STU, CGPL, APL and Industries shall be formed and nominations should be sent to WRPC to look into matter once again within 2-3 days.
- The newly formed group shall study the disturbance afresh and if it is felt necessary that studies are required to be carried out by professional bodies such as IIT-B, CPRI, PRDC, etc. the same shall be funded through contribution from WR constituents. No need to wait for next WRPC meeting but studies may be awarded by WRPC Secretary directly / through a circular resolution.

WRPC Discussions:
MP requested that they are also included in the study group.Tata Power opined that if committee agrees for studying by IIT-B, then the report has to be submitted to WRPC for deciding further course of action.

WRPC agreed for Chairman TCC suggestion as above.

Follow-up after 34th WRPC:

Expert Group meetings and recommendations:

The Expert Group was formed in line with the decision taken in the 34th WRPC to study the CGPL disturbance of 13th July 2016 afresh and come out with recommendation.
The 1st Meeting of Expert Group to study the CGPL disturbance of 13th July 2016 afresh was held on 23.8.2017 (MoM at **Annexure** -7A) and 2nd meeting was held on 10.10.2017 (MoM is at **Annexure** -7B)

The key-findings of expert group based on studies is as follow :

1. It is observed that if the 3-Ph fault current contribution from CGPL end for lines emanating from CGPL is around 7-8kA and if any of 400kV Bacchau-Ranchodpura D/C and 400kV CGPL-Bacchau-1 lines senses the fault in Zone 2, from Ranchodpura and CGPL end respectively and if it is persistent for 300 ms, then it is desirable to trip one unit out of the four (4) running units of CGPL.

2. As per the simulation results for the updated network case with LILO of 400 kV CGPL-Choronia and 400 kV CGPL-Halwad at Bhachau substation (45 simulations case studies were carried out and as per the Transmission Planning criteria) the network was found to be stable for a fault of 100 ms. However, it was further observed from the study that the system is not stable for any three phase faults at CGPL/Bhachau, if the fault clearance time is more than 150 ms. The detailed study report of the CGPL with the future network is attached as **Annexure -7C.**

Meeting Discussion:

TCC Discussion:

(i) M.S., WRPC stated that based on decision taken in 34th WRPC meeting, an expert group was formed to study the CGPL disturbance of 13th July 2016 afresh and come out with recommendation. Two meetings of this expert group were held. In the first meeting RLDC was assigned to carry out study and dynamic simulation and the same was presented in the second meeting of expert group. He requested RLDC to present a summery of study.

(ii) Representative of WRLDC stated the following: In first meeting of expert group the events were discussed in detail and members suggested that the WRLDC would do the dynamic study for analysis of CGPL events. Accordingly, WRLDC has done the study by taking into account different scenarios. One study we have conducted is an exact case what had happened on 13.07.2016 that time one unit of CGPL was out. The member actually validated the result and output. The CGPL has suggested that for future case, when Chorania – CGPL line is LILO at Bachau is also has to be studied with the full generation. In the first case the expert group has come to conclusion that the root cause was the delayed fault clearance at Varsana end. The fault was persisted for 370 ms and the tripping of Bachau – Ranchorpura due to some protection coordination issue. If CGPL one unit has tripped, it would have saved the system. Then protection coordination was discussed in PCM and it was done and there was a suggestion of line differential protection on short line Bachau-Varsana line which has to be implemented by PGCIL by laying OPGW. In the second study with network change, and full generation, the system is not stable if the fault is persisting beyond 150 ms so the group recommended that all protection should be in service at CGPL and Bachau and system should be in place so that fault can be cleared within 100 ms as per standard and all testing to be done on regular basis. There should not be any delayed fault clearance at CGPL and Bachau. Line differential protection on Bachau –Varsana should be implemented at the earliest. The CGPL has suggested some changes in SPS that we will consider.

(iii) TCC, Chairman asked representative of CGPL to make comments. A representative of CGPL stated that they are agreeing with the study carried out by expert group. However, he said that regarding tripping of one unit of CGPL they are discussing with their management to decide which unit is to be tripped. He further stated that the condition is going to be dynamic to decide the unit to be tripped. Probably system strengthening should resolve this problem. He also stated that differential protection at Bachau –Varsana will certainly

help the stability of the system. He also appreciated study carried out by expert group by taking into account 40+ scenarios. He informed that the other recommendation is to trip one unit of CGPL to make the system stable. He informed that they are working on this recommendation by taking into account various aspects and they will come back with the identification of the CGPL unit to be tripped in eventuality.

(iv) TCC, Chairman enquired that even with tripping of one unit at of CGPL, what is the significant of 150 ms delay? Representative of WRLDC replied that the group has observed if there is any fault at Bachau or CGPL, the system becomes unstable after 150 ms.

(v) TCC, Chairman stated that the CGPL need to decide which unit they are allocating for tripping in case of eventuality. He further elaborated that CGPL need to decide whether it is unit no. 1 or unit no. 2 or unit no.3.

(vi) Representative of CGPL stated that we are ok with the present scenario where there seems to be no option other then tripping the CGPL unit. However, we are saying that this cannot become regular norms because system strengthening should be able to take out of this situation. We have lot of SPS system which are in place so there is lot of loss due to operation of SPS.

(vii) E.D., WRLDC stated that the tripping of CGPL unit would certainly not be frequent therefore CGPL need not worry. He suggested that CGPL should participate in final discussion with study group by 15th of January, 2018 for making decision on identification of CGPL unit for tripping in future eventuality.

TCC recommended convening a final meeting of expert group by 15th January 2018 to identify CGPL unit for tripping in future eventuality.

WRPC Discussion & Decision:

WRPC noted TCC recommendations as above. Further, it was decided that no protection settings would be changed without the knowledge PCM or TCC for all elements which are part of evacuation system of CGPL and CGPL complex. It is also agreed that no protection settings would be changed without consent of PCM / TCC of WRPC for any element of WR Grid

8	**New Interface Energy Meters, AMR system and meter data processing system: installation**
	Agenda background:
	75th CCM (28.06.2017): WRLDC vide letter no. WRLDC/MO/1551/2017 dated 26.09.17 (Copy enclosed at **Annexure- 8**) informed that the "Technical specifications for Interface Energy Meters (IEM), Automated Meter Reading (AMR) system and Meter Data Processing system (MDP) for Western Region" prepared by WRLDC was discussed in the 75th CCM. 34th TCC/WRPC (27-28 July 2017): After incorporating the suggestions of the members, the revised draft was put up in the 34th TCC/WRPC meeting held at Mumbai on 28.07.17 and was approved by the committee. The approved document has been uploaded on the WRPC website at the URL http://wrpc.nic.in/wrpc/IEM_AMR_final.pdf. Discussions during 76th CCM (23.10.2017): POWERGRID representative informed that the work related to installation of new Interface Energy meters, AMR system and meter data processing system have not yet been started. SE(C), WRPC informed that WRPC Secretariat shall write a letter to PGCIL to get the action plan for the implementation of the project. Subsequently, WRPC vide letter No. WRPC/Comml-I/Follow up /2017/1352 dated 02.11.2017 requested Director (Operation) PGCIL to expedite the matter so that the work of replacement of interface energy meter, installation of AMR system and meter data processing system can be completed at the earliest. PGCIL may update the status.
	Meeting Discussion:
	TCC discussion: (i) MS WRPC enquired about the updated status of the work related to installation of new Interface Energy meters, AMR system and meter data processing system. (ii) ED PGCIL informed that they have written a letter to MS WRPC, wherein their concerns have been raised. Unless these concerns are resolved we are unable to proceed for procurement of the meters. The main concern raised is as follows: The metering system is not approved by the forum of regulator (FOR); Being an ISTS and installing these meters in WR, will be affecting other regions also

because other regions are not adopting 5 minute metering.

(iii) ED WRLDC stated that after a long 7-8 months of hard work, a very futuristic meter was proposed and approved in last WRPC meeting. These futuristic meters will take care of next 10-15 years because the old meters were installed 10 years back and their life is over. Their repairing cost is much more than the new meters. This new meter is having 5-min features so that we can get 5-min data if needed in future. He stated that PGCIL has already agreed in 34th WRPC meeting to carry out the installation of meter and AMR. He stated that they have tested 5-min/15-min meters with out-side agency at Magarwada S/S.

(iv) ED PGCIL stated that they are going to spend 30 Crores of Rupees, so decision on 5 min or 15 min need to be taken before the procurement. The proposal which they received for replacement of meter involved expenditure of Rs. 30 Crores. The AMR for 5 min meter and 15 Min meter is entirely different and therefore we cannot purchase 5 min AMR unless it is decided that 5 min metering is to be installed since these meters have not yet been approved by CEA or forum of regulators.

(v) ED PGCIL further stated that there are many issues related to installation of meters and AMR. These are: "*First we have to decide whether to purchase 5min or 15 min meter; Whether all existing meters are to be replaced in one go or phased manner. We are agreeing with the decision taken on replacement of the meter but we are concerned that the value of those meters would become zero which we have replaced in the recent past*".

(vi) Chairperson TCC stated that if all the members are agreeing then PGCIL need not oppose it. PGCIL should justify their stand with literature.

(vii) ED PGCIL stated that their technical team is having a PPT and they are saying that either they can go for 5 min or 15 min. The AMR does not support both 5 mins and 15 mins. If the meter is changed for 5 min configuration in future the entire AMR system has to be changed. Therefore it must be clarified whether all the constituents agree for it.

(viii) CE SLDC GETCO stated that they have already taken up installation of meters having feature of 5 mins and 15 mins with AMR facility.

After long discussion, TCC recommended that PGCIL to start installation of New Interface Energy Meters, AMR system and meter data processing without any time delay; the meter to be procured shall as per the specification approved in 34th WRPC meeting; it is the responsibility of CTU to install a meter with AMR

at all location of inter connection of ISTS irrespective of the substation owned by CTU or STU.

WRPC discussion:

(i) MS WRPC summarised TCC discussion. He further added that in last CCM meeting PGCIL was stating that they will do the work at CGS, NTPC and CTU stations but due to some issues regarding integration they will not carry out this work at STU stations.

(ii) ED PGCIL stated that it is CERCs jurisdiction to decide 5 min metering and the issue was discussed with Director (Opn.) and their management's view is that after getting approval from CERC procure and replace the existing15 min meters with new meters at the estimated cost of Rs.30 crores.

(iii) Principal Secretary (Energy) Govt of MP stated that *PGCIL is a big, and technologically advanced organisation and they are the one who set bench mark for other TRANSCOs. He also* stated that when even DISCOMs are being asked to *install smart meters/ prepaid meters/ AMR, etc., PGCIL should be positive about implementing this scheme.*

(iv) Chairman WRPC stated that ED WRLDC has clarified that the requirement of 5 min is not immediate requirement, basically provision should be there and with this caveat it should be okay with PGCIL.

(v) TCC Chairman insisted that PGCIL/CTU should provide similar meter/AMR system, as provided to PGCIL/CTU, at interface points of STU stations also.

(vi) Chairman WRPC stated that PGCIL/CTU should go ahead with the purchase of meter and replacement of meters and obtain required approvals, if any, separately.

WRPC decision:

WRPC agreed to TCC recommendations and decided that PGCIL/CTU should go ahead with the replacement of existing meters with installation of New Interface Energy Meters, AMR system and meter data processing system having specifications as approved in 34th WRPC meeting.

WRPC also noted that it is the responsibility of CTU to install the meters with AMR at all location of inter connection of ISTS, irrespective of the substation owned by CTU or STU.

9	**SAMAST: status of implementation of recommendations**
	Agenda Background:
	TCC, Chairman asked all the constituents to intimate the status of implementation of the SAMAST report. Representative from Daman informed that they would intimate the progress within a month. Representative from WRLDC requested specific feedback regarding intra state ABT composite meters from Maharashtra. Goa representative was not present to make comment. <u>Discussions during 76th CCM:</u> During 76th CCM, MSEDCL representative was asked to update the progress made in Implementation of SAMAST report recommendations. In reply, he informed that a petition has been filed with the regulator (MERC) and the order is yet to be received. In view of the same, frequency linked deviation and deviation settlement for intra-state generators is not functional in Maharashtra. Updates of Goa and DD could not be obtained as representatives from Goa, DD were not present in the 76th CCM. Goa and DD may update the status.
	Meeting Discussion:
	TCC discussion: (i) MS stated that SAMAST Status of implementation of recommendations was discussed in the 76th CCM and requested Goa & DD to update the status. (ii) TCC Chairperson expressed concern over non-participation of Goa & DD in the meeting and henceforth their problems would not be shared, heard and discussed if they continue not to participate. **WRPC Discussion:** (i) MS WRPC stated that the issue was discussed in the last meeting and also in the 76th CCM. During the discussions it was informed that Maharashtra having filed petition with MERC and therefore status could not be given by Maharashtra. It was informed that MERC has not yet issued its final order. (ii) ED MSETCL stated that there are • 26 check points for any state for implementation of this SAMAST and they are regarding identification of areas, Discom, generation, G2T points and T2T points.

	• MSETCL do not have AMR system. They are under process of implementing AMR and in first phase they will be taking up all G2T interface for providing AMR, thereafter they would take up T2T interface points. All other requirement of SAMAST are already completed in Maharashtra except frequency linked ABT system. • In Maharashtra, 15-min based intra-state ABT system is in place, however it is based on system marginal price and it is not linked with frequency. Whereas SAMAST is based on frequency linked ABT. Due to this reason MSETCL could not implement SAMAST. In this regard, MERC need to issue the order. (iii)During the discussion, it was noted the non participation of representatives of Goa and DD in WRPC meeting. WRPC Secretariat would take up this issue with Goa & DD and ensure participation in all WRPC meeting in future. **WRPC noted as above.**
10	**Signing of TPA by State Govt with GoI & RBI**
	Agenda Background:
	During 2000-01, when the sustenance of power sector was under severe threat due to default of payments by many of SEBs/DISCOMs to CPSUs, GoI planned a One- time Settlement Scheme for SEBs dues wherein a Tri-Partite Agreement (TPA) was signed by GOI with State Govts and RBI. The TPA facilitates GOI to settle the dues of CPSUs in case of default by any State Utility in making payment and the amount shall be recovered by GoI from the funds transferable by it to respective State Govts. Though vigorous efforts put up by POWERGRID to recover its dues never created a situation so far to operate the TSA, however, existence of the same provided necessary impetus to State Utilities to maintain fiscal discipline. This has also provided confidence to our lending agencies and thus helped in securing the loans at most optimal rates, benefit of which are ultimately passed onto the customer. Presently the TPA is valid only upto 31.10.2016 and prevailing situation demands that the TPA signed with the States and RBI should be continued further and validity be extended upto 31.12.2030. In this regard, necessary information sought by the MOP was also forwarded by POWERGRID vide letter No:CC/CP/MOP, dtd 16.01.2015. All the WR constituents except Maharashtra have signed the TPA. In case the same is not done, State Utilities have to open LC for 210% of

	average billing (instead on 105%) as per the provisions of BCD Procedures of CERC Sharing Regulations, 2010. POWERGRID may update the status regarding Maharashtra.
	Meeting Discussion:
	TCC discussion: (i) MS informed that Maharashtra & PGCIL have to sign the TPA. (ii) ED PGCIL informed that all WR States have signed the TPA, except Maharashtra. (iii)TCC Chairperson observed that from last three to four months the status is same. He requested Maharashtra to expedite signing of TPA and update the WRPC forum regarding the efforts taken. **WRPC discussion :** (i) MS WRPC stated that according to representative of Maharashtra, TPA signing is under consideration by Govt. of Maharashtra. (ii) When Maharashtra was asked by Chairman WRPC to comment on the issue, Maharashtra representative stated that signing of TPA is under consideration by Govt. of Maharashtra and it is expected to be signed by 31st January, 2018. **WRPC decision:** **WRPC decided that Maharashtra should expedite the signing of TPA by 31st January 2018.**
11	**Progress of downstream network of constituents whose terminating bays are under construction by POWERGRID**
	Agenda Background:
	The important assets were planned under various transmission schemes & under implementation. However, implementation of downstream 220kV system needs to be commissioned for utilization of the system. The Status of unutilized 220kV line bays at Existing Substations in WR and under Construction 220 kV line bays at New Substations / Substation Extensions in WR is attached at **Annexure – 11**. Constituents may update the status.

	Meeting Discussion:
	TCC discussion: (i) MS stated that the agenda is regarding progress of downstream network by constituents whose terminating bays are under construction by power grid, the same is available at **Annexure-11**. (ii) TCC Chairperson stated that MS informed him that they are regularly conducting a Transmission Review Meeting (TRM) so that downstream network and other projects and issues, which are coming up in this year, can be discussed and addressed; but hardly four or five participants are participating in this meeting. (iii) ED PGCIL suggested that TRM meeting should be held along with OCC meeting. MS explained that if TRM is merged with OCC meeting, then adequate time might not be available for TRM, because of large number of outages that come up for OCC approval which is extending the meeting time into evening also. He informed that TRM could be held either prior or after OCC day. (iv) In respect of item no.1 of Table-2, MD MPPTCL expressed concern over receipt of false news from Adani representative one week back that 400kV Gwalior to Morena (Adani) line has been completed. He said that MPPTCL was asked to charge 220 kV s/s and charge the 400 KV line. He asked POWERGRID to update the status of the said 400 line. POWERGRID replied that the line was not yet charged. MD MPPTCL stated that they would not charge the 220 kV side until the 400 kV side is ready. TCC Chairperson stated that unless there is 400kV line, there is no use of charging 220kV side, since there is no effective power flow. (v) MPPTCL requested PGCIL for constructing the 400kV bays for MPPTCL at Khandwa by June 2018. (vi) MS requested the constituents (i.e. GETCO, MSETCL, CSPTCL, MPPTCL, DD, DNH, and Goa) to update the status of their systems given in the agenda. **TCC/WRPC agreed on the stand taken by MPPTCL.**
12	**Ongoing transmission schemes (765/400 KV & above): status of completion**
	Agenda Background:
	The ongoing transmission projects (which are being executed/ implemented by transmission agencies) are regularly being monitored in Transmission scheme progress Review Meeting (TRM) meeting. In line with decision taken in 34th WRPC meeting (28th July, 2017), TRM

	meeting was held on 21.08.2017 and 09.10.2017 at WRPC wherein reviewing of the status of ongoing projects and other associated issues like readiness of down-stream networks, Railway crossing works, ROW related issues, other constraints etc. were discussed. Serious concern was raised during last TRM meeting on poor participation from Utilities. Therefore, It is requested that the management of all concerned utilities may ensure participation of suitable level officer conversant with the subject matter in TRM henceforth so that review of transmission scheme progress can be done more effectively. This will also facilitate smooth progress in ongoing work of all the scheme because of better coordination among the utilities. The updated status on various ongoing transmission schemes for the year 2017-18 as per the latest TRM is available at **Annexure-12**. <u>Issue:</u> Whether to continue to hold TRM meeting regularly considering poor participation in the last meeting. Constituents may update the status.
	Meeting Discussion:
	TCC discussion : MS stated that the issue under this agenda Item has been comprehensively discussed under Item no. 11. He further stated that constituents should participate in TRM meeting so that all the issues will be resolved amicably and work of construction of ongoing transmission schemes could not get hampered. **WRPC discussion:** MS WRPC stated that based on the decision that is taken in the last WRPC meeting, regular TRM meetings are being held; two meetings were held; 1st meeting had good response; in the last meeting only few people turned up for the meeting; so after discussion, TCC expressed a serious concern over poor participation in the TRM meeting and requested Transmission licensees to take TRM meeting seriously and depute one of the senior level officer who is conversant with the issues of the Transmission line Erection/Commissioning activities. In TCC, it was decided that the quarterly TRM would be conducted either before or after OCC meeting day to get full participation. **TCC/WRPC suggested the constituents to ensure participation in the TRM meeting which shall be conducted on quarterly basis either before or after OCC meeting.**

13	**Extension of LILO arrangement for evacuation of power by ESSAR Power M.P. Ltd., 2x600 MW ("EPMPL")**
	Agenda Background:
	As per CERC order dated 28.09.2016 on Petition no. 30/MP/2014, "CTU shall take up all the existing cases of connectivity on interim LILO with the RPC of respective regions within a period of one month from the date of issue of this order for review and decision on disconnection of the interim arrangements through LILO. All such interim arrangements through LILO shall be disconnected within a period of three months of the issue of this order unless the RPC grants extension for continuation of LILO keeping in view of all relevant factors." The progress of all dedicated transmission lines of IPPs in Western Region, which were connected through interim arrangement, was reviewed in 41st SCM in WR held on 21.12.2016. Out of 6 dedicated transmission lines to different IPP's only following two dedicated lines have not been completed: 1. VVL – Dharamjaygarh PS 400kV D/c line for evacuation of Vandana Vidyut Ltd. (VVL) (2x135+270MW) (IPP) which was connected through LILO of 1st ckt of 400kV Korba - Birsinghpur D/c line. This LILO arrangements is presently disconnected as per Hon'ble CERC order. 2. EPMPL - Bilaspur PS 400kV D/c (triple) line for evacuation of Essar Power M.P. Ltd (EPMPL) (2x600MW)(IPP) which is presently connected through LILO of 1st ckt of 400kV Korba STPS – Vindhyachal STPS D/c line. The SCM directed VVL to complete the balance work by march 2017 whereas EPMPL was also directed to complete the line before monsoon of 2017. LILO arrangements of VVL was disconnected due to non completion of dedicated line. The matter of contuation of interim LILO of Essar was also discussed during 33rd TCC/WRPC meeting. The relevant abstract is follows: Quote: *"TCC discussed the issue and recommended that the decision to grant interim connectivity to M/s VVL was taken by Standing Committee on PSP, and further they have decided to remove the interim connectivity to M/s VVL. Also M/s VVL agreed for the same in the SCM. Hence the TCC endorsed the decision of SCM and recommended to open the interim connectivity for M/s VVL by 31st March 2017, if not already done.*

Regarding EPMPL case, SE(Comml) WRPC informed that SCM had permitted interim connectivity only up to June 2017 to complete the works otherwise the interim connectivity shall be opened.

As given in the agenda, TCC discussed the Hon'ble CERC order and noted that Hon'ble CERC has directed CTU to bring such cases to RPC. Accordingly future cases may be brought to RPC notice.

In the EPMPL case, TCC recommended that hitherto the SCM on PSP decided on such decisions. It noted that representatives from EPMPL, CTU, CEA & STUs of WR had deliberated in detail and had given directions to EPMPL to complete the line by 30th June 2017. Considering this TCC endorsed the decision of SCM and recommended that EPMPL shall complete the line by 30th June 2017, else the interim connection would be removed by CTU. Hence forth such cases shall be brought to the RPC forum by CTU.

WRPC:
WRPC agreed to TCC recommendation of opening the interim connectivity for M/s VVL by 31st March 2017, if not already done. Further WRPC agreed to the TCC recommendation for EPMPL case to complete the line by 30th June 2017 and CTU to discuss such issues in WRPC forum."

Unquote:

M/s Essar Power M.P. Ltd., 2x600 MW ("EPMPL") vide letter no. 4003/10 Dated: 1st June, 2017 requested WRPC Secretariat for extension of LILO arrangement for evacuation of power on 400 kV Vindhyachal – Korbacircuit-I of PGCIL.

Subsequently, WRPC Secretariat informed to M/s Essar Power that extension of interim LILO arrangement for injection of firm power can not considered since the extension can only be granted by WRPC forum but not WRPC Secretariat alone. Also it was not convenient to call a special WRPC meeting within short notice as the next meeting of WRPC is already scheduled in July, 2017.

Subsequently M/s Essar Power filed a petition before Hon'ble CERC for extension of LILO arrangement. Hon'ble CERC vide Petition no 127/MP/2017 with I.A.No. 36/2017 Order dated 30.06.2017 directed to WRPC to take a decision on the matter on or before 05.07.2017.

Since the 34th TCC/WRPC meeting is scheduled on 27th& 28th July, 2017, WRPC secretariat after taking approval from competent authority intimated CTU to continue interim LILO arrangement till a decision is taken in the said WRPC meeting.

34th TCC/WRPC Discussion (27/28 July, 2017):

TCC Discussion:

TCC Chairman asked to EPTCL to give brief presentation (copy enclosed **Annexure 13.1**) containing progress and status of work related to construction of EPMPL -Bilaspur PS 400kV D/c (triple) dedicated line. From presentation by EPTCL, it is emerged that the line will be completed latest by December 2017. It was also noted that the second 600 MW unit of M/s Essar power plant is also ready for synchronization.

NTPC raised concerns regarding the increasing fault level at NTPC power plants on account of introduction of 2x600 MW power plant on the line under discussion. NTPC further informed that in 39th SCMPSPWR held on 30.11.2015, the issue of higher fault level at Vindhyachal was discussed and it was decided to remove/delink some elements. However, it was deliberated that this LILO has been in operation since long time without causing any fault level problem so far and as such there is no addition of any further injection by the elements till the existence of interim arrangement of LILO and therefore there is no valid ground for discontinuation of LILO.

Madhya Pradesh representative did not agree for extension for the interim LILO arrangement and expressed concerns over the security of the line. He further stated that the NTPC flow between Korba - Vindhyachal NTPC line should not be restricted.

WRLDC stated that as of now 350 MW is injected by Essar plant on interim LILO and opined that up to next WRPC meeting, the interim LILO can be allowed to continue.

Based on detailed discussion, the following were decided by TCC:

- Chairperson TCC suggested that a two-month extension i.e. till 30th Sep, 2017 to the interim LILO be granted and further decision on the issue shall be taken by WRPC based on the progress made by M/s Essar in construction of the dedicated lines.
- As regards to the commissioning of Unit No. 2, Essar shall be permitted but at a time the power flow shall not be increased beyond 600 MW in any case till the dedicated line work is completed by Essar.
- TCC Chairperson/WRLDC suggested that the generation at Essar with both units shall not exceed 600MW and WRLDC would ensure that the generation at Essar is equal to/below 600MW during real time operation.

WRPC Discussion:

Chairman, TCC briefed about the request from M/s Essar for continuation of interim LILO. He also briefed about the present progress and present status of construction work of dedicated line. He also stated that there was a concern from NTPC regarding increasing fault level at Vindhyachal on account of LILO, however it was deliberated during TCC that this LILO have been in operation since long time and as such there is no addition of any further injection by the elements till the existence of interim arrangement of LILO and therefore there is no valid ground for discontinuation of LILO. He further stated that as per the request of Essar for commissioning of unit-2 (600MW), Essar should be permitted to synchronise unit -2, but power flow from their generating station should be restricted upto 600 MW only till the work of construction of dedicated line is completed. He added that even after COD of unit -2, Essar could not be permitted to inject more than 600 MW and this would be ensured by WRLDC in real time.

TCC, Chairman also stated that during deliberation in TCC, Madhya Pradesh was not agreeing for the extension of LILO because of increase in power flow between Korba and Vindhyachal due to injection from existence of LILO and therefore MP did not want the NTPC power flow through Korba-Vindhyachal line is restricted owing to presence of LILO. TCC, Chairman also elaborated that if required, backing down of generation shall only be done by Essar.

Gujarat opined that LTA for the plant shall be made operational. NTPC insisted that for Korba-Vindhyacal line, studies are to be conducted for contribution of fault level and the study has to ensure (n-1) contingency criteria also.

After detailed deliberation, TCC, Chairman stated that based on planning of construction work of transmission line and balance work of transmission line, Essar could be allowed to continue with LILO for two months of time (i.e. till 30th September 2017) to demonstrate visual progress in construction of dedicated line.

After September 2017 further decision in this regard could be taken.

It was noted that during the last six to seven months of interim LILO in service on extension, there was no problem faced by CTU and WRLDC in system operation as there were no communications received from them for disconnecting the interim LILO. During the discussions, it was also noted that CTU & WRLDC did not oppose the proposed extension of interim LILO. Study reports submitted by is CTU enclosed **Annexure-13.2**.

After deliberation, Chairman, WRPC stated that next two months time is crucial for Essar to demonstrate visible progress in ongoing construction work of dedicated transmission line. He further added that Essar shall regularly update the progress of work on weekly basis to the WRPC Secretariat.

Based on above discussion, the following decision have been made:

(1) Essar shall continue with existing interim LILO arrangement till 30th September, 2017. After September, 2017 decision shall be reviewed by WRPC based on visible progress made in construction work of dedicated line.

(2) Essar shall furnish Weekly Progress Report showing details like no. of foundation completed, stringing completed, no. of tower erected etc. to WRPC Secretariat.

(3) Essar shall be permitted to synchronise Unit No. 2, however Essar shall also have to ensure total generation of Essar Complex within the limit of 600 MW. WRLDC shall restrict injection of Essar upto 600 MW in real time operation.

<u>Follow up after 34th WRPC:</u>

- Portion of MoM of 34th WRPC related to this issue was submitted to Hon'ble CERC in response to their letter no. 127/MP/2017, dated 04.08.2017 and 07.09.2017. (WRPC Ltr. No. WRPC/WRPC Mtg./AS/2017/1221 dated 13.09.2017)

- Extension of this interim LILO arrangement up to September, 2017, as decided in the 34th WRPC meeting, was conveyed to CTU. (WRPC Ltr no. WRPC/AS/2017/1267 dated 29.9.2017)

- Weekly Progress Report of construction of dedicated Essar Mahan-Sipat 400 kV D/C transmission line is being furnished by M/s Essar Power MP Limited (EPMPL) to WRPC.

- Extension of this interim LILO arrangement up to December, 2017 was approved by the competent authority based on the weekly progress report. And the same was conveyed to CTU. (WRPC Ltr no. WRPC/AS/2017/1267 dated 29.9.2017)

- Weekly Progress Report was submitted to Hon'ble CERC in response to their letter no. 127/MP/2017, dated 10.10.2017. (WRPC Ltr. No. WRPC/WRPC Mtg./AS/2017/1221 dated 13.09.2017)

Issue:

M/s Essar Power MP Limited (EPMPL) may update the status of construction work of dedicated transmission line.

Meeting Discussion:

TCC discussion:

(i) MS informed that in the last meeting (34th WRPC), WRPC gave 2 months extension to the LILO arrangement at Essar Power on 400kV Korba-Vindhyachal line to M/s EPMPL up to Sept 2017. In that meeting it was also decided that based on the progress made by the developer, further extension will be considered. Accordingly Essar Power was submitting the weekly progress report to WRPC and so based on this WRPC decided to give extension up to Dec-2017. It was anticipated that the line will be completed by Dec 2017, so accordingly with the approval of competent authority the extension was given and was conveyed to CTU. In the meanwhile minutes of the meeting of 34th WRPC meeting was submitted to Hon'ble CERC also in response to Secretary CERC vide letter dated 10.10.2017, wherein WRPC was directed to submit the weekly progress report of construction of dedicated line. The same is being regularly sent to Hon'ble CERC. He further informed that Dec 2017 end is approaching and WRP Committee can decide next course of action. He then requested Essar Power to give update on the progress of the construction of the dedicated line.

(ii) M/s Essar Power informed the following progress;

- *When we started the work in the month of July 2017, we were having four foundation balance out of 942, 33 erection of tower were balance and 140km of stringing work was balance. As on today what we have completed the total foundation all the four foundations. We could complete 17 out of 33 erection of towers so balance is 16. We could complete 66km of stringing part and 74km is balance.*
- *We have done mobilization of four TSC gangs working and there are two manual gangs working. For tower erection six gangs are working simultaneously. Also we have put up 5 gangs who are doing the rectification job at various locations like tightening the towers etc.*
- *At six towers the work is in progress as on today with the deployment of 6 gangs. Stringing 263 done and now 4 nos of TSC and 3 nos of manual gangs are working and approximately 7 km stringing work is in progress as on today.*
- *We have faced challenges during this period and these are:*

a) The monsoon got extended roughly for 1 month, it continued up

to mid of Oct 17 and we have deployed the gangs but the whole area was submerged into water. We tried to work but the progress was affected due to the monsoon. Even with lot of water logging we continued to work.

b) *Other than monsoon we were facing the severe ROW issue but we have done what we can do. We have requested the administration to help us out and our end also we have put crack team at several places there were several foundation where we had the issue and we have to request the police protection, to work there.*

c) *We are giving some numbers where we have the severe erection issue due to the ROW, roughly 12-13 tower where we were facing the severe ROW issue. Stringing part also there were several issues of ROW, in fact we were thinking that once the foundation is done ROW issue will be reduced. Even at the end of tower erection when we go for stringing people comes out and at several times we get bunch of people whose names are not there on the land record but they use to stay there and stall our work.*

d) *At several location we have faced the robbery means we have security guard where people come in at night they have tied our people with ropes and took away cables what we had there. There are some people whose name are not in the land record but when we go there we found that they are not allowing us to work and then we have to take a help of the local administration.*

(iii) TCC Chairman stated that this is a natural phenomenon while construction of the line and enquired Essar Power what is their proposal now.

(iv) Essar Power informed that we are adding one more TSC gang and three manual gangs to expedite the stringing work. We have now several task force in place.

(v) MS asked Essar Power when they will complete the dedicated line.

(vi) Essar Power representative informed that we have the plan. We are targeting the tower erection and will be completed by second week of Jan 2018 and stringing by end of March 2018 and inspection and testing commissioning by Feb 2018. We request the committee to give us the extension till April 2018. In fact after the last meeting when the committee was kind enough to allow us to synchronise the unit 2, after getting the permission we could synchronise the m/c within 3 days.

(vii) MD MPPTCL asked Essar Power that you are informing that local administration is also reluctant to take strong action against the villagers. If this is the case then you may not complete the line by 2018 also.

(viii) TCC Chairperson stated that because this is the normal phenomenon of resistance of the people and seeking the support from

the administration. Essar Power representative stated that the monsoon extended upto middle of Oct 17, still man power of 4 TSA as well as 3 manual gangs were there during monsoon. The work is affected and then if we see frankly in Chattisgarh (Korba area), we did not have ROW problem with the same manpower deployed there our progress is 65 % was achieved there. But where as in MP very close to our plant there were lot of issues related to even plant and earlier issues. So even this police protection continuously we did not get like for 7 days, if there is VIP movement or some law and order problem happen. As already said theft took place at so many places. Of course we have provided 15 restoration gangs who are seriously working on that and on daily basis, morning evening we have been reviewing it and trying to resolve the issue but certain issues which are of local nature, due to these reasons our progress is getting hampered.

(ix) TCC Chairman asked *"How confident are you in completing the line by April 18?"*. Essar Power stated that we have mobilized the crack team at several location. In fact what we do, we negotiate with the villagers and issue them the cheque on the spot. That is why in the last four months we could issue three thousand one hundred cheques by negotiating with them. Therefore we are very much confident.

(x) MPPMCL representative stated that we have some bilateral issue with the Mahan project. These issues are being sorted out separately. We have objected to allow them to be LILO on the line. There were some technical constrains between Korba and Vindhyachal power house, even then the power was flowed and permission was granted after our objection. We are paying the PoC charge of the Vindhyachal-Korba line and the line is being used by Essar.

(xi) MD MPPTCL opined that the particular line should be to Essar Power account, then only they will try to complete the line. They should be made to bear the PoC charges of that line till they construct their own line.

(xii) MPPMCL representative stated that the problem is, we are paying the PoC charge of this particular Korba Vindhyachal line and the line is being utilized by Essar Power. We are not getting 150MW from Essar as per contracted supply from them. It is a separate issue and not going to discuss over here.

(xiii) Essar Mahan representative clarified that all other commercial issues will be done as per the CERC regulations.

(xiv) TCC Chairman stated that this is again a new dimension and requested WRLDC/CTU to give their views.

(xv) Essar Power representative informed that the LTA is operationalized and STOA is already being paid and whatever commercial issues are there it will be paid as per CERC regulations. There is no issue on that its only as rightly said by MP representative, if this line is ready we want to run the second unit and 150 MW will be given. So we want to run both the units and complete this work. We are requesting forum to allow the generation of plant to continue.

If generation of plant is stopped again we are already problem because of that coal block and other things so we will be in more problem. We want to come out of these problems, it is our earnest request we want to run that unit and complete this asset and have a maximum generation so that MP also get 150MW.

(xvi) MPPMCL representative informed that in the 34th WRPC meeting MP objected it.

(xvii) TCC Chairman informed that this arrangement in the last meeting we have continued. It is not that the new connectivity and new LILO arrangement granted in last meeting. It was only extension granted.

(xviii) MD MPPTCL enquired how long we should continue this arrangement. Next meeting also this issue will come. Same reply will be given by Essar.

(xix) TCC Chairman stated we all are transmission people. We are expert in this business. We are discussing from July 2017, in which there were four foundation balance, 33 erection and almost 140km of the stringing pending. We also need to understand and see the objective of the company. Whether he has not done anything then it is ok. But you see the progress they have completed all the foundations. They have completed half of the erections, straightway they have also gone for the rectification of the missing members and all other things. They have completed 50% of the stringing so we cannot say that they have not made the effort. They have made all the effort in-spite of this rainy season. Now it is for the technical people to decide what is the ground to restrict because the company is still continuing the work. He also informed that he had interacted as the Chairman of the TCC with the person who is executing this job, he endorsed that almost all the gang what he has mentioned here available on the ground and they are working. So TCC can allow time so that they can finish by the April 2018 date given by them, because in the first meeting TCC Chairman told that the Dec 2017 was a too hard commitment. But they can try to finish by Feb 2018 or at least by March 2018. On the other hand one issue has been raised by MP i.e PoC. WRLDC may inform about the network constraint and network reliability is there, WRLDC can throw light on this.

(xx) CTU representative informed that PoC charges we can't tell that it is already included in the PoC and PoC is an all India phenomenon it can't be billed one to one and the contention of MP that it is in use only by Essar power is not correct, because when Essar power is generating low, power can flow either ways. The contention that the line is used by Essar is not correct. It is already built in PoC. This is an all India phenomenon and it cannot be billed one to one.

(xxi) ED WRLDC informed that the petition for renewing the LILO of 16 such LILO in the entire country was done by NLDC to Hon'ble CERC in 2014. All 15 LILO has been removed, only this LILO is remaining. There are various petitions on this issues and harmonious reading of various judgements by Hon'ble CERC, RPC in consultation with CTU

after considering the proposal in the light of the relevant factors can permit injecting of firm power for a period of three months which can be extended for another period of maximum 3 months, if the dedicated transmission line is not commissioned within the period granted by RPC then interchange of firm power shall not be permitted by the RLDC concerned on interim LILO arrangement. So what is my understanding is that WRPC have already exhausted power. He stated that, last time also he personally on behalf of WRPC tried to push this, because 300-500MW of power coming to the grid is good. He further stated that this time also he wished but now the decision has to be taken by Hon'ble CERC. The message is very clear, also in the last validation committee meeting where MS was also there which happened just 10 days back CERC has already made 0 injection from Essar Power. He continued to say that personally he would wish that this continues but he afraid now the power given by Hon'ble CERC to WRPC is exhausted by six months extension and further extension can be done by Hon'ble CERC. He informed that one more thing he would like to say that just two months back in this almost same situation Vedanta's LILO was cut few days back. We have cut Vandana on the same petition. So at this stage having got this order it is very clear that six months power is only with WRPC, he cautioned the forum that it will become vulnerable, if it gives further extension.

(xxii) MS informed that last letter sent to CERC in July 2017, before conducting the last WRPC meeting. Essar wrote to our Secretariat for extension and WRPC advised Essar Power to approach for CERC. Subsequently Essar Power approached CERC and CERC referred it back to WRPC only and directing WRPC to decide. So as on today's record CERC has given the power to WRPC to decide.

(xxiii) TCC Chairman enquired what is the last communication from CERC in this regard ? MS informed that CERC asked WRPC to furnish weekly progress report of construction of dedicated line.

(xxiv) TCC Chairman said CERC has given maximum 6 months time to WRPC. Beyond six months again we have to refer to CERC.

(xxv) MD MPPTCL enquired who will approach CERC whether Essar or CTU?

(xxvi) TCC Chairman informed that this order was issued on 20th September 2016 and enquired whether six months can be counted from Sept 2016?

(xxvii) ED WRLDC replied that it is from the time they came. Further he explained that the Standing committee has given time up to June 2017, after that the six months extension was given. He further added apart from this, 15 out of 16 have gone. Sterlite was opened in night. It is better, Hon'ble CERC decide, otherwise we would be vulnerable. We tried our best in spite of strong opposition from MP during last WRPC meeting. Now again giving extension will certainly make us vulnerable. Tomorrow, the people whose LILO discontinued

are closely watching they may file petition.

(xxviii) TCC chairman stated let the decision in this regard leave for tomorrow in WRPC meeting.

(xxix) Essar representative stated that he agreed what was interpreted but ultimately what CERC said is that, it is the general order for so many LILO, but for case to case basis. WRPC to take the decision based upon the situation for the particular case. As a generator, we will definitely complete the line and please consider our request to give extension till April 2018.

(xxx) ED WRLDC stated that CERC on the petition of this case wrote, "*we direct the staff to proceed under the appropriate provision of the electricity act and transmission licensees regulation of the commission against the EMPTC for its failure to execution transmission project in time*". It indirectly says that if project is not completed in time their transmission licence would be cancelled. The generation for this project was taken zero in recently held validation committee meeting. It was also observed in validation committee meeting minute which is as fresh as 13/12/2017. It was also observed that there is no certainty of commissioning of Mahan -Sipat dedicated line by December 2017 in light of the above, it was decided that the generation of the Essar Mahan shall be taken zero for the next quarter.

(xxxi) CTU representative added that there was a meeting in CEA in end of June 2017, in that meeting it was decided transmission system for evacuation of power from Essar Mahan is ISTS being implemented by Essar power TRANSCO and it is not a dedicated system for developer. As such LILO of Vindhyachal Korba would not be an interim arrangement. Our general view is that the LILOs are not helpful to the system. CTU does not support LILO being in the system. CTU representative replied that they have done studies but there was a meeting in which WRPC was there, all the participants were there.

(xxxii) MS stated that we are not discussing here whether the line is ISTS or not, we are discussing here the continuation of the LILO.

(xxxiii) ED stated that the very fact the CTU is stating that it is an ISTS line and this is known to Hon'ble CERC and Essar as well since 2009, then why it was not clarified by them that the line is not LILO but a ISTS line. So this interpretation suddenly coming in between in last moment should be interpreted by Hon'ble CERC. This was known to Essar who has giving petition why not they said why our LILO should be removed, our LILO is an ISTS line, it will never be removed.

(xxxiv) Essar representative stated that definitely, this LILO was part of ISTS and this is also a LILO and both the things are correct. When the petition gone from NLDC for removing the LILO so this particular LILO arrangement was also indicated there, so it was not from the Essar side that this is the interim or this thing. We respect that particular issue also that LILO should not be kept for longer

time. Now present study has been carried out by CEA, it was carried out by PG (CTU) and they came up with the conclusion that even after completion of Mahan -Sipat line this LILO need to be maintained for the security of the grid so that the generation continues. They found instability if this LILO is removed so what is happening, even if Mahan -Sipat line is completed, LILO need to be there. So it is we also feel, in our interest we are not interested to continue LILO only because with LILO we can not evacuate the power for two units so it is in our interest also. I mean in past we had fund problem as a generator, we want to complete this line we want to make a permanent arrangement and go ahead. So LILO may be kept permanently also that depends upon the regulator, CEA and PGCIL. So we did not interfere in that. As a generator, we wanted that LILO should not be kept continuously. We wanted permanent arrangement. So that is how we are going ahead. We are very clear that with LILO we can operate one unit only. But to sustain we have to operate two units and for that purpose we have to bring this line. If we recall, on 20th of July 2017 we got a permission that we can synchronise unit -2, however keeping the export to 600 MW. We got a permission on 30th July 2017 and 4th early morning we synchronise the machine. By 5th evening we reached 310MW on total coal no oil support. We could not no go further because if we have to go further we have to stop the running machine which is the bread and butter for us. So vi-a-vis in our interest we complete this line at the earliest.

(xxxv) ED WRLDC stated that the issue is so simple that in his own words and backed up by CTU that once they go to Hon'ble CERC they can say that it is ISTS and further they will show that by study they have come to that it is also required. Hon'ble CERC will take a decision that this will never to be opened and it will continue and one agenda will also go from here. So we all will be benefitted and only thing this has to come from Hon'ble CERC. This agenda will also be killed once for all and LILO will always be there. But when for last seven years this was never discussed in Hon'ble CERC in writing and it is there and it should be opened and this extra ordinary decision to be taken by this WRPC.

After long discussion, forum could not arrive at conclusion / decision therefore TCC suggested further discussion in WRPC meeting and based on discussion, decision on the matter of disconnection /continuation of LILO shall be taken.

WRPC discussion:

(i) MS WRPC, stated that during the TCC meeting M/s Essar gave a presentation on the progress of construction of the dedicated transmission line. After long discussion in TCC as there was no consensus on the issue and therefore it was decided that the issue

of granting further extension to the interim LILO arrangement at Essar Mahan Power station be put up to WRPC for further deliberation and decision.

(ii) Chairman WRPC requested M/s Essar Mahan to give presentation in brief.

(iii) Essar representative stated that in the 34th WRPC meeting when we started the work in the month of July 2017, we were having four foundation balance out of 942, 33 erection of tower were balance and 140km of stringing work was balance. As on today what we have completed the total foundation all the four foundations. We could complete 17 out of 33 erection of towers so balance is 16. We could complete 66km of stringing part and 74km is balance. We have deployed 1 TSE & 3 manual gangs and it is expected that the work will be completed as follows; Tower erection : 2nd week of Jan, 2018; Stringing : end of March 2018; Commissioning : end of April 2018

(iv) TCC Chairman stated that this issue we discussed yesterday at length; there are some of the observations from WRLDC. As per the Hon'ble CERC order on the above issue WRPC can give the extension to interim LILO for the maximum period of 6 months which is already exhausted. So it is now not in the jurisdiction of WRPC to give further extension and they also have the concern that out of 16 LILO, 15 have been disconnected, except this. MPPTCL who has the same apprehension and they have apprehension of the cost of the line being shared by beneficiaries and used by Essar Mahan. Some documents it has been given by WRLDC also and as a TCC Chairman he stated that he has not taken any decision but after going through these documents available and the progress done by the Essar during the last 34th WRPC to this time, so basic technical things is emerged out of this line is that it is being a part of ISTS line which is used for evacuation of power of 300-400 MW from Essar Mahan. They already taken the LTA, generation is also there, it is also helped in this area; the system study also has been carried out by CEA. As per the study, system is found to be much stable if you continue with the LILO and looking to the progress of work done by Essar, TCC Chairman stated that he is of the opinion that we at the WRPC can't take decision for further extension to this. Let Essar to approach CERC for seeking further extension by that time till CERC takes the decision whether to continue with the LILO or open with the LILO. He further stated that view of WRLDC and other constituents is required to be taken to arrive at the decision.

(v) ED WRLDC stated that he has already elaborated yesterday and he again reiterated his stand. These days, the issues related to powers comprises of legal engineering more than power engineering. Out of 16 LILO, 15 have already been removed in the same petition. Giving this further extension beyond the power of

WRPC may make WRPC highly vulnerable. Other LILOs were opened just 15 days back and be very specific Vedanta and Sterlite matter went up to very high level, they will take this opportunity to put a petition what is wrong with me that I was opened. We have to be very careful. It is my personal view since we are not here to close or open but the right forum to decide is Hon'ble CERC. He said for System operation 300 MW comes into the grid and it is welcome but whether to take or not this decision should rest with Hon'ble CERC because they gave us powers only for 6 months time which we have exhausted.

(vi) Chairman, WRPC stated that time limit has already exhausted; are we ok with this observation what Mr. Shrivastava (ED WLDC) said.

(vii) MD MPPMCL stated that there are two orders one is generic order in which NLDC was the petitioner. In the order on Pet. No. 13/MP/2014 which came in Sept 16, the two paras are important i.e. para(d) and para(e). He also read out the paras (d) & (e) of the order. Existing cases of LILOs as on Sept 16 would be governed by para (e) and under this it can be interpreted both ways and WRPC has been given powers. Para (d) is applicable to future projects wherein it has been stated that RPC can give extension of 3 months and thereafter another maximum 3 months.

(viii) Chairman, WRPC stated that this forum have already exhausted 6 months time given by CERC as suggested by Chairman, TCC and by Mr. Shrivastava (ED WLDC) also. I think the correct forum is Hon'ble CERC now. So we can now request Essar Power to approach Hon'ble CERC for getting of further order in the matter and what we can do basically is we can give them 1 month time to obtain suitable orders from Hon'ble CERC till that time they will continue with LILO arrangement. Is it ok. Let us give one month till 20.01.2017

(ix) Essar Mahan representative requested for more time.

(x) GM, GUVNL informed that there is already extension given up to 31.12.2017 so if they want something they can immediately approach CERC. WRPC need not extend it beyond 31.12.20176 as still there is a time of 10 days. They may approach the CERC and get order.

(xi) Principal Secretary (Energy), Govt of MP stated that if there is no order from CERC, extension of LILO will be terminated on 20.01.2018; you are giving them 20 days more to approach CERC and after the deadline of 20.01.2018, the interim LILO shall be disconnected by WRLDC without coming to WRPC.

(xii) TCC Chairman stated that let CERC give a directive to this forum. We request Essar to immediately file a petition to CERC seeking further extension of LILO till they complete the work and give the copy of the petition to WRPC.

(xiii) Principal Secretary, (Energy) Govt. of MP stated that if CERC gives an interim order, the Committee can authorize the Chairman

	WRPC to taken decision and inform WRPC in next meeting. (xiv) Essar representative stated that last time also when we went to CERC for this petition, it was said that it was not the similar case as other LILOs. This is ISTS and then it will be continued as per the system requirements. (xv) Chairman, WRPC stated that CERC has given us 6 months, we have exhausted these 6 months and now let CERC give a fresh look basically and we will wait for the orders whatever they decide. We have given you enough time of 30 days which is enough time to approach any judicial authority. **WRPC decided the following;** **(i) M/s Essar Mahan may approach CERC if they want extension to the interim LILO arrangement beyond 20.01.2018.** **(ii) In absence of extension order from CERC by the deadline of 20.01.2018, the interim LILO shall be disconnected by WRLDC without coming to WRPC.** **(iii) If CERC gives an interim order before 20.01.2018 on the petition to be filed by M/s Essar Mahan seeking extension for the interim LILO arrangement, the WRP Committee authorized the Chairman WRPC to take decision as per the directives in the interim order and inform WRPC in next meeting (36th WRPC).**
	C. Items for Noting purpose
	(a) Commercial
14	**5-minute scheduling:** Impact of forthcoming five minutes scheduling and energy accounting.
	Agenda Background:
	In the 11thMeeting of the "Technical Committee for Implementation of Framework on Renewables at the State Level" held at Chennai on 28thMarch 2017, it was decided to form a Sub-Group to examine the various aspects of migrating from 15-minute to 5-minute scheduling, metering, accounting and settlement at the inter-state level to facilitate large scale integration of renewables. Accordingly, the Sub-Group has been constituted and so far three meetings were held on the following dates: First meeting: 3rd August, 2017 Second meeting: 28th August, 2017

Third meeting: 25th October, 2017

For agenda of 76th CCM (23rd October, 2017), Chief Engineer SLDC, Gujarat vide letter No. Guj-SLDC/SCH/F/12/4247, dated 26/10/2017 intimated that following are the likely impact of forthcoming five minutes scheduling and energy accounting.

- All the associated inputs are required to be changed. Viz. RE forecasting, DISCOM load forecasting.
- More numbers of Agriculture groups (AG) are required to be formed in order to align with the five minutes load forecasting as presently, AG have ½ or hourly schedule.
- Hence, DISCOM may find difficulty in 5 minutes load forecasting.
- In case of any short/momentary eventualities, presently generator has about one time block of 15 minutes to mitigate the schedule. Whereas, in case of 5 minutes time blocks, there are more chances that generator falls under DSM limit violation.
- Appropriate regulatory changes are also required to be done particularly those are based on time blocks. Viz. effect of revision, change of sign of sustained deviation etc.
- Number of pick up/back down of the generator during the day will be increased. That may affect the life of the generators.
- Number of scheduling revisions during the day will be increased and computation process also becomes somewhat more complex due to increase of time blocks.

Discussions during 76th CCM:

The issue was also deliberated in 76th CCM details of which are as follows:

a) GUVNL representative informed that there is huge impact involved with the five minute scheduling as the generators take some minimum time to respond. This item is never discussed in WRPC therefore it can be discussed in CCM or other forum before going to the WRPC Board.

b) NTPC representative informed that if the scheduling is changed from 15 minutes to 5 minutes then there is huge stress on the boiler, turbine has to respond fast and the wear & tear and hysteresis losses may rise and it will reduce the life of the generator. He further mentioned that CERC have came out with Automatic Generation Control (AGC) system implementation, so first complete the AGC control system then move to the 5 minute scheduling.

c) WRLDC representative informed that there are three actions to control the power dispatch. The primary action is the governor control, secondary action is AGC and the tertiary action is

Ancillary services. The 5 minutes scheduling shall optimize the ancillary services and AGC operation.

d) SE (C), WRPC stated that before adopting the 5 minutes scheduling, through analysis /discussion with regard to changes required in switching over in terms of requirement of various kind of resources at various levels (i.e. RLDC/RPC/SLDs) along with the discussion on pros and cons as suggested by CE, SLDC Gujarat need to be carried out.

Recommendation of 76th CCM:

After detailed discussion, CCM recommended to constitute a separate group of WRLDC, WRPC, SLDCs, NTPC, DISCOMs and IPPs. So that this group can analyse /discuss the issue in totality and come up with the suggestions. The Group can analyse/discuss the following:

(i) Need for changeover to 5 minute scheduling.
(ii) Can the switching over eases the existing problems related to communication in real time operation in 15 minutes existing system.
(iii) Advantage of 5 minutes scheduling in comparison of 15 minutes scheduling.
(iv) Whether financial /system improvement analysis for the change over have been carried out?
(v) Impact on generators due to probable frequent ramp up/ramp down on account of 5 minute scheduling.
(vi) Existing practice of demand forecasting in 15 minutes time block v/s requisition to be made in 5 minutes.
(vii) Consequences of delay in implementation at State level.
(viii) Alignment of existing ramp up/down rate of the generator.
(ix) Infrastructure requirements in terms of hardware & software upgradation needed for scheduling, metering, accounting and settlement by the NLDC, RLDCs, SLDCs and RPCs/NPC.
(x) Detailed action plan for migration including phasing of activities if required.
(xi) Time –frames for the implementation of identified activities and target date for migration to 5 minute scheduling, metering accounting and settlement.
(xii) Capacity building measures required for all stakcholders.

In line with decision taken in 76th CCM, WRPC vide letter No. WRPC/Comml-I/Follow-up/2017/16007 dated 02/11/2017 requested WRLDC, SLDCs, NTPC, DISCOMs and IPPs to nominate an officer to the group. The nomination from these organisations are still awaited.

	Meeting Discussions:
	TCC discussion : (i) MS briefly explained the agenda point and informed that regulation for changeover from 15 minutes to 5 minutes is yet to be notified. MS stated that based on the 76th CCM recommendation a group was formed to discuss the issue further and nominations are being received from the constituents. (ii) MD MP Genco requested that state Gencos be given representation in the committee since technical things will come in this and everybody will be equally affected. (iii)TCC Chairman raised concerns over non-receipt of nominations from few constituents and urged them to expedite the nomination for the group and send it by 30.12.2017. He stated that based on the discussions in the group, the issue could be further deliberated with meter manufacturers, CERC and other forums. **TCC decided that nominations be given within a week time. i.e. by 30th Dec 2017 without waiting for minutes of the meeting. The working group shall interact with meter manufacturers if required and shall represent WRPC at appropriate forum.** **WRPC discussion:** MS informed that the agenda is regarding impact of 5 minutes scheduling and summarised the TCC discussion. He informed that meeting of the formed Committee/Working group would be held and any deliberation/ recommendation would be put up and discussed in the lower forum first, then the outcome will be put up to the higher forums. **WRPC noted and agreed as suggested by TCC.**
15	**DOCO:** Declaration of Transmission elements into commercial operation by ISTS licensees
	Agenda Background:
	PGCIL vide email dated 13.06.17 has intimated the list of transmission elements into commercial operation for the period from 01.10.2016 to 31.05.2017.

S. No	Asset	Project	DOCO (Date of Commercial Operation)
1	Raipur Pooling station-Wardha 765kV D/c 2nd line alongwith bay extension at 765kV Raipur Pooling station & Wardha S/s.	System Strengthening in Raipur-Wardha Corridor for IPP projects in Chhattisgarh.	31.03.2017
2	1500MVA 765/400kV Transformer(ICT-4) & associated bays at 765/400kV Raigarh Pooling Station(Tamnar)	Installation of Bus Reactor & ICT in Western Region	01.04.2017
3	i) 400kV D/C Kakrapar APP -Vapi line along with associated bays at Vapi SS. ii) 400kV D/C Kakrapar APP – Navsari line along with associated bays at Navsari SS.	Transmission System associated with Kakrapar Atomic Power Project - 3&4	29.06.2017
4	Lara(NTPC)-Champa(POWERGRID)400kV D/c (Quad) Line alongwith associated Bays at Champa Pooling Station(POWERGRID)	Transmission System associated with LARA STPS-I(2x800MW) Generation Project of NTPC Ltd.	21.07.2017
5	1x1500 MVA, 765/400 kV ICT (ICT # 3) along with associated bays at Vindhyachal Pooling Station	Substation extensions for Transmission System associated with Vindhyachal -V (500 MW) project of NTPC (Part-A)	31.07.2017
6	I.) 500 MVA, 400/220 kV ICT (ICT # II) along with associated bays at Itarsi SS. II.) 2 nos. 220 kV line bays at Itarsi SS.	Western Region System Strengthening Scheme – XIV	14.08.2017
7	i) 400kV D/C Mauda-II – Betul (Quad) line along with associated bays and 2x50 MVAR line reactors at Betul	Transmission System associated with Mauda Stage–II (2 x 660 MW)	24.08.2017

	GIS. ii) 400kV D/C Betul – Khandwa (Quad) line along with associated bays at both ends and 2x50 MVAR switchable line reactors at Betul GIS & 2x50 MVAR line reactors at Khandwa SS. iii) 315 MVA, 400/220kV ICT # I and ICT # II along with associated bays and 04 Nos. 220kV line bays at Betul GIS. iv) 125 MVAR, 420kV Bus Reactor along with associated bay at Betul GIS.	generation project	
8	2 No .765kV 3*80MVAR Switchable Line Reactor (for Aurangabad-Solapur D/C line) and associated bays at 765/400kV S/s	Inter-Regional System Strengthening Scheme in WR and NR(Part-A)	25.08.2017

In case of serial no. 3 related to transmission system associated with Kakrapar Atomic Power Project 3 & 4 (KAPP) Committee recommended PGCIL to confirm and ensure that generator has to pay the cost of asset till CoD of the unit.

Meeting Discussion:

TCC discussion:

(i) MS stated that the agenda item for the noting of the committee, but comments if any may be discussed.

(ii) GUVNL representative stated that Item no 3. (i.e. lines from Kakrapar APP) became CoD on 29th of June, 2017 – it is already six months and he would like to know whether CTU have started PoC billing on DISCOM, since the generator has not yet come. He opined that DISCOM should be billed when there is generation and PoC charges for this should be on the generator. He added that the generation is not expected to come up till 2019.

(iii) CE, SLDC, Gujarat stated that in CCM it was requested that billing should be made on generator only.

	(iv) TCC Chairman stated that when CCM has taken decision, it should be implemented; otherwise objective of CCM and other sub-Committees would be diluted. He stated that it is an evacuation scheme for particular generator and generator has not yet come, hence DISCOMs are not to be burdened with. (v) MD MPPMCL opined that wrong billing by PGCIL should be avoided. He informed that, DISCOMs are facing thousands of cases in the court in regard to billing dispute from customers and some of them are who committed offence also. He advised DISCOMs to take a cue from such a scenario and address the issue of billing with PGCIL. (vi) When TCC Chairman asked CTU to confirm in writing that the billing would be done to generator, CTU stated that as billing issue is not the agenda, if a letter or mail from DISCOMs is given, then they would reply. TCC Chairman suggested that CTU take suo-moto decision based on the discussion in the meeting and avoid billing DISCOMs. **It was decided that CTU will confirm to WRPC before 30th of December 2017 that whether DISCOMs are billed under PoC or not.** **WRPC discussion :** (i) MS summarised TCC discussion and informed that SLDC/GUVNL raised concern regarding billing i.e. GUVNL shall not be charged for the evacuation line meant for Kakrapar Unit 3 & 4 till the generation comes. (ii) TCC chairman stated it is to be billed to the generator till the generator comes under CoD. **WRPC agreed to the recommendation of TCC.**
16	**LC:** Status of Letter of credit (LC) opening against Deviation charges liability for 2017-18
	WRLDC vide letter No.: WRLDC/MO/2017-18/ dt 03.05.17 has informed LC amount to the entities who have to open LC for the year 2017-18. The details of LC to be opened by WR entities for the FY 2017-18 and the status is given below:

Sl. No.	WR Entity who have to open LC	No of weeks in which UI payable	Average payable weekly UI (Rs in lakhs)	LC Amount (Rs in lakhs)	Remarks
1	**ACBIL**	30	39	**43**	
2	**BALCO**	51	152	**167**	
3	**BARC**	4	1	**1**	
4	**CGPL UMPP MUNDRA**	34	71	**78**	
5	**CSPDCL**	40	218	**240**	
6	**D&D**	46	36	**40**	
7	**D. B.Power**	20	17	**19**	
8	**DCPP JSPL**	23	21	**23**	
9	**DGEN (Torrent Energy Limited)**	51	9	**10**	
10	**Dhariwal Infrastructure Ltd.**	4	4	**4**	
11	**Essar Power MP ltd**	29	38	**42**	
12	**Essar Steel Ltd**	49	104	**114**	
13	**GMR Chhattisgarh Energy ltd**	45	17	**19**	
14	**GMR Warora Energy ltd**	18	23	**25**	LC amended to 25 Lakhs on 22 May 2017
15	**Goa**	42	106	**117**	LC amended to 5 Lakhs on 27 June 2017
16	**HVDC Bha.**	14	1	**1**	
17	**JAYPEE NIGRI TPP**	8	89	**98**	
18	**JHABUA POWER**	46	23	**25**	
19	**JINDAL POWER LIMITED**	7	49	**54**	
20	**KORBA WEST POWER Corp. LTD**	46	48	**53**	
21	**KSK Mahanadi**	10	13	**14**	
22	**Lanco Amarkantak Power Ltd**	11	10	**11**	

23	**MB POWER**	22	40	**44**	
24	**MSLDC UI Settlement account**	24	129	**142**	
25	**RGPPL**	13	10	**11**	
26	**RKM POWERGEN**	46	10	**11**	
27	**SKS POWER**	52	6	**7**	
28	**TRN Energy ltd**	32	23	**25**	
29	**Vandana Vidyut Ltd**	50	8	**9**	

All entities who are yet to open LC are requested to open LC at the earliest.

WRPC/TCC noted.

17 Status of pool account fund

(i) Deviation Settlement Mechanism (DSM) & RRAS

Status of Deviation & RRAS charges Payable/Receivable by WR entities to WR Deviation pool account fund maintained by WRLDC as on 23rd Nov, 2017

(+) Payable / (-) Receivable from Pool

Sl. No.	Name of DSM Pool Member	*Total dues*	*Payments overdue*
		Principal	*Principal*
1	ACBIL	-9,676,477	-9,676,477
2	BALCO	9,838,515	9,838,515
3	BARC (PAO, PREFRE, Tarapur)	-16,631	-16,631
4	CGPL UMPP MUNDRA	-8,114,911	-8,114,911
5	CSPDCL	-16,593,233	-16,593,233
6	D&D	2,688,054	2,688,054
7	D&NH		
8	D. B.Power	-6,531,259	-6,531,259
9	DCPP JSPL	-125,134	-125,134
10	DGEN (Torrent Energy Limited)	1,328,563	1,328,563
11	Dhariwal Infrastructure Ltd.	924,554	924,554
12	ER		
13	Essar Power MP Ltd	8,295,031	8,295,031
14	Essar Steel India Ltd	21,366,215	21,366,215

15	GETCO LTD.	11,574,963	11,574,963
16	GMR Chhattisgarh Energy Ltd	33,206,771	33,206,771
17	GMR Warora Energy Ltd.	-14,621,124	-14,621,124
18	Goa	-1,562,086	-1,562,086
19	HVDC Bha.	-798,480	-798,480
20	HVDC CHAMPA	140,961	140,961
21	HVDC Vin.	-259,167	-259,167
22	JAYPEE NIGRI TPP	-23,886,086	-23,886,086
23	Jhabua Power Ltd	16,486,710	16,486,710
24	JINDAL POWER LIMITED	-16,325,383	-16,325,383
25	KAPS 3&4(INFIRM)		
26	KORBA WEST POWER Co. LTD	22,140,843	22,140,843
27	KSK Mahanadi	-4,244,924	-4,244,924
28	Lanco Amarkantak Power Ltd	-12,664,062	-12,664,062
29	MB Power (Madhya Pradesh) Ltd.	25,534,966	25,534,966
30	MP Power Management Co. Ltd.	143,768,130	143,768,130
31	MSLDC UI Settlement account		
32	NR		
33	NSPCL	-3,117,830	-3,117,830
34	NTPC	-394,446,249	-394,446,249
35	RGPPL	-46,339,448	-46,339,448
36	RKM Powergen Pvt Ltd.	-28,324,860	-28,324,860
37	SASAN Power Limited	-124,342,150	-124,342,150
38	SKS POWER GENERATION (CHHATTISGARH) LTD	30,606,779	30,606,779
39	SR		
40	TRN Energy Ltd.	-2,547,172	-2,547,172
41	Vandana Vidyut Ltd	100,023,191	100,023,191

Note : This includes -

1. DSM Accounts issued on 14.11.17 for the week 32th week (30.10-05.11.2017) of 2017-18.
2. RRAS Accounts issued on 10.11.17 for the week 31st week (23.10-29.10.2017) of 2017-18.
3. DSM & RRAS Payments received upto 22.11.17 and disbursed upto 23.11.2017.

WRPC/TCC noted.

(ii) Reactive Energy Charges (REC)

Status of Reactive Energy charges Payable/Receivable by WR entities to Reactive pool account fund maintained by WRLDC as on 23rd Nov, 2017.

		Amount in Rs.
	Total dues	***Total over-dues***
	Principal	***Principal***
GETCO	-1,060,628	-1,060,628
MPMPCL	-940,631	-940,631
CSPDCL	-853,272	-853,272
MSEDCL	**1,992,098**	**1,992,098**
Goa	-56,204	-56,204
DD	**1,107,049**	**1,107,049**
DNH	-188,412	-188,412
Total	0	0

(+) Payable / (-) Receivable from Pool

- When Receivables are more than payable, total of all receivables made equal to payable.
- When all are receivable and no fund is available, all receivables are made zero .

Note: This includes -

1. REC Accounts issued on 21.11.17 for 33th Week (06-12.11.17) of 2017-8.
2. REC Payments received up to 22.11.17 and disbursed.

WRPC/TCC noted.

(iii) Congestion Charges

Status of Congestion Charges Payable/Receivable by WR entities to Congestion charges account fund maintained by WRLDC as on 12th July 17 is given below

No defaulters in Congestion charge.

WRPC/TCC noted.

18 Status of Reconciliation

Status of Reconciliation of Deviation and REC pool account for the period Apr'17 to Oct'17.

WRLDC vide letter dated 31st Oct.2017, has uploaded the signed reconciliation statement for the period **Jul'17 to Sep'17** to all Deviation/Congestion/REC pool members as . All the details of payments/receipts of Deviation charges, Congestion charges and REC during **Apr'17 to Oct'17** are also uploaded on WRLDC website (www.wrldc.com/commercial/Pool Reconciliation). All DSM, REC and Congestion account members are requested to kindly reconcile the same at your end and submit the reconciled statement by 31st Jan'2018.

As per financial audit, signed reconciled statement is required, all the above entities are requested to reconcile at their end and send the signed statement to WRLDC at the earliest***. Non receipt of signed statements by 31st Jan'2018 shall be treated as deemed reconciled and WRLDC shall not reopen any discrepancy/mismatch after that.***

WRPC/TCC noted.

(b) Operation

19 Performance of WR grid: during July to October 2017

(i) System performance

a) Frequency:

Period: July 2017 to October 2017	
IEGC frequency range of 49.90 Hz to 50.05 Hz	from 76.15 % to 78.50 % of time
frequencies below 49.9 Hz	from 6.56 % to 13.61 % of time
frequency remained above 50.05 Hz	from 9.21 % to 17.29 % of time
monthly average frequency	49.98 Hz.

The detail of frequency profile for the months of during July 2017 to October 2017 is placed at **Annexure-19 (i)(a).**

	b) Demand: The maximum unrestricted demand of Western Region was in the range of 50,580 MW to 50,960 MW(Ex Bus) in during July 2017 to October 2017. The details of unrestricted peak demand, demand met and energy requirement and availability are as furnished at **Annexure-19 (i)(b).** **(ii) Voltage Profile** Overall voltage profile had been satisfactory during the period under review. However, instances of high voltages beyond the IEGC specified operating range were observed at some of the EHV sub-stations in the region. Higher voltages in the range of 421 kV to 440 kV were noted at Bhopal, Khandwa, Damoh, Nagda, Indore, Raipur, Raigarh, Bhilai, Wardha, Dhule, Parli, Boisar, Kalwa, karad, Dehgam, Vapi, Mapusa, Magadwada and Hazira substations. Also higher voltages of around 800 kV were observed at 765 kV Wardha, Kotra & Tamnar. To contain high voltages WRLDC resorted to opening of lightly loaded EHV lines on certain days. The detail of voltages at important 400 kV and 765 kV sub-stations during the period of during July 2017 to October 2017 is placed at **Annexure- 19(ii)(a)**. The schedule of installation of reactors in attached at **Annexure -19(ii)(b).** **WRPC/TCC noted.**
20	**Anticipated power supply position in WR:** **January to March 2018**
	The anticipated power supply position in the region for the period from January to March 2018 is at **Annexure-20**. The anticipated regional demand is likely to vary between 50,000 MW to 51,000 MW and the capacity surplus will be around 4.00 - 7.0 %. In terms of energy, the unrestricted requirement is expected to range from 29,300 MUs to 32,100 MUs with regional energy surplus of around 4.0 % to 9.0 %. **WRPC/TCC noted.**
21	**New generating units in WR:** **during the current year 2017-18**
	The status regarding Generating units, commissioned /expected to be commissioned during the current year 2017-18 as updated in 501th OCC meeting held on 15.11.2017 at WRPC, Mumbai is attached at **Annexure-21**. **WRPC/TCC noted.**

22	**Installation of FGD in generating units:**
	Background : A special meeting was held on 01/09/2017 at New Delhi to review implementation of new environment norms for Thermal Power Plants under the Chairmanship of Secretary, Ministry of Environment, Forest and Climate Change. The MoM of this meeting is at **Annexure-22(a)**. Subsequently, CEA directed WRPC to organise a Special TCC meeting to discuss above issue. In this regard a discussion was held by PCE, CEA with some of the generators on 21.09.2017 at WRPC, Mumbai. After this, a Special TCC meeting of WRPC was held on 28.09.2017 at WRPC, Mumbai to discuss a single point agenda for revised plan for Installation of FGD in generating units to comply with new MOEF norms of SOX emissions. MoM of this meeting is at **Annexure-22(b).** **WRPC/TCC noted.**
	(c) Protection
23	**SPS formulated for JP-Nigirie and MB Power**
	As decided in the 130th PCM held on 12.09.2017, the SPS for JP-Nigirie and MB Power were formulated in a special meeting held at WRPC on 23.08.2017. The SPS formulated is enclosed at **Annexure-23.** **WRPC/TCC noted.**
	(d) Details about WRPC Secretariat
24	**Establishment charges**
	Reimbursement of Establishment Charges of WRPC Secretariat For the Year 2017-18: The revised estimate worked out for the year 2017-18 towards the establishment charges of WRPC Secretariat is as follows;

Head of A/c	Amount in Lakhs of Rs.
Major Head of A/c 2801 Non-plan/Regional Coordination	79.70/-
Major Head of A/c 2801 Non-plan/Load Despatching Stations	266.37/-
Total	346.07/-

The revised estimate for the year 2017-18 was forwarded to budget Section vide WRPC letter dated 04.10.2017(copy enclosed at **Annexure-24).** The actual expenditure incurred towards the establishment charges of WRPC Secretariat for the year 2017-18 would be distributed equally among all the WRPC members for the year 2018-19.

WRPC/TCC noted.

25 Meetings conducted

Meetings of WRPC from April 2017 to Nov., 2017

SN	Name of Meeting	Date	Place
	April		
1	Special TCC Meeting	05.04.2017	WRPC, Mumbai
2	494th OCC	12.04.2017	WRPC, Mumbai
3	19th Electric Power Survey Power Committee Meeting	17.04.2017	WRPC, Mumbai
4	Meeting on integration of RE generators in WR (REIF)	21.04.2017	WRPC, Mumbai
5	Meeting on FRA	27.04.2017	WRPC, Mumbai
	May		
1	495th OCC Meeting	12.05.2017	WRPC, Mumbai
2	REA meeting	29.05.2017	WRPC, Mumbai
3	NTPC Mouda SPS Meeting	30.05.2017	WRPC, Mumbai

	June		
1	Transmission Line Availability Certification meeting	02.06.2017	WRPC, Mumbai
2	496th OCC	13.06.2017	WRPC, Mumbai
3	75th CCM	28.06.2017	WRPC, Mumbai
4	129th PCM	29-30 June, 2017	WRPC, Mumbai
	July		
1	497th OCC	20.07.2017	WRPC, Mumbai
2	RGPPL Special Meeting for Railways	21.07.2017	WRPC, Mumbai
3	34th TCC/WRPC meeting	27-28 July, 2017	Mumbai
	August		
1	RES Integration: Meeting of Sub group of Technical Committee of FOR	14.08.2017	WRPC, Mumbai
2	TRM Meeting	21.08.2017	WRPC, Mumbai
3	2nd Meeting of REIF	21.08.2017	WRPC, Mumbai
4	498th OCC	22.08.2017	WRPC, Mumbai
5	Meeting of Expert Group for study of CGPL disturbance	23.08.2017	WRPC, Mumbai
6	SPS meeting: JP Nigrie & MB Power	23.08.2017	WRPC, Mumbai
7	Transmission Availability Meeting	31.08.2017	WRPC, Mumbai
	September		
1	7th NPC Meeting	07.09.2017	Indore, MP
2	130th Protection Committee Meeting	12.09.2017	WRPC, Mumbai
3	499th OCC Meeting	20.09.2017	WRPC, Mumbai
4	FRA of Commercial Meeting	27.09.2017	WRPC, Mumbai
5	Discussion on FGD by CEA with Generators	21.09.2017	WRPC, Mumbai
6	Special TCC Meeting reg.- FGD commissioning	28.09.2017	WRPC, Mumbai

	October		
1	TRM Meeting	09.10.2017	WRPC, Mumbai
2	Meeting of Expert Group for study of CGPL disturbance	10.10.2017	WRPC, Mumbai
3	76th CCM	23.10.2017	WRPC, Mumbai
4	500th OCC Meeting	12.10.2017	Mahabaleshwar, MH
	November		
1	Annual Maintenance Program	14.11.2017	WRPC, Mumbai
2	501st OCC	15.11.2017	WRPC, Mumbai

WRPC/TCC noted.

26 **Status of staff position**

Details of posts of WRPC Secretariat:

i) Head of account: LDS

Name of the post	Sanctioned	Filled	Vacant
MS	1	1	0
SE	3	1	2
EE	3	2	1
AD-Gr.I	4	3	1
AE/AD-II	2	0	2
Draftsman Gr-II	1	0	1
Head clerk	1	1	0
Hindi Translator	1	1	0
Stenographer Gr-II	1	1	0
UDC	4	3	1
LDC	5	0	5
Asst. Store Keeper	1	0	1
Driver	1	0	1
MTS	7	3	4
Total	**35**	**16**	**19**

ii) Head of account: RC

Name of the post	Sanctioned	Filled	Vacant
AS	1	1	0
PS	1	0	1
AD(OL)	1	0	1

Stenographer Gr-I	2	1	1
LDC	1	1	0
MTS	2	2	0
Total	**8**	**5**	**3**

Divisions of WRPC Secretariat:

Division	**No. of posts**	**Remarks**
MS	1	
Operation		
SE	1	Additional charges: • Commercial • Protection
EE	1	Additional charges: • Assistant Secretary • Rajbhasha Adhikari
AEE	1	
Commercial		
SE	Vacant	
EE	1	Additional charges: • Services of Office & Staff quarters • Purchase of Goods/Services
AEE	1	
AEE	1	Additional charges: DDO
Protection		
SE	Vacant	
EE	1	Additional charges: Administration
AEE	1	

TCC/WRPC noted as above.

27 Action Taken Report for MoM of 34th WRPC meeting (27-28 July, 2017)

The action taken report in pursuance of MoM of 34th TCC/WRPC meeting held on 27th & 28th July 2017 is attached at **Annexure-27.**

WRPC/TCC noted.

28	**Any Other Item**
	Additional agenda items:
	(1) Installation of additional ICT at Kakrapar:
	This item was not the part of agenda, however during the discussion in TCC Chief Engineer SLDC, GETCO Gujarat requested to discuss the issue of installation of additional ICT at Kakrapar. In this regards the discussion is as follows: **TCC Discussion:** (i) CE SLDC GETCO stated that in the 34th WRPC meeting, ICT at Kakrapar issue was discussed and it was informed by Kakrapar APP that there was no space available at Kakrapar. He added that considering that Unit 1 and 2 are out since long time and there is no sight of unit-3 & 4 coming soon, an ICT is mandatory for power transaction, and improve grid reliability & stability. He proposed to form a small team comprising of GETCO and CTU officials to visit KAPP for exploring the feasibility of installation of ICT, which is essential for system operation and control. (ii) NPCIL representative stated that it is already minuted in the past meetings that there is no space and there was a meeting at Mumbai of Standing Committee wherein, CEA was of the opinion that there is no advantage of putting ICT there because there is no power flow between 400 and 220kV system. He opined that any expenditure on this account of ICT would be of waste and no help. NPCIL stated that generation would come up by 2019, and before that ICT cannot come. (iii) TCC chairman stated that commercial issues are not decided here & if there is a merit in system operation point of view that an ICT at Kakrapar is required then it should be addressed. He agreed on visit of the team to KAPP by 30th December, 2017. **TCC decided that the group/Committee comprising of GETCO, PGCIL & WRPC would visit Kakrapar station and decide on the space availability for installation of additional ICT by the 30th Dec 2017.** **WRPC noted as above.**

	(2) Additional Transformer of 1 x 500 MVA capacity at Jabalpur, PGCIL s/s
	Chief Engineer (P&D), MPPTCL vide letter dated 13.12.2017 informed that additional 1x500 MVA transformer is to be installed at Jabalpur (PGCIL) 400/220 kV Substation. He further informed that in this context, looking to the current loading of existing transformers at Jabalpur (PGCIL) 400 kV S/s, it is necessary to implement this additional transformer before the ensuing Rabi Season-2018. In view of this, PGCIL may install and commission 3rd 400/220 kV ICT before October-2018 to manage the load of Jabalpur area. **TCC discussion:** (i) MD MPPTCL informed that Standing Committee has approved one transformer at Jabalpur which will take around 2 or 3 years to install and so in the meantime one spare transformer might be made in parallel with the existing one. This arrangement at Jabalpur will serve the purpose till the main ICT comes. (ii) PGCIL representative stated that it will require at least 8 months from approval from CEA and spare transformer is available at Satna. (iii) PGCIL representative stated that CEA clearance is required for installing spare transformer at Jabalpur. He stated that MPPTCL has to take up the matter with CEA and get the clearance from CEA so that installation could be completed by PGCIL in at least 8 months after getting clearance from CEA. **TCC suggested M.P. to write to PGCIL for installation of spare transformer and furnish a copy to CEA. TCC also suggested that MPPTCL shall pursue the matter with CEA for timely approval in order to complete the installation of spare transformer by October 2018.** **WRPC noted as above.**
	(3) WRLDC SCADA
	a) Status of SCADA/EMS upgrade project in WR The SCADA/EMS upgrade project in WR has been commissioned successfully. Post commissioning, one year warranty period is also over and 6-year AMC period has commenced in all control centres of WR. The status of all control centres is given below.

SN	Utility	Installation status	COD date	Warranty period status	Commencement of AMC
1	WRLDC	Complete	28-03-2016	Complete (16-08-2017)	17-08-2017
2	MPPTCL	Complete	01-07-2016	Complete (14-11-2017)	15-11-2017
3	GETCO	Complete	05-08-2016	Complete (31-10-2017)	01-11-2017
4	CSPTCL	Complete	05-09-2016	Complete (31-10-2017)	01-11-2017
5	DD	Complete	15-06-2016	Complete (14-06-2017)	15-06-2017
6	DNH	Complete	17-06-2016	Complete (16-06-2017)	17-06-2017
7	Goa	Complete	01-06-2016	Complete (31-05-2017)	01-06-2017

WRPC noted as above.

b) Progress of URTDSM project in WR

It may be highlighted that URTDSM implementation in WR is much ahead of all other regions where project is still in integration stage. Except Maharashtra, in WR, SAT has been completed & SAVT has commenced at all control centres which is a significant milestone of project implementation. The current progress is given as under. Members may like to note please.

Schedule-WR (Implementation Phase)

Control Centre	Jan' 17	Feb' 17	Mar' 17	Apr' 17	May' 17	June' 17	July' 17	Aug' 17	Sept' 17	Oct' 17	Nov' 17	Dec' 17	Jan'18
WRLDC	I&C	SAT								Awaiting Conformation for SAVT		SAVT	
SLDC-GJ	I & C						SAT	Awaiting Confirmation for SAVT				SAVT	
SLDC-MP				I&C			SAT	Awaiting Confirmation for				SAVT	
SLDC-CH							I&C	SAT	Awaiting Confirmation for			SAVT	
SLDC-MH	I & C	Awaiting Confirmation for SAVT										SAT	SAVT

WRPC noted as above.

	(4) Presentation by WRLDC
	Presentation on operational performance of WR Grid since last WRPC meeting made by WRLDC is attached at **Annexure-28.4.**
	(5) Presentation by MPPMCL
	Presentation on Sharing of URS power of Central / State Generating Station made by MPPMCL is attached at **Annexure-28.5.**
29	**Date and venue of next WRPC meeting**
	Gujarat has agreed to host the 36th TCC/WRPC Meeting and the exact date and venue of meeting would be intimated later on.

****

ANNEXURE

ANNEXURE A

LIST OF PARTICIPANTS OF 35 th TCC MEETING HELD ON 19.12.2017 AT JABALPUR

Sl.No.	Name & Organisation	Designation	Mobile No.	E-mail
I	**Members of TCC**			
1	Shri B.B. Chauhan, Chairman, TCC,GETCo	MD-GETCo.	9925208081	md.getco@gebmail.com
2	Shri A.P. Bhairve, M.D., MPPGCL	MD-MPPGCL	9425805265	anandpb_yarr@yahoo.com
3	Shri P.A.R. Bende, M.D., MPPTCL	MD-MPPTCL	9425805264	parbende@gmail.com
4	Shri B.B. Mehta, C.E., SLDC	C.E.	9879200736	bbm@gebmail.com
5	Shri N.P Jadav, A.C.E., GETCo.	A.C.E.	9978934978	serc.getco@gebmail.com
6	Shri H.P. Kothari, Addl.C.E., PGVCL	Addl.C.E.	9925014791	adlproj.pgvcl@gebmail.com
7	Dr. Sanjay S. Kulkarni, E.D., MSETCL	E.D.-MSETCL	9819363329	drsanjaykulkarni@gmail.com
8	Shri B.R. Soni, C.E., CSPTCL	C.E.	9425188807	celdcg@sldccg.com
9	Shri K.K. Parbhakar, C.E., MP-SLDC	C.E.	9425805267	kkparbhakar@yahoo.co.in
10	Shri K.P.Singh, C.E., NPCIL	E.D.	9969184889	kpsingh@npcil.co.in
11	Shri V.K. Shrivastava, E.D. , WRLDC	E.D.	9869450221	vks@posoco.in
12	Dr. V.K. Khare, E.D., POWERGRID	E.D.	9480687467	vkkhare@powergridindia.com
13	Shri T.K. Bhaskaran, Head-PSCC, Tata Power	Head PSCC	9223550622	tkbhaskaran@tatapower.com
14	Shri K.V. Ghate, Dy. CEO, CGPL	Dy. CEO	9227295496	kvghate@tatapower.com
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ANNEXURE - B

LIST OF PARTICIPANTS OF 35 th WRPC MEETING HELD ON 20.12.2017 AT JABALPUR

Sl.No.	Name & Organisation	Designation	Mobile No.	E-mail
	Members of WRPC			
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ANNEXURE 7A

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पश्चिम क्षेत्रीय विद्युत समिति
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आई एस ओ ः 9001-2008
IS/ISO: 9001-2008

No. : WRPC/Protection/Meetings/2017/14444 Date: 28/09/17

To,

1. Smt Pushpa Sheshadri, Assit. GM, WRLDC Mumbai.
2. ED, PGCIL, Vadodara.
3. Shri Janak Pancholi (officer on special duty), GETCO CO, Vadodara.
4. Peeyush Sharma, Superintending Engineer(Protection), PAC Unit Airoli.
5. Shri Uday Trivedi, AVP, M/s APL.
6. Shri G.T. Jawale, M/s TATA Power.
7. Shri Alok Uppal, M/s CGPL.

Subject: **Minutes of the meeting of Expert Group to discuss CGPL studies to be carried out through IIT-B, held on 23.08.2017 at WRPC, Mumbai.** – Reg.

Sir,

Please find enclosed herewith the minutes of the meeting of Expert Group to discuss CGPL studies to be carried out through IIT-B, held on 23.08.2017 at WRPC, Mumbai, for further needful action please.

Yours' faithfully

Encl. : As above

J.K.Rathod,
SE (Protection)

Minutes of the meeting of Expert Group held on 23.8.2017 to discuss Power Swing disturbance at CGPL

In line with the decision of 34th WRPC meeting held on 28.07.2017 at Mumbai, an Expert Group comprising of representatives from WRPC, WRLDC, CTU/PGCIL, CGPIL, APL and Relay manufacturing Industry was formed to investigate and analyse afresh, the power swing disturbance of 13.07.2016 at CGPL Mundra and recommend measures to avoid such disturbance in future. As decided in the WRPC meeting, after investigation and analysis by the Expert Group, if it is felt necessary, further studies may be carried out by professional bodies such as IIT-B, CPRI, PRDC, etc. through funding from WR constituents.

The members of the Expert Group formed is enclosed at **Annexure-I** and the list of participants is at **Annexure-II**.

Member Secretary, WRPC welcomed the members of the Expert Group to the meeting. He welcomed the representatives from the Relay Manufacturer Industry, M/s GE T&D, M/s Siemens & M/s ABB and thanked for attending the meeting at a short notice. He said that the Expert Group would discuss the disturbance in detail and come up with recommendations/suggestions. Thereafter, he handed over the proceedings of the meeting to SE(P) and EE(P).

a) Brief background of the issue

On 13.07.2016 at 20:29 hrs, there was a bus fault (BF) at 400 kV Bus-1 of Versona 400/220 kV s/s and the elements connected to that bus got disconnected.

Then at 21:50 hrs, there was bus fault (BF) at 400 kV Bus-2 of Versona s/s, and all the elements connected to the bus got disconnected.

Afterwards, when Bhachau-Versona-1 line was charged from Bhachau end, line fault (LF) in Zone-2 was sensed at Bhachua end of the line and also at Ranchdopura end of Bhachau-Ranchodpura lines and CGPL end of CGPL-Bhachau-1 line and the lines tripped.

Subsequently, remaining five lines at CGPL end sensed power swing (PS) in Zone-1 and got tripped. At the same time, Generating units (10, 30, 40, & 50) at CGPL got tripped on account of Out of Step (OOS) protection. Loss of generation at CGPL was of the order of 2875 MW.The faults and tripped elements are depicted in the following figure:

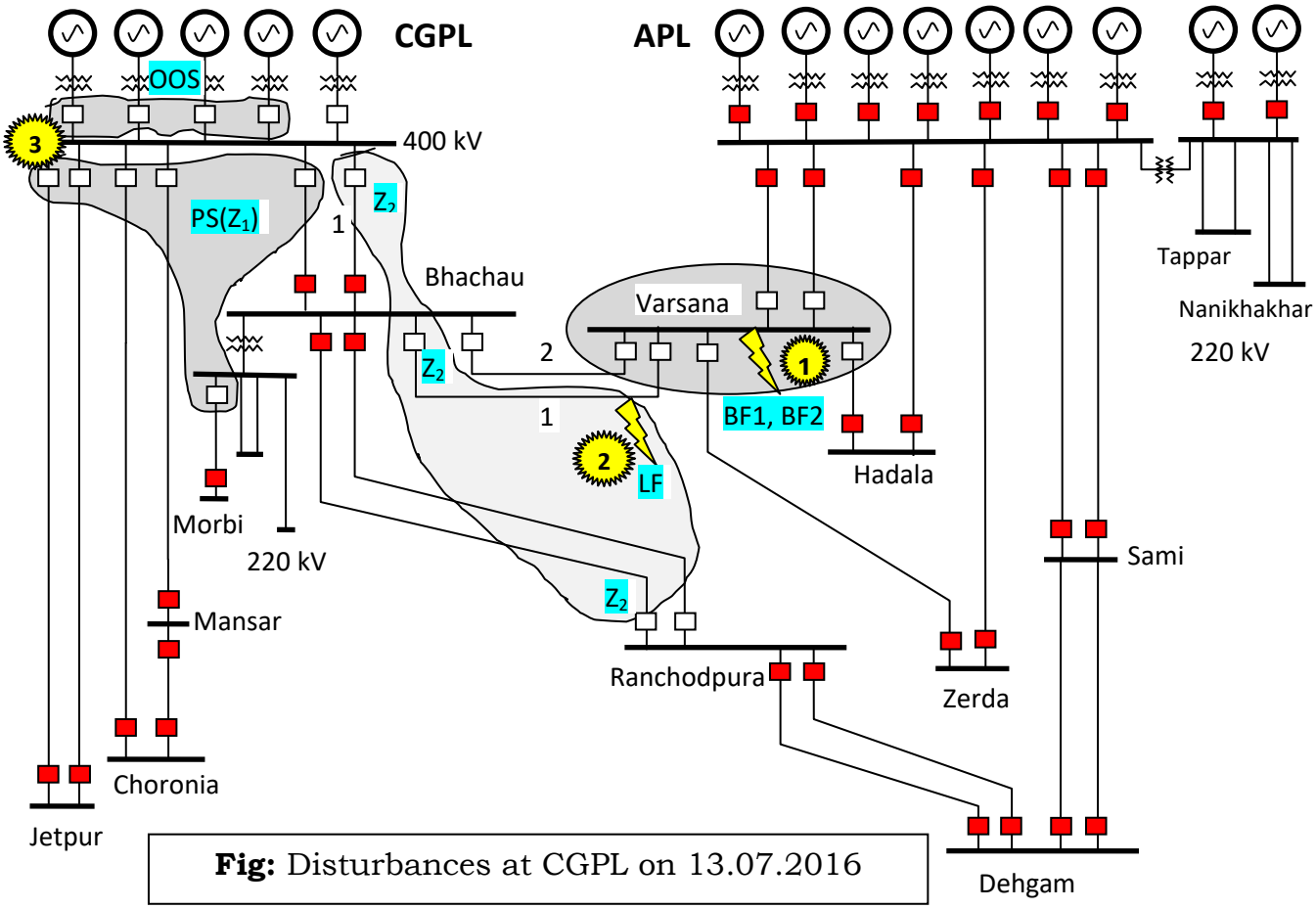


Fig: Disturbances at CGPL on 13.07.2016

EE(P) briefly informed regarding the recommendation of the earlier report dated 13.10.2016 on the power swing phenomenon observed at CGPL during the disturbance of 13.07.2016 and the developments thereafter in various PCM and WRPC forums. He also informed that the recommendation of the WRPC report dated 13.10.2016 was discussed in the 33rd & 34th WRPC meetings. WRLDC have carried out simulation studies on the CGPL disturbance of 13.07.2016. The studies were discussed briefly in 127th PCM. However in light of the decision of the 34th WRPC meeting, a detailed discussion and analysis of the studies carried out by WRLDC and the philosophy adopted by M/s APL at their Tirora plant is required to be done in this meeting, so that this Expert Group could suggest the way forward in this matter to

WRPC. WRLDC was requested to explain the studies carried out by them.

b) WRLDC presentation

WRLDC informed that the transient studies were carried out by them by considering the base case of CGPL disturbance on 13.07.2016, under different simulated fault conditions. The simulation study results are enclosed at **Annexure-III.**

WRLDC representative informed that under different scenarios of fault conditions on the evacuating lines from CGPL, the loss of transient stability was accessed and the observations/conclusions of the studies are as follows;

- As the Present scenario is the condition where all lines are in service yet under list of contingency without SPS action system is quite vulnerable in terms of Angular stability, Voltage stability, Small signal stability and Relay operation on power swing.
- Under the condition of any additional 400 kV line outages from Choronia/Jetpur/Ranchodpura/Bhachau the CGPL becomes more vulnerable from the aspect of security. So, under full generation line outage from 400 kV remote end substation should not be allowed.
- Further, if the tripping is associated with the fault the chances of relay entering swing zone is quite more as observed in the case study.
- It can be observed from last case that opening of several line on High voltage and higher generation at CGPL causes relay vulnerability of 400 kV CGPL-Bhachau.

c) Comments from APL Tirora

APL representative informed the special arrangement made at APL Tirora to negate the power swing effect, which is as follows;

The evacuation at APL Tirora consists of 400kV Tirora-Warora-Wardha D/c lines & 765kV Tirora-Koradi-Akola D/c with one 500MVA ICT between 400kV & 765kV Bus. 5x660MW capacity is connected to the above system.

On 400kV Tirora Warora D/c lines all the Zones on power swing is blocked for 2secs from tripping and if the power swing is detected on these lines, a 660MW unit is tripped immediately.

Further if any one ckt trips then a backing down by around 500-600MW is done at APL Tirora.

APL representative informed that earlier during tripping of one of the 400kV lines, the other line on two occasions tripped on instantaneous power swing trip in Z-1. To avoid tripping of other line on power swing and lose both the 400kV lines, study was carried out and based on the studies, 1x660MW unit instantaneous trip was envisaged in the scheme, whenever a power swing is detected on the lines, with DPS (Distance Protection Scheme) power swing blocking on lines for 2 secs.

d) Discussions on the APL Tirora & WRLDC studies:

To various queries of members WRLDC/APL representative gave following explanation;

(i) WRLDC representative to a query whether simulations of Units tripping along with critical Lines was done & the quantum (Number of Units) required to be tripped to maintain the system stable was checked. WRLDC representative informed that such simulation was not done.

(ii) Simulation for the system on 13.07.2016 was done. On 13.07.2016 many GETCO lines and PGCIL lines were under outage.

(iii) WRLDC representative informed that transient studies on the Siemens PSSE software was carried out by modelling the case similar to that existed during the disturbance.
APL representative stated that transient studies on mypower software were done.

EE(P) WRPC stated that transient stability simulations studies are done over a very small period of time equal to the time required for one swing, which approximates to around 1 sec or even less. If the system is found to be stable during this first swing, it is assumed that the disturbance will reduce in the subsequent swings, and the system will be stable thereafter. The transient stability studies include identifying critical fault clearing time, checking generator rotor angle stability etc. However with transient studies, the response characteristics of the control equipment on the generators, the dynamic characteristics of the loads, the control equipment installed is modelled with assumptions. The machine dynamic response to

any impact in the system is oscillatory. The equipment used for excitation controls are also fast acting. He further informed that Unit tripping would definitely improve the transient stability, but it may not improve the dynamic stability. Since an instantaneous Unit tripping, leads to another disturbance to the system, which may be trying to recover.

e) Settings around CGPL Complex:

GETCO representative stated that there is lot of inconsistency in settings adopted by PGCIL and CGPL around CGPL complex. He pointed out that the Zone-2 settings adopted at Ranchodpura end on 400kV Ranchodpura-Bacchau Lines is 500msec. The Z-2 setting adopted at Bacchau end on 400kV Bacchau-Vearsana lines is 250 msec. The Z-2 setting adopted at CGPL end on 400kV CGPL-Bacchau lines is 350 msecs.

MS WRPC stated that with standard guidelines available there should not be any coordination issue.

EE(P) WRPC & PGCIL representative informed that before the disturbance there were lot of relay coordination issues around CGPL complex. However after the disturbance all these issues were resolved by the PCM forum in consultation with CGPL, GETCO & PGCIL. The above settings were approved in the 129th PCM. The rationale for adopting the above settings was explained.

M/s GE T & D representative informed that Zone-5 be introduced to coordinate the Z-2 settings. However PGCIL representative informed that any time setting below 250msec is not possible, as this would mean that this protection will act before the LBB timings. This is not a good practice to trip the line before LBB protection other than Zone-1. EE(P) WRPC informed that most of the lines are D/c lines and it would not be possible to restrict the Z-2 reach of these lines to less than 130%. This would result in under reaching due to mutual coupling effect. EE(P) WRPC suggested that Line differential protection is the only solution for the Distance protection Coordination. The 8.5 km long 400kV Bacchau-Varsana lines should be provided with Line differential protection.

Conclusion:

- **After detailed discussion, all the members were of the view that preliminary transient studies be carried out by WRLDC involving GETCO and any other member who likes to get associated with the studies. Based on this studies, further course of action may be suggested by the Expert Group. WRLDC would coordinate for the preliminary transient studies.**
- **Further, a simulation for a complete system without outage of lines in GETCO and PGCIL system shall also be done to ascertain whether with the complete system, the CGPL is vulnerable to such disturbances.**

MS, WRPC informed that as decided in the 34th WRPC meeting held on 28th July, 2017, the Expert Group has to carry out investigation/studies and submit report within a month (i.e. by 31st August, 2017).

The meeting ended with thanks to the Chair.

xxxxxxx

Annexure-I

Members of the Expert Group

1. Smt Pushpa Sheshadri, Assit. GM, WRLDC Mumbai.
2. Shri Ankit Vaish PGCIL, Vadodara.
3. Shri Janak Pancholi (officer on special duty), GETCO CO, Vadodara.
4. Peeyush Sharma, Superintending Engineer(Protection), PAC Unit Airoli.
5. Shri Uday Trivedi, AVP, M/s APL.
6. Shri G.T. Jawale, M/s TATA Power.
7. Shri Alok Uppal, M/s CGPL.
8. Shri P. D. Lone EE(P) WRPC

Annexure 'A'

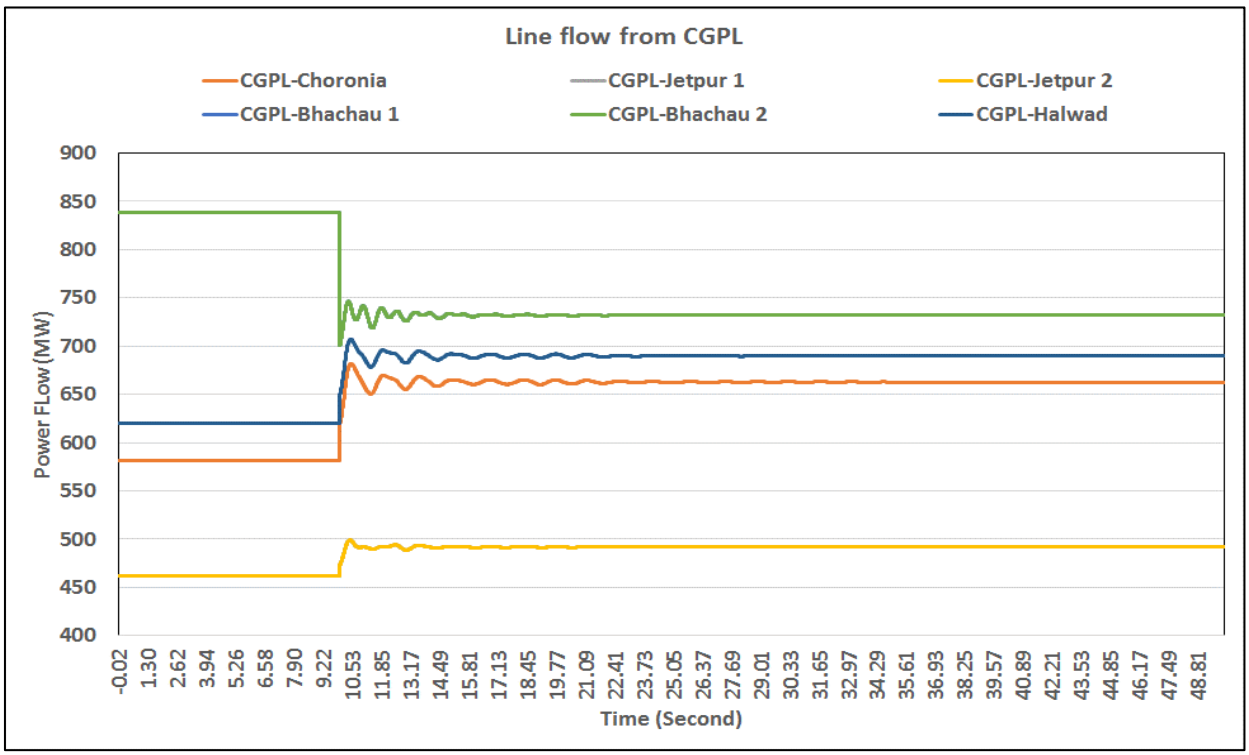
S.NO	NAME & DESIGNATION	ORGANISATION & ADDRESS	TELEPHONE NUMBER	MOBILE NUMBER	FAX NUMBER	E-MAIL ID	SIGNATURE
1	S PARAMESWARAN APPLICATION ENGG	ABB BANGALORE	9880812863		—	Parameswaran.S@in.abb.com	
2	SREENATHA RAO Lead Tech. Specialist	GE T&D India Chennai	044-22648120	9952099336		Sreenatha.rao@ge.com	
3	J.N. Panchal	GETCO	9978493615			jnpanchal@[illegible]	
4	S.H. Patel	GETCO	9925212402			sldcsecot@gmail.com	
5	P.A. Patel	SLDC GETCO	9925214015			sldc.getco@gmail.com	
6	Pradeep Kumar	WRLDC	8452095338			psamodiya@posoco.in	
7	SANJAY KR. JHA	M.B. POWER	8435003325			Sanjay.jha@hpppl.in	
8	RAVENDRA SINGH	"	9873003701			ravendra.bhadauria@[illegible].in	
9	Navin Tinguria	JPVL Nigri	8349788717			navin.tinguria@jalindia.co.in	
10	CHANDAN KUMAR	WRLDC POSOCO	9869251460			protectionwrldc@posoco.in	
11	Ashutosh singh	Siemens GOA	8805627155			ashutosh.s@siemens.com	
12	Alok Uppal	CGPL	9099006430			uppalalok@tatapower.com	
13	Girish Jawale	Tata Power	9223311419			gtjawale@tatapower.com	
14	Ankit Vaish	POWERGRID, Vadodara	9409305725			ankit_vaish@powergridindia.com	
15	Pushpa, Asst GM	WRLDC POSOCO	28302209	9869404482		pushpa@posoco.in	
16	Selvamani M (Engineer)	WRLDC POSOCO		9629125521		selvamano@posoco.in	
17	CHITRANKSHI	WRLDC POSOCO	9869004892			Chitrankshi@posoco.in	
18	Uday TRIVEDI	APL, Adani	9099077034			Uday.Trivedi@adani.com	

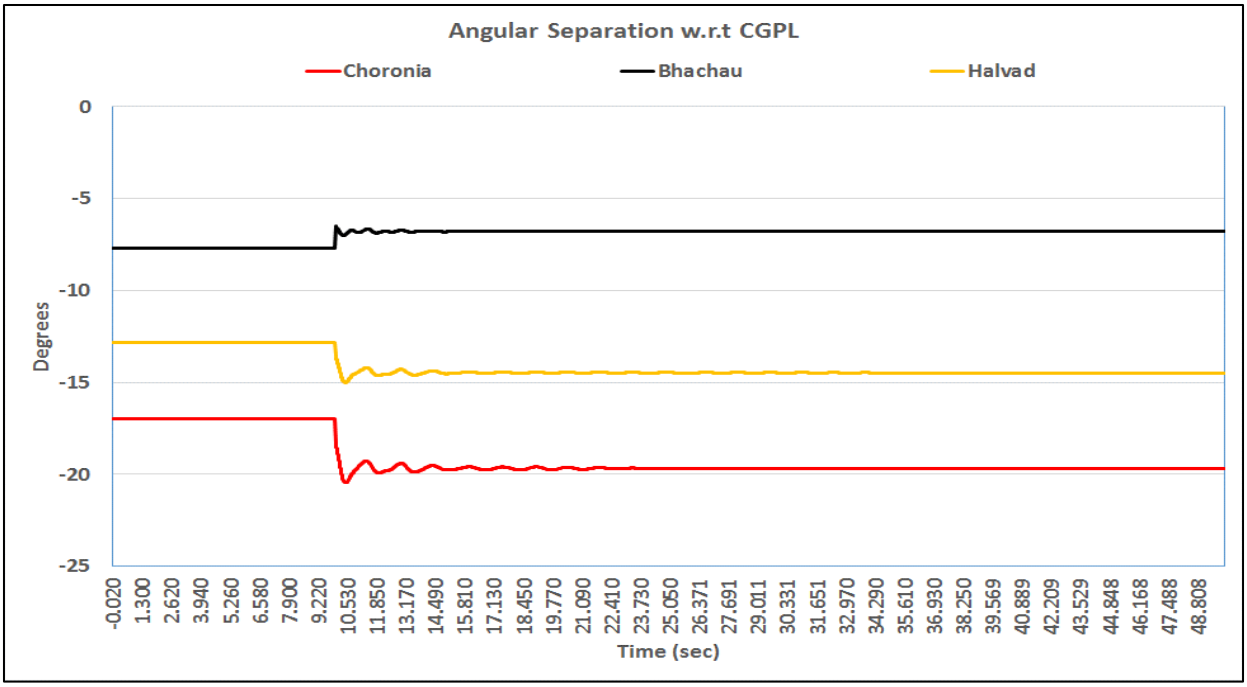
	A	B	C	D	E	F	G	H
20	S.NO	NAME & DESIGNATION	ORGANISATION & ADDRESS	TELEPHONE NUMBER	MOBILE NUMBER	FAX NUMBER	E-MAIL ID	SIGNATURE
21	19	A-Balan, MS	WRPC	9483540528			ms-wrpc@nic.in	
22	20	J. K. Rathod SE	WRPC	9987910799			cpc-wrpc@nic.in	
23	21	P D Lone	WRPC	9867622823			pdc-wrpc@nic.in	
24	22	Deepak Gandi	WRPC				—"—	
25	23	Vikas Mandoliya	—"—				—"—	
26	24							
27	25							
28	26							
29	27							
30	28							
31	29							
32	30							
33	31							
34	32							
35	33							
36	34							
37	35							
38	36							

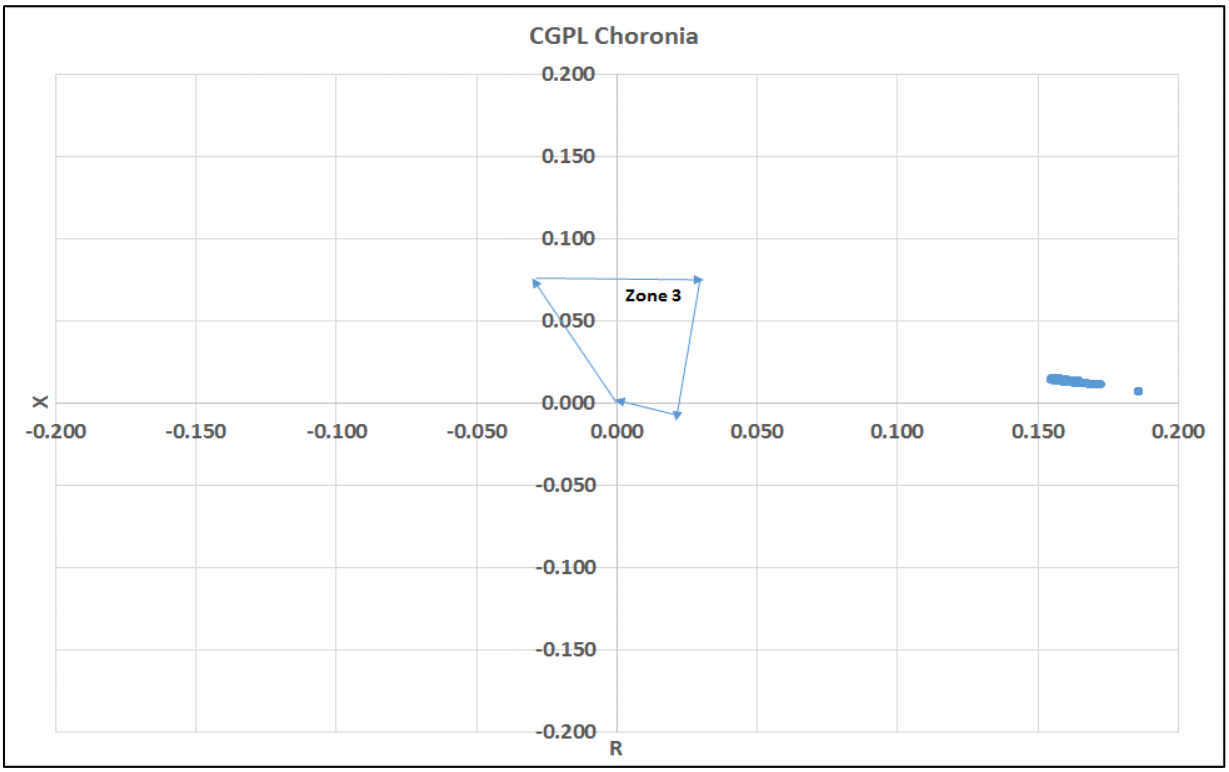
Annexure-III

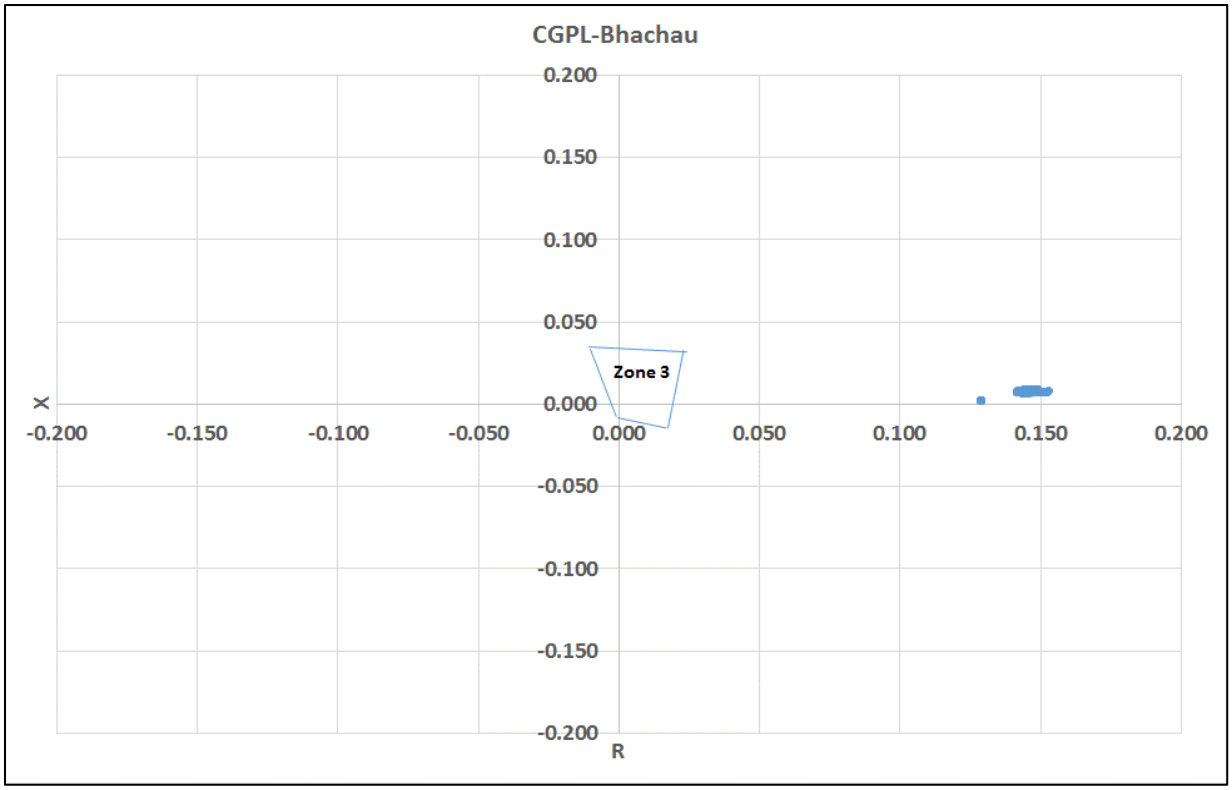
Few Case Studies on CGPL showcasing the vulnerability of the system under N-1-1 Contingency with Full generation.

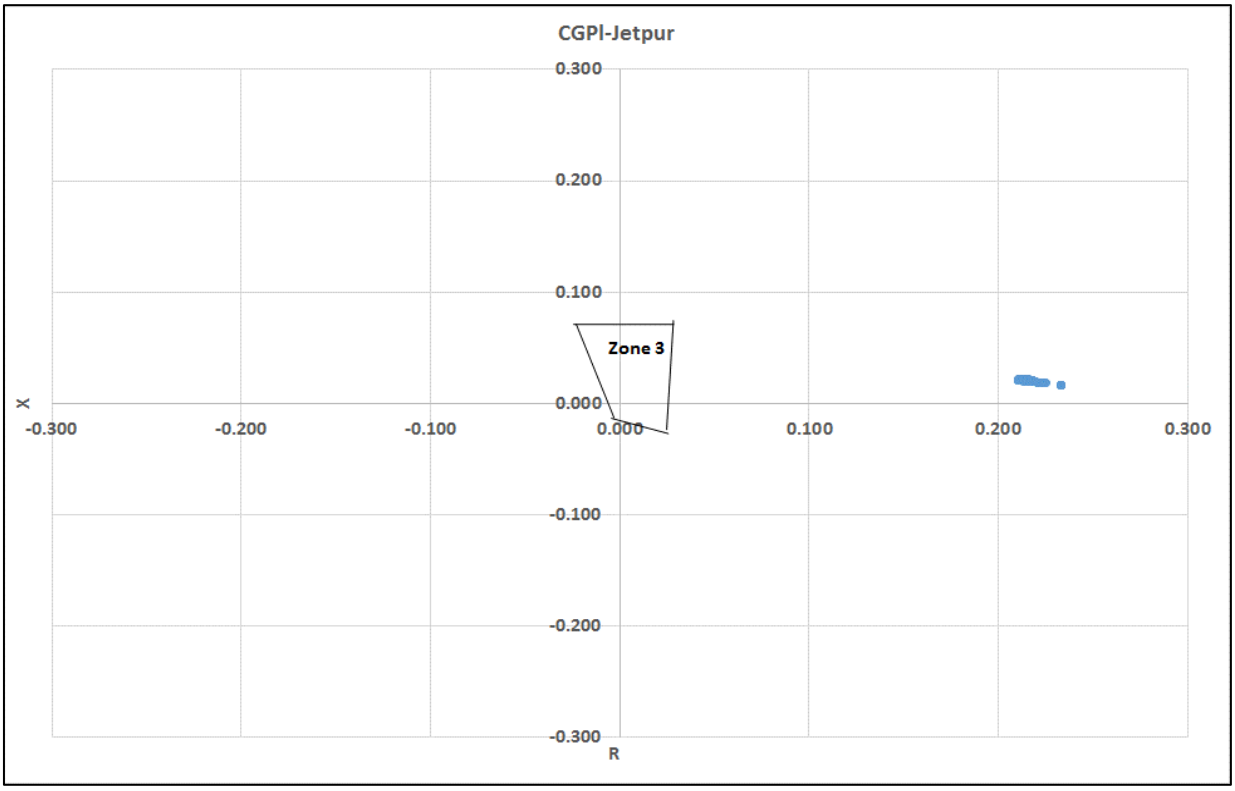
1. Full generation at CGPL and tripping of 400 kV Bhachau-Ranchorpura D/C without Any SPS Action



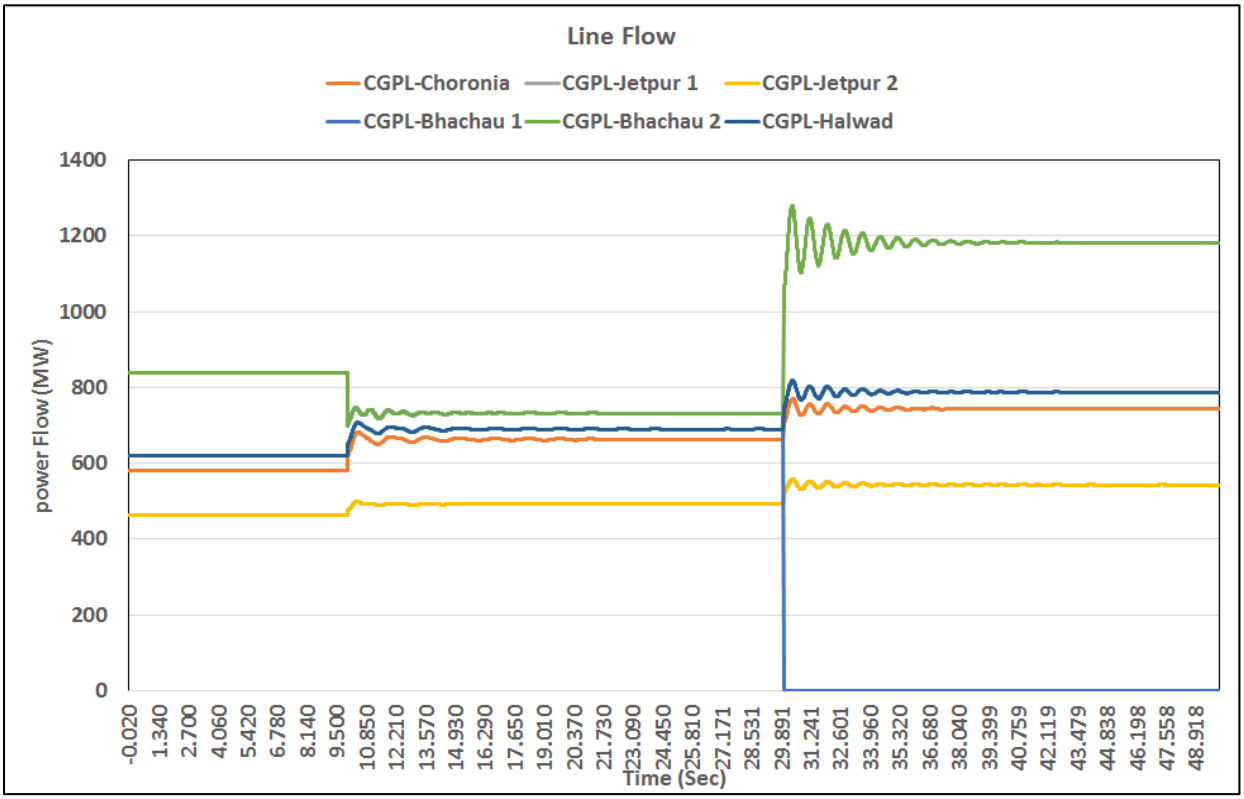

Angular Separation w.r.t CGPL
Choronia
Bhachau
Halvad
Degrees
0
-5
-10
-15
-20
-25
-0.020
1.300
2.620
3.940
5.260
6.580
7.900
9.220
10.530
11.850
13.170
14.490
15.810
17.130
18.450
19.770
21.090
22.410
23.730
25.050
26.371
27.691
29.011
30.331
31.651
32.970
34.290
35.610
36.930
38.250
39.569
40.889
42.209
43.529
44.848
46.168
47.488
48.808
Time (sec)

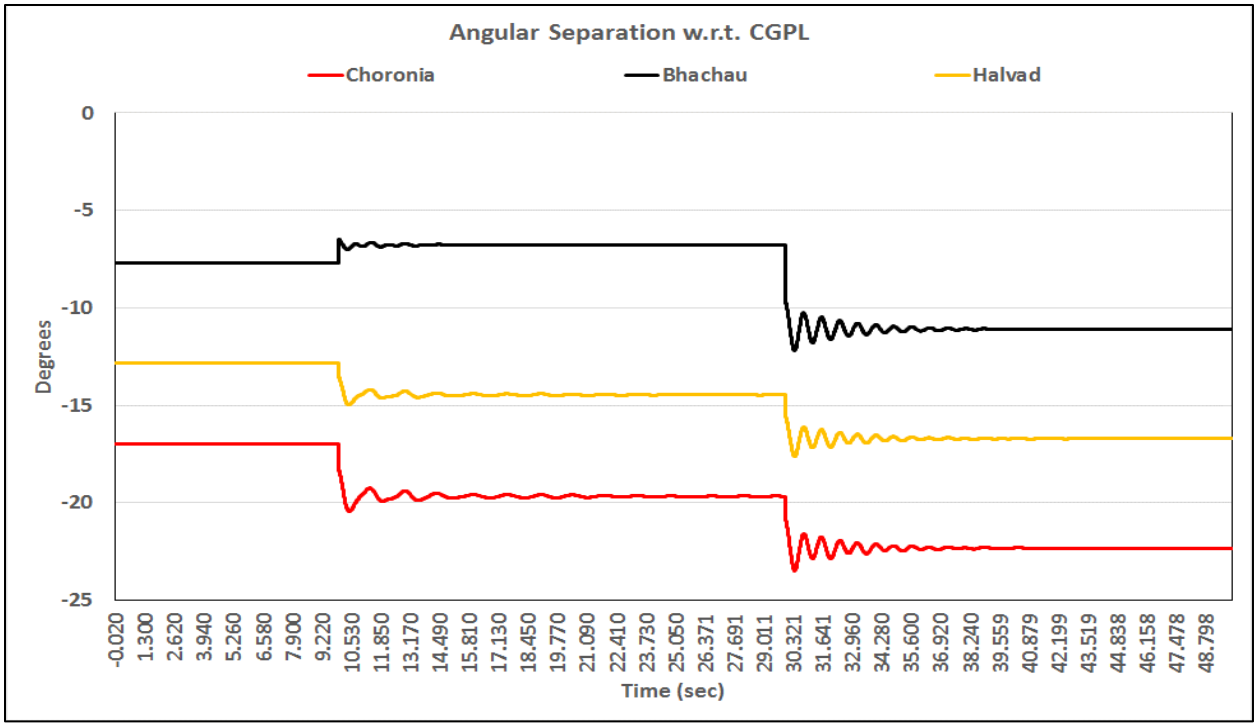

CGPL Choronia
Zone 3
X
R
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200

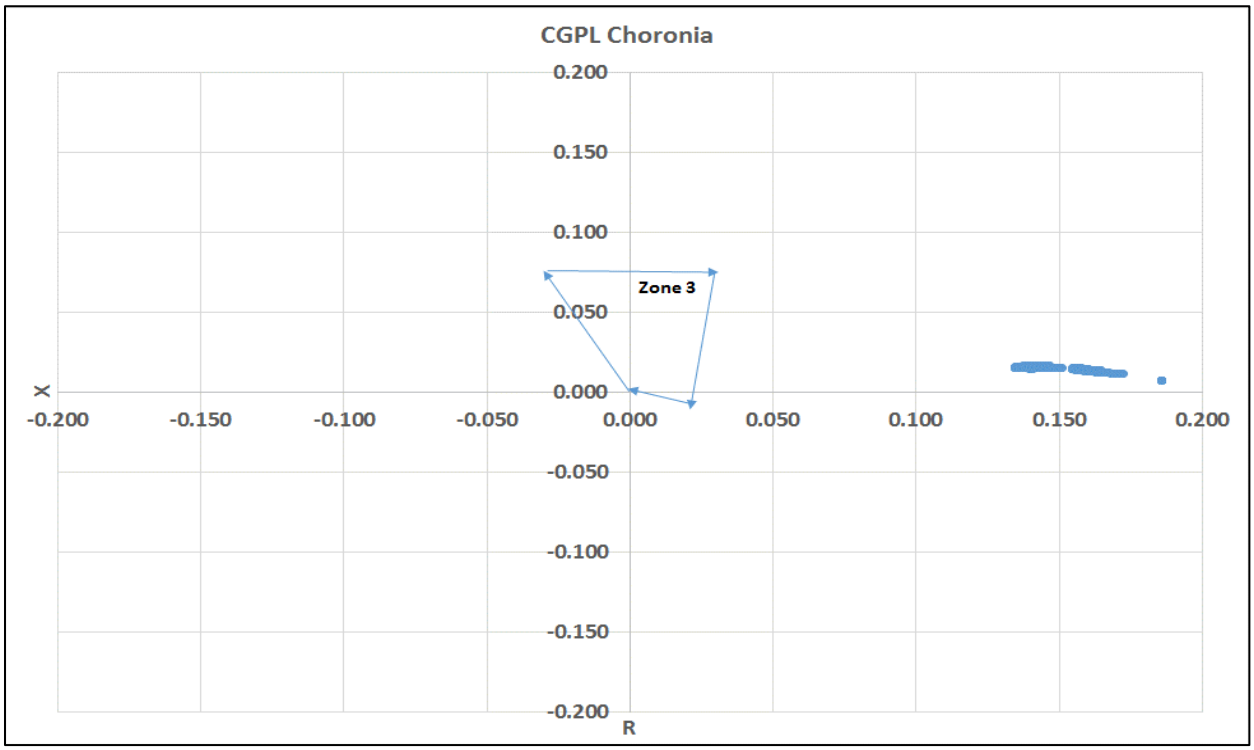

CGPL-Bhachau
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
Zone 3
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
R

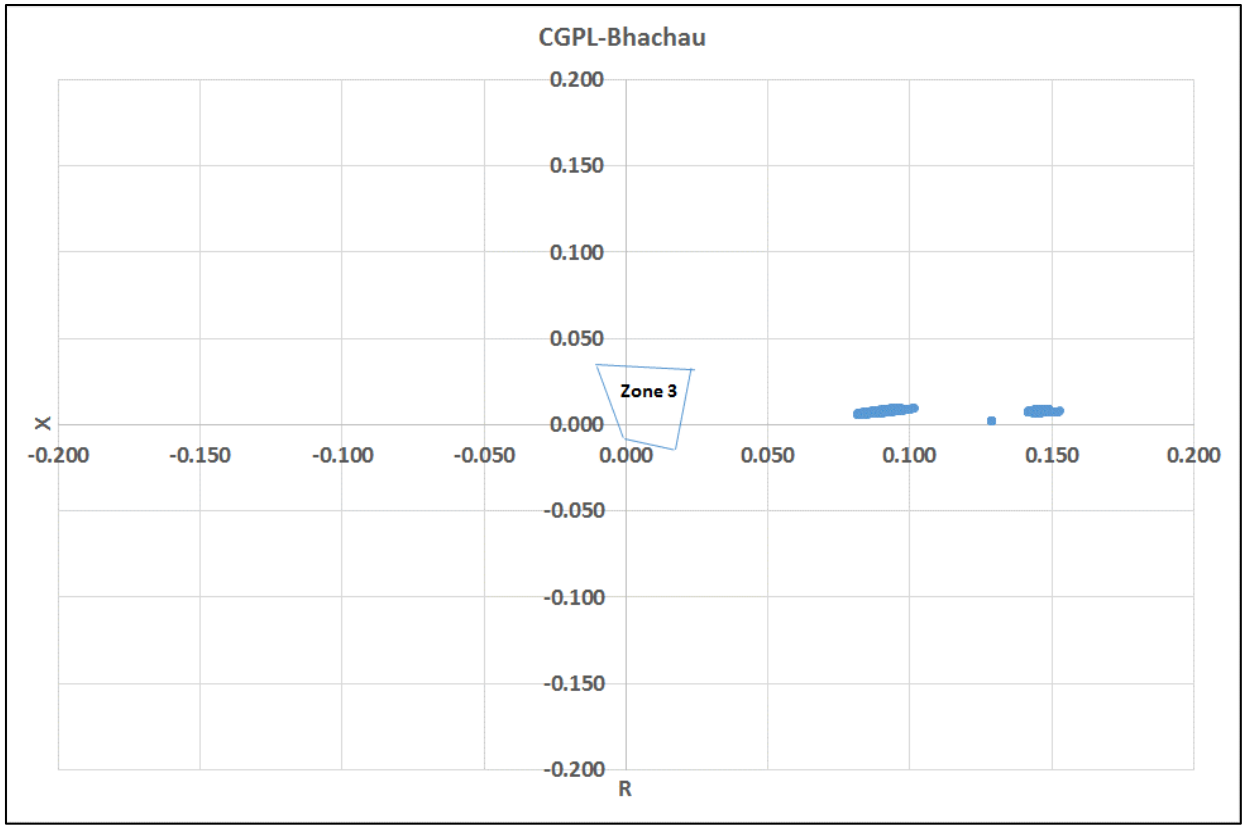

CGPl-Jetpur
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
Zone 3
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R

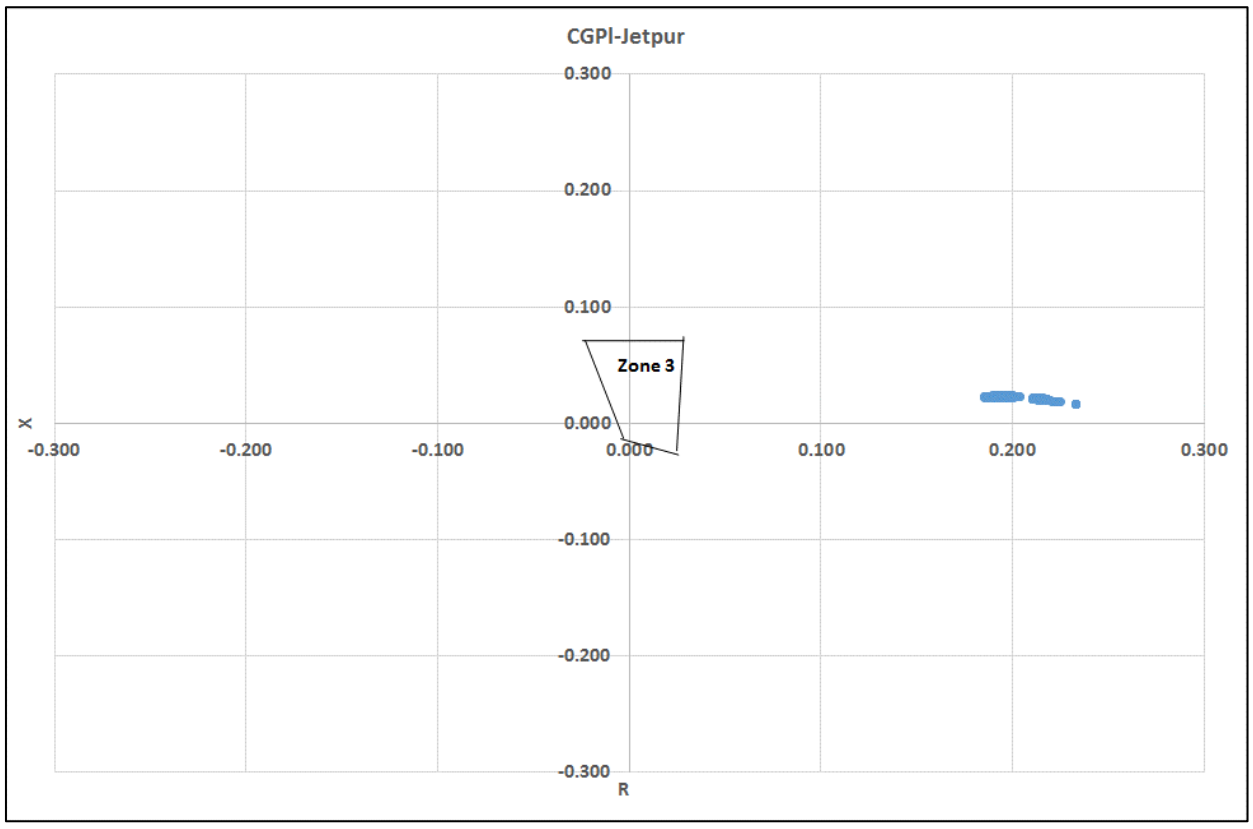
2. Full generation at CGPL and tripping of 400 kV Bhachau-Ranchorpura D/C and CGPL-Bhachau 1 without Any SPS Action



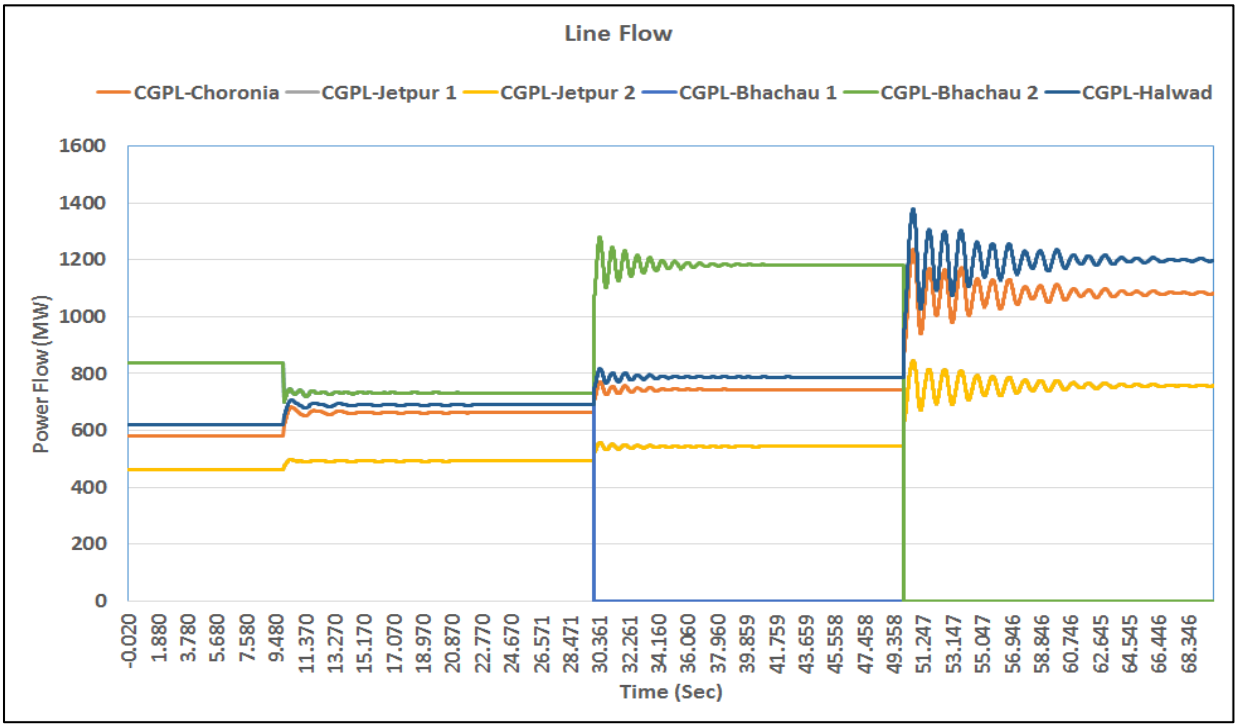

Angular Separation w.r.t. CGPL
Choronia
Bhachau
Halvad
Degrees
0
-5
-10
-15
-20
-25
-0.020
1.300
2.620
3.940
5.260
6.580
7.900
9.220
10.530
11.850
13.170
14.490
15.810
17.130
18.450
19.770
21.090
22.410
23.730
25.050
26.371
27.691
29.011
30.321
31.641
32.960
34.280
35.600
36.920
38.240
39.559
40.879
42.199
43.519
44.838
46.158
47.478
48.798
Time (sec)

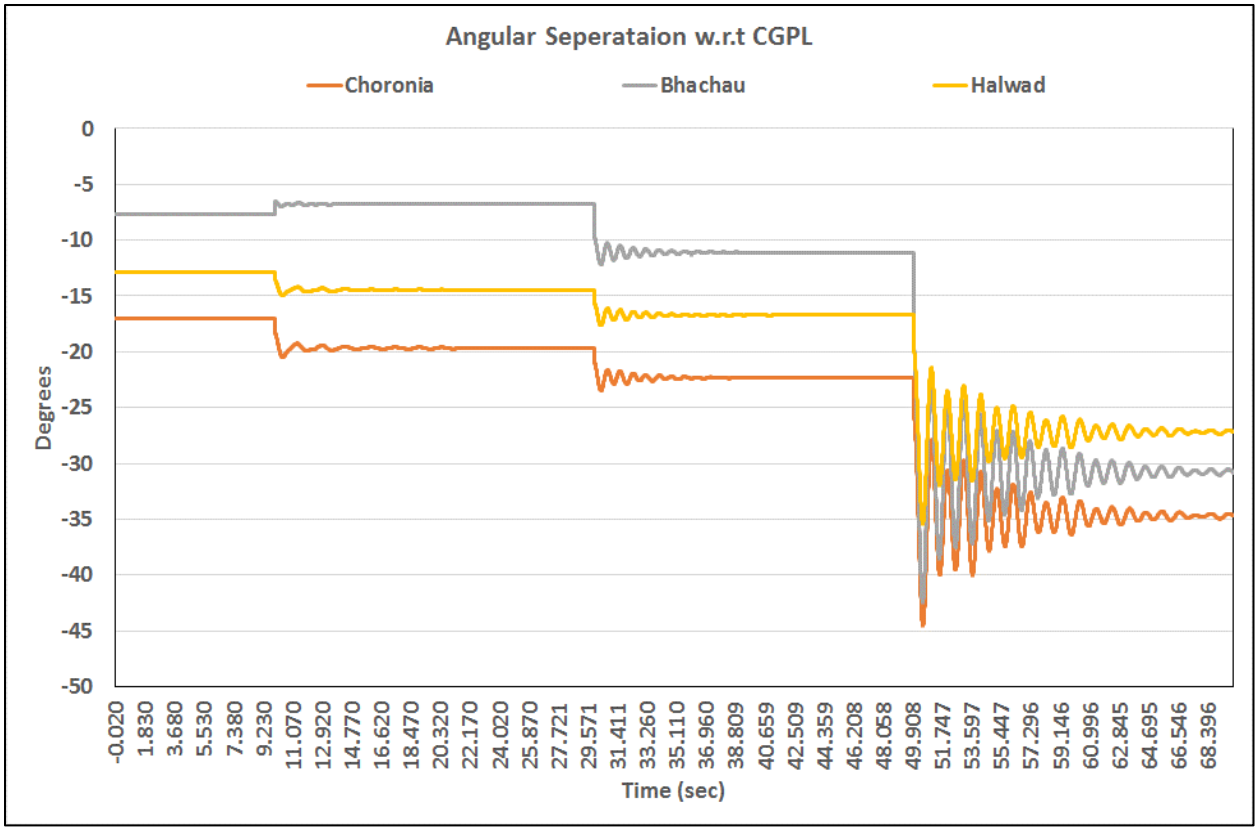

CGPL Choronia
Zone 3
X
R
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200

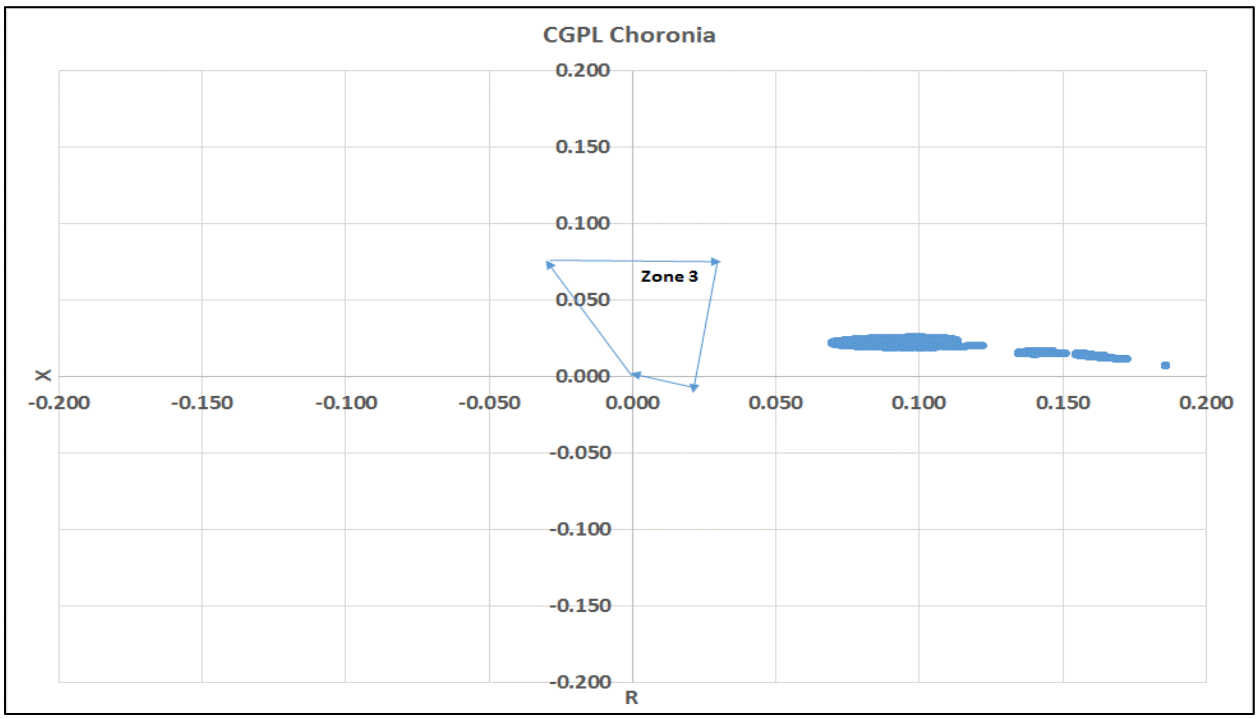

CGPL-Bhachau
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
R
Zone 3

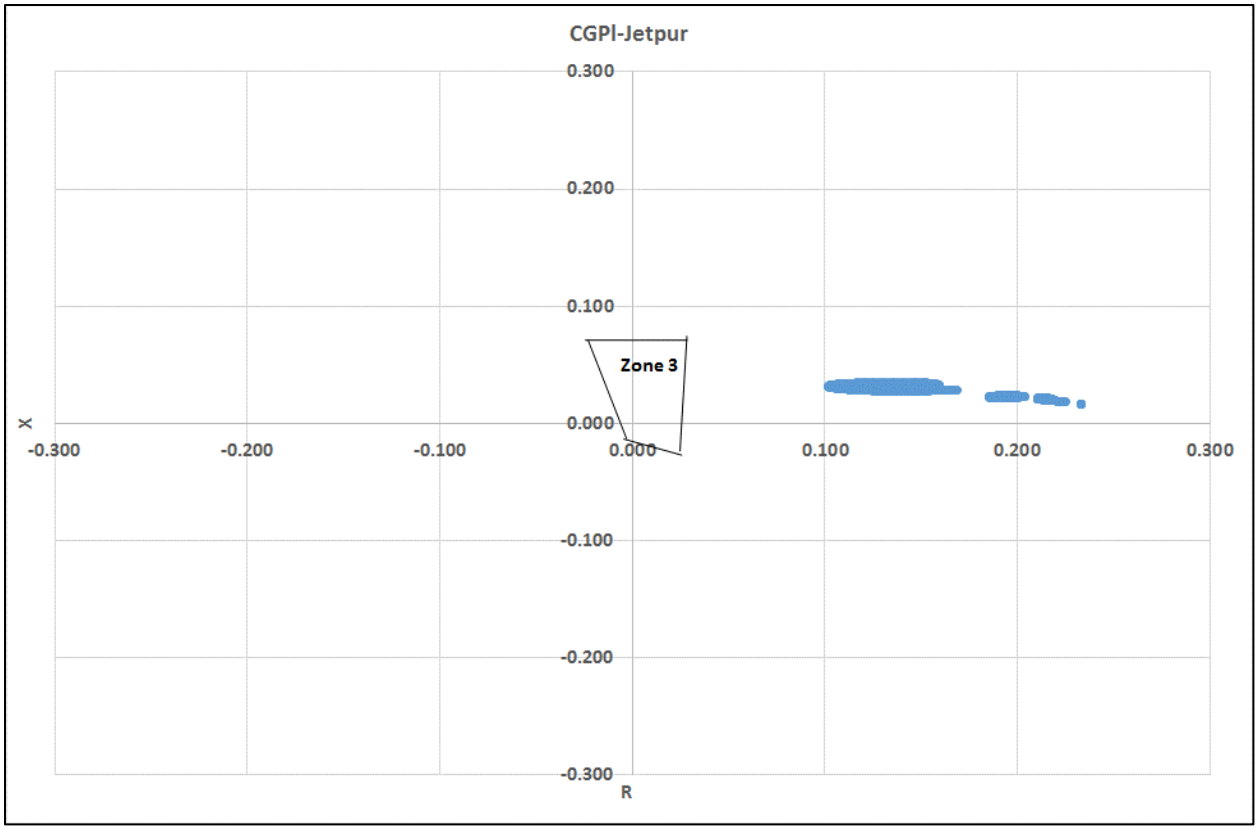

CGPl-Jetpur
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R
Zone 3

3. Full generation at CGPL and tripping of 400 kV Bhachau-Ranchorpura D/C and CGPL-Bhachau D/C without Any SPS Action

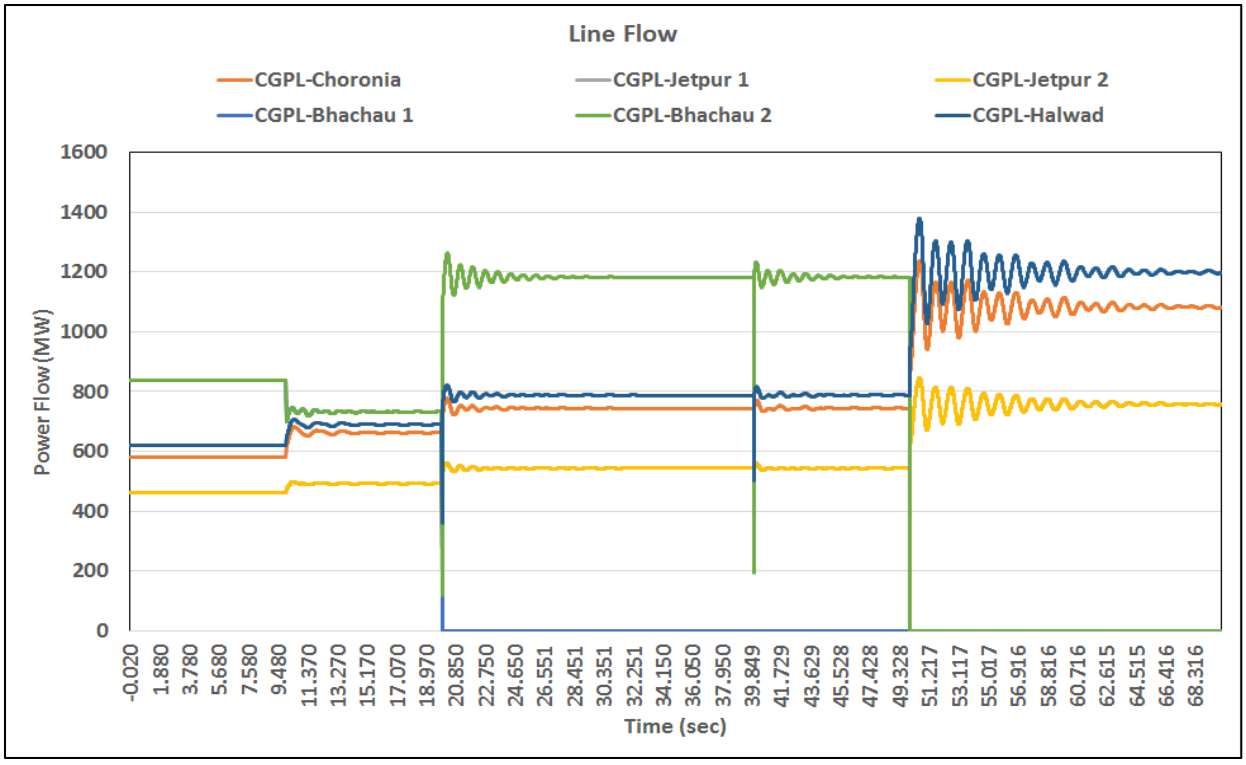


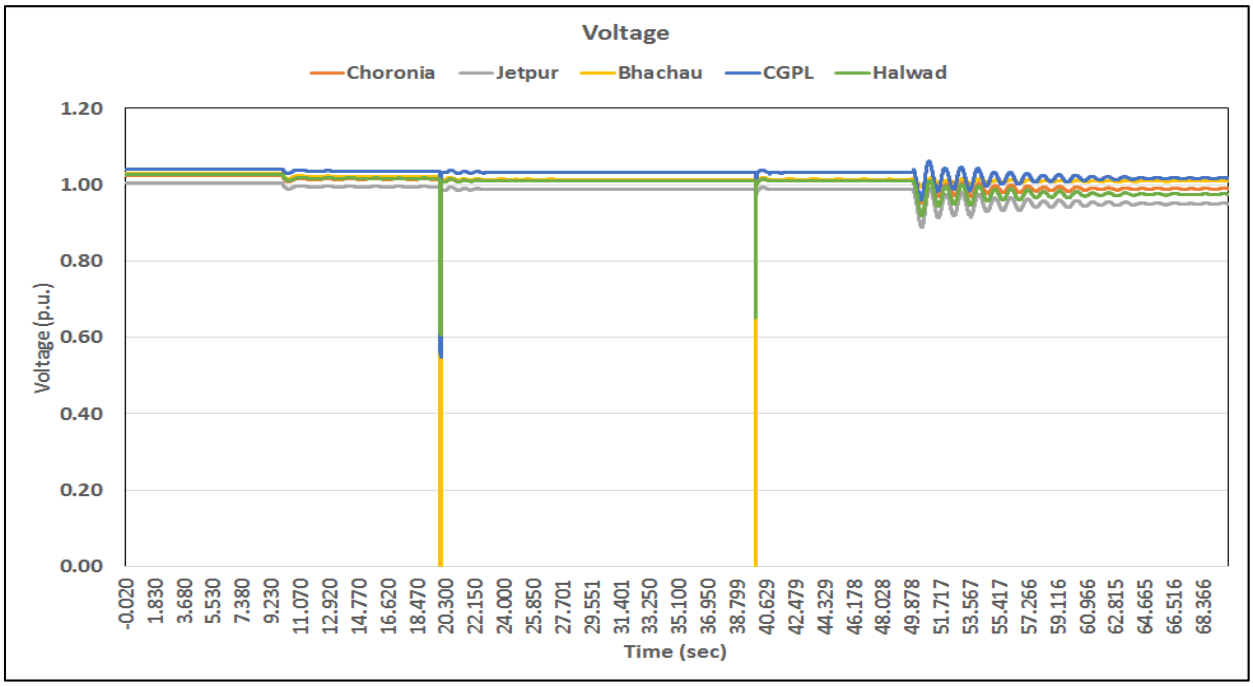

Angular Seperataion w.r.t CGPL
Choronia
Bhachau
Halwad
Degrees
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-0.020
1.830
3.680
5.530
7.380
9.230
11.070
12.920
14.770
16.620
18.470
20.320
22.170
24.020
25.870
27.721
29.571
31.411
33.260
35.110
36.960
38.809
40.659
42.509
44.359
46.208
48.058
49.908
51.747
53.597
55.447
57.296
59.146
60.996
62.845
64.695
66.546
68.396
Time (sec)

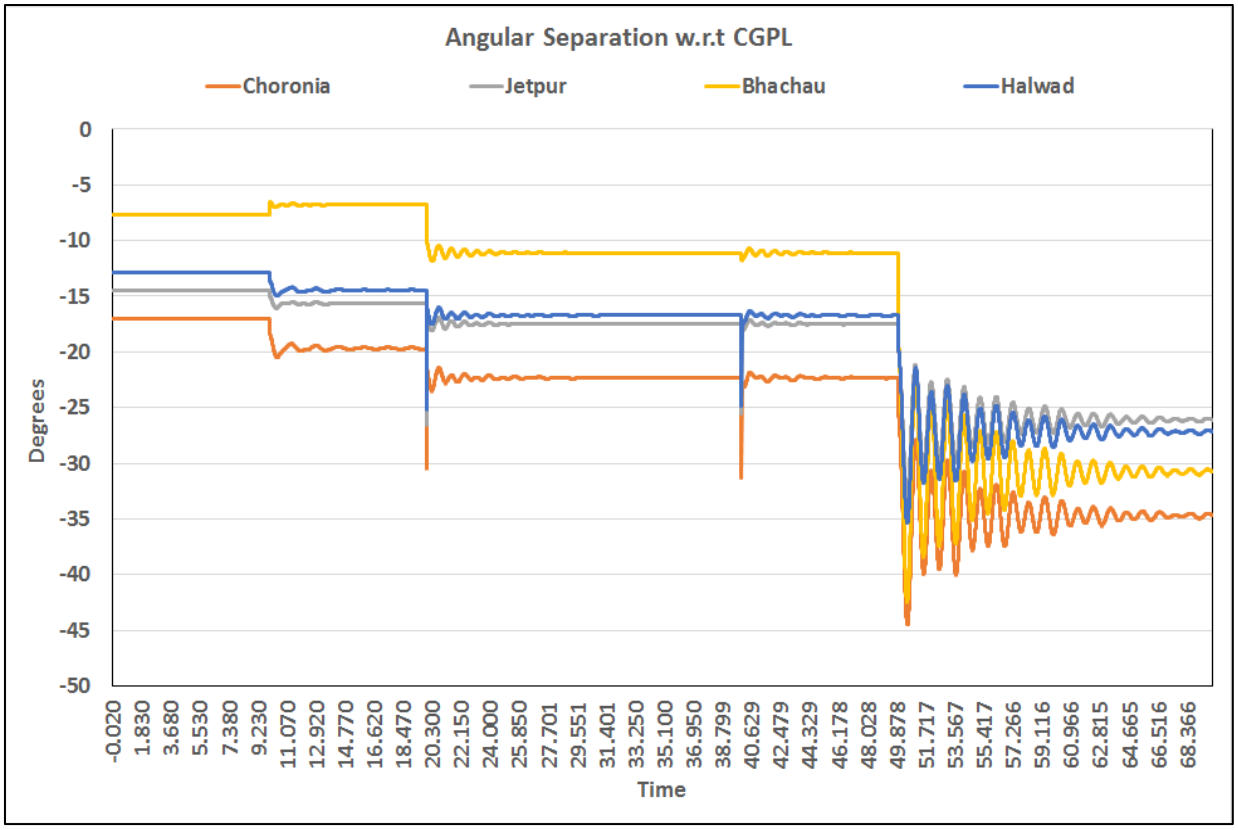

CGPL Choronia
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
Zone 3
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
R

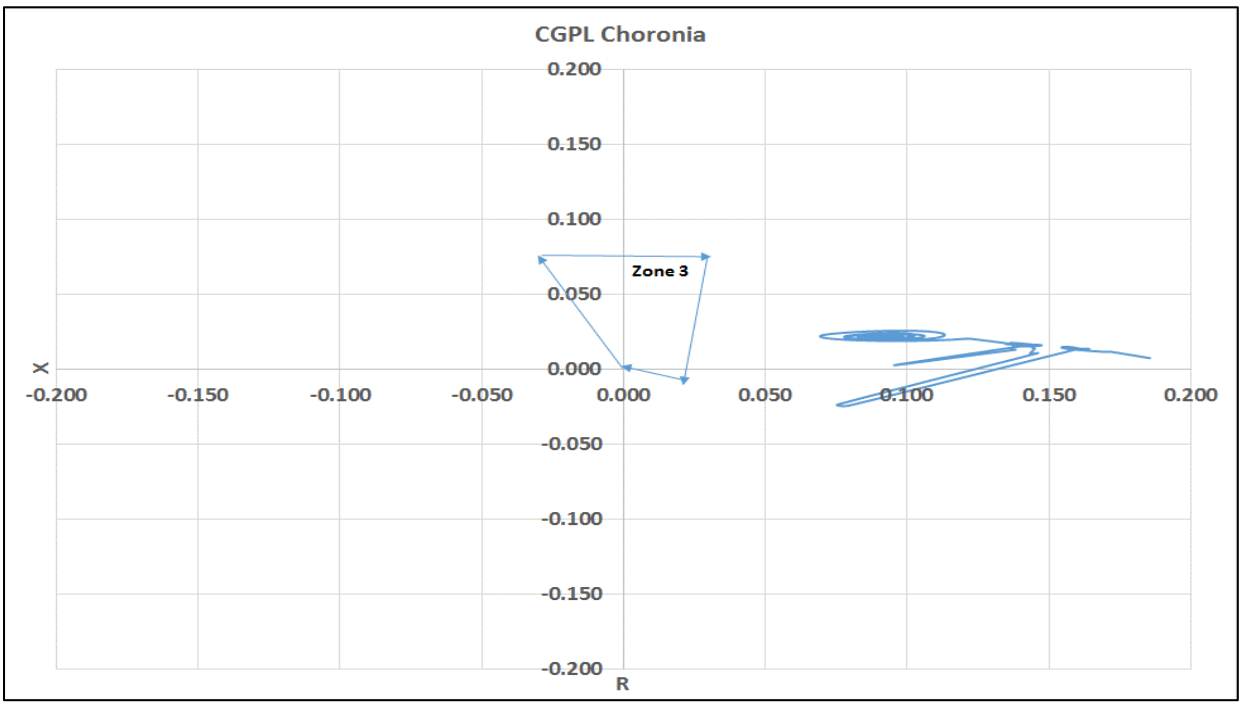


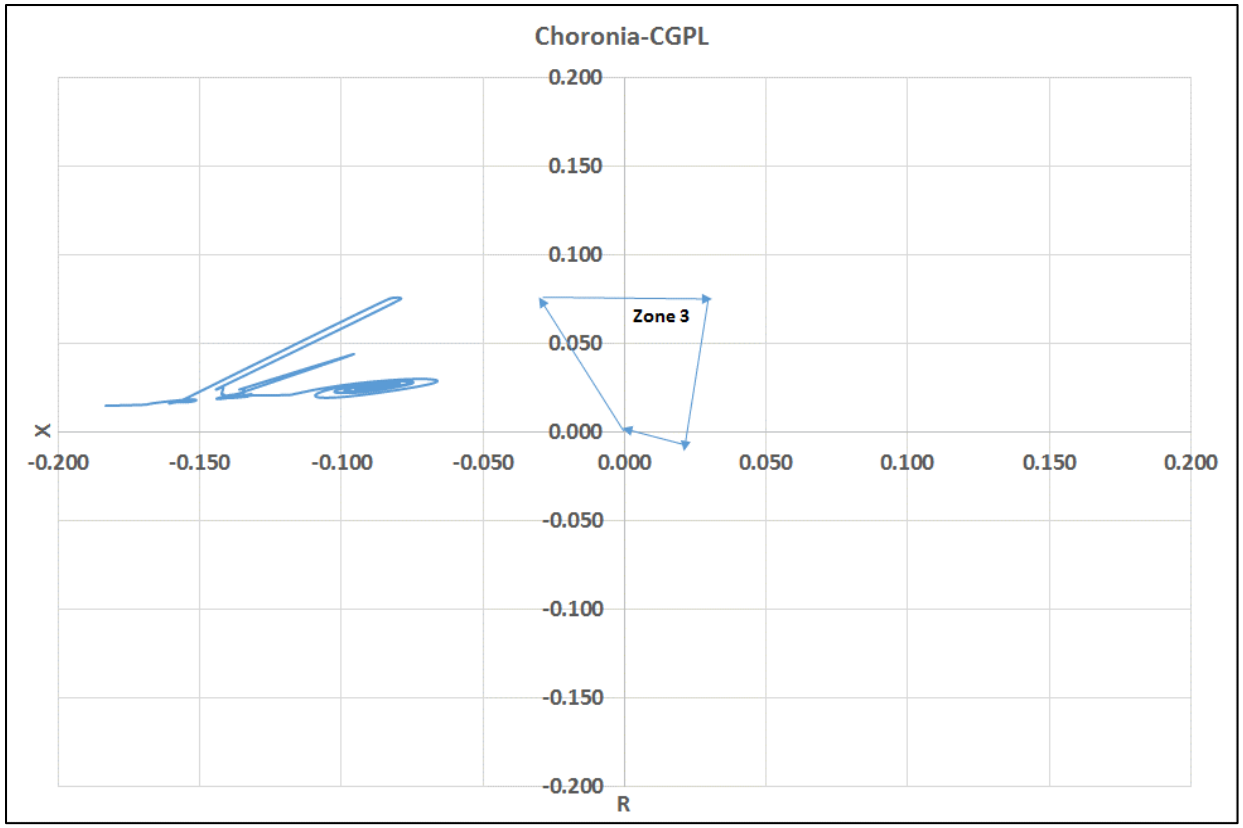
4. **Full generation at CGPL and tripping of 400 kV Bhachau-Ranchorpura D/C and CGPL-Bhachau D/C (with 100 ms of three phase fault followed by its tripping) without Any SPS Action**

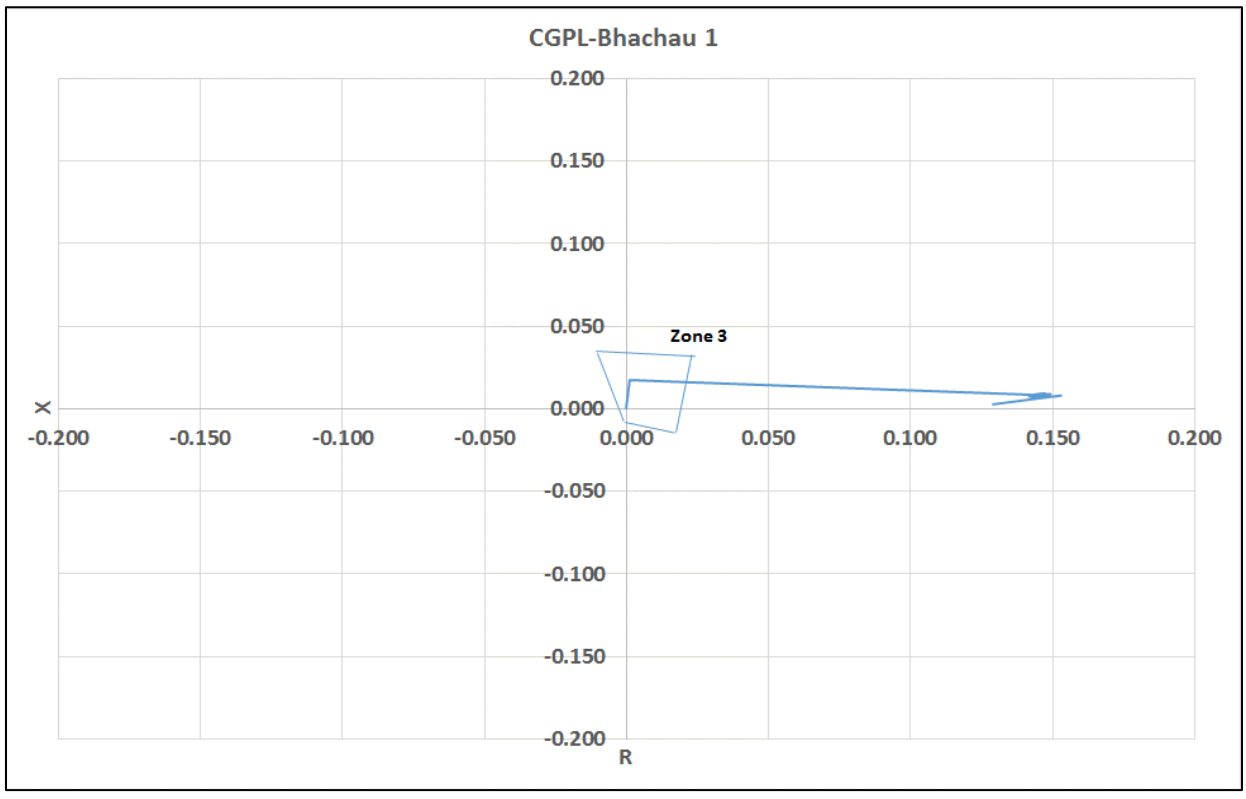

Line Flow
CGPL-Choronia
CGPL-Jetpur 1
CGPL-Jetpur 2
CGPL-Bhachau 1
CGPL-Bhachau 2
CGPL-Halwad
Power Flow (MW)
1600
1400
1200
1000
800
600
400
200
0
-0.020
1.880
3.780
5.680
7.580
9.480
11.370
13.270
15.170
17.070
18.970
20.850
22.750
24.650
26.551
28.451
30.351
32.251
34.150
36.050
37.950
39.849
41.729
43.629
45.528
47.428
49.328
51.217
53.117
55.017
56.916
58.816
60.716
62.615
64.515
66.416
68.316
Time (sec)

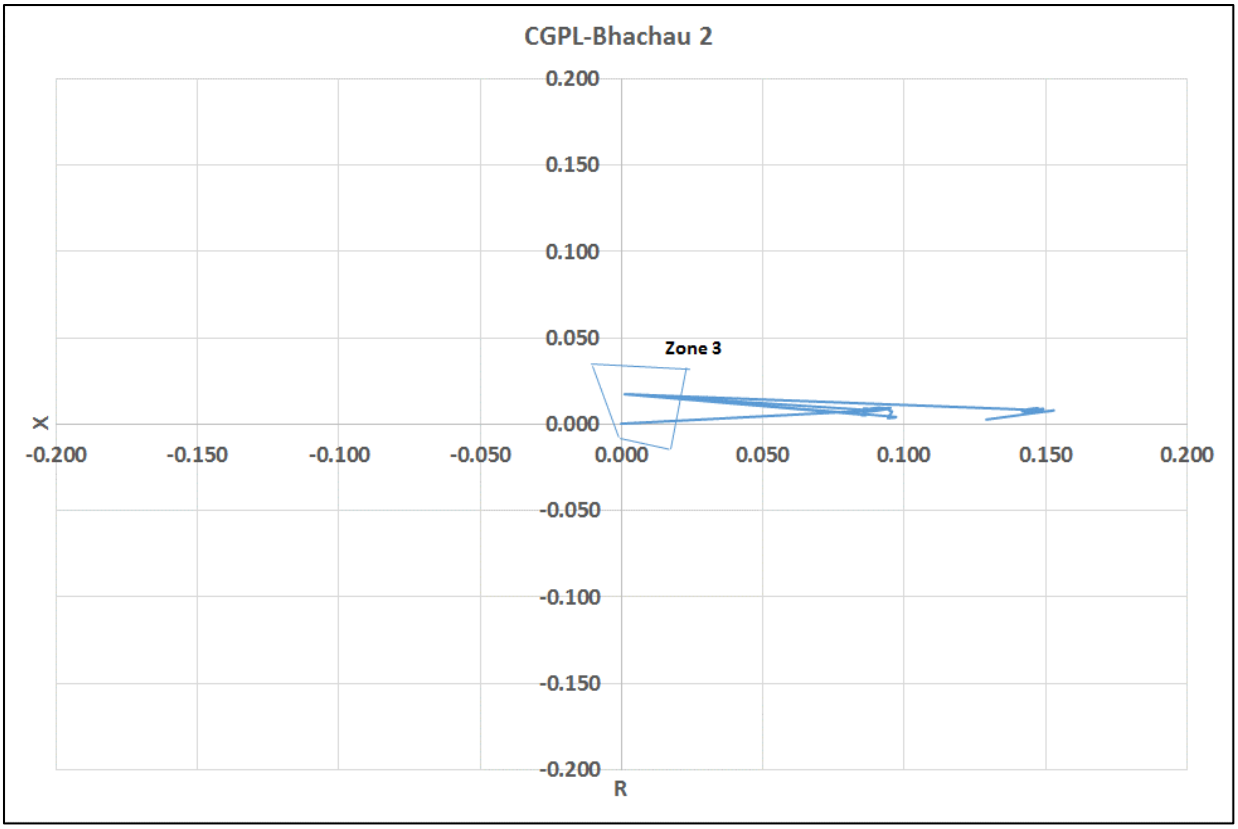

Voltage
Choronia
Jetpur
Bhachau
CGPL
Halwad
Voltage (p.u.)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.020
1.830
3.680
5.530
7.380
9.230
11.070
12.920
14.770
16.620
18.470
20.300
22.150
24.000
25.850
27.701
29.551
31.401
33.250
35.100
36.950
38.799
40.629
42.479
44.329
46.178
48.028
49.878
51.717
53.567
55.417
57.266
59.116
60.966
62.815
64.665
66.516
68.366
Time (sec)

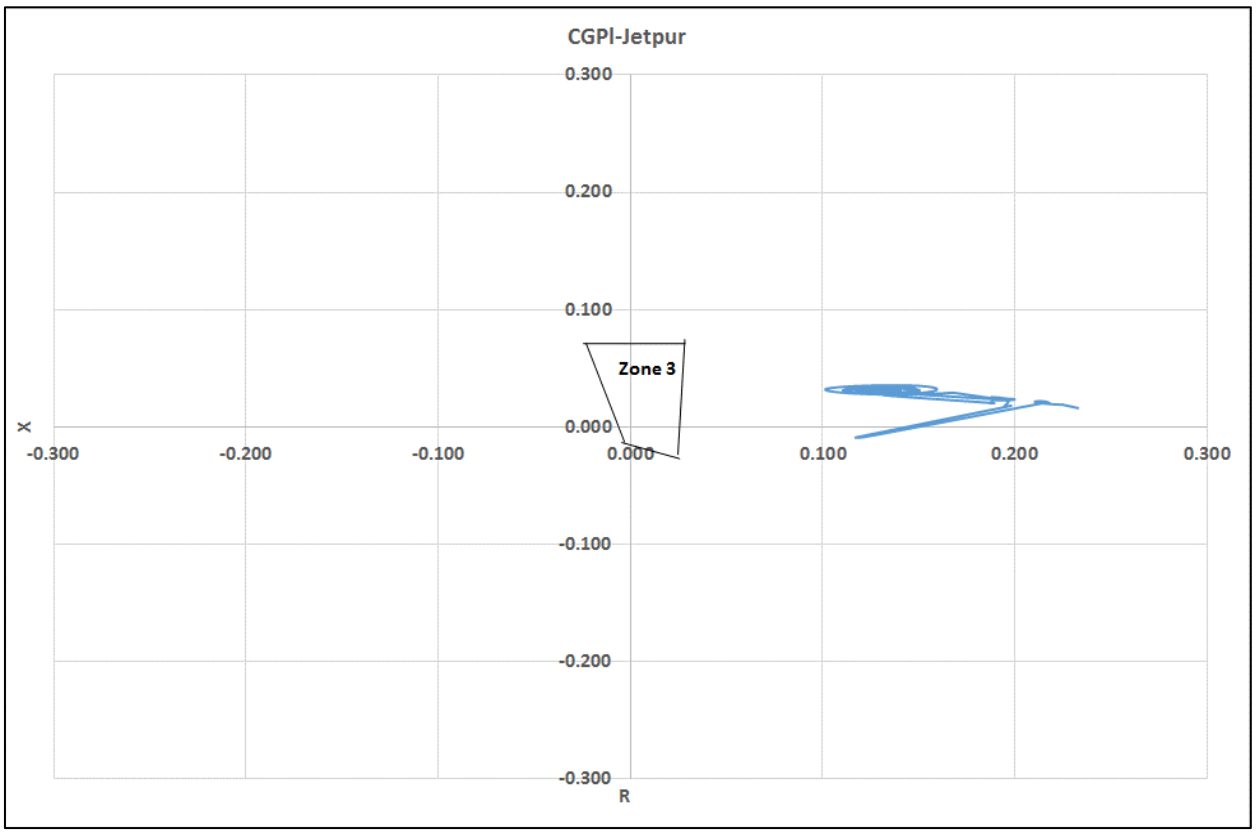

Angular Separation w.r.t CGPL
Choronia
Jetpur
Bhachau
Halwad
Degrees
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-0.020
1.830
3.680
5.530
7.380
9.230
11.070
12.920
14.770
16.620
18.470
20.300
22.150
24.000
25.850
27.701
29.551
31.401
33.250
35.100
36.950
38.799
40.629
42.479
44.329
46.178
48.028
49.878
51.717
53.567
55.417
57.266
59.116
60.966
62.815
64.665
66.516
68.366
Time

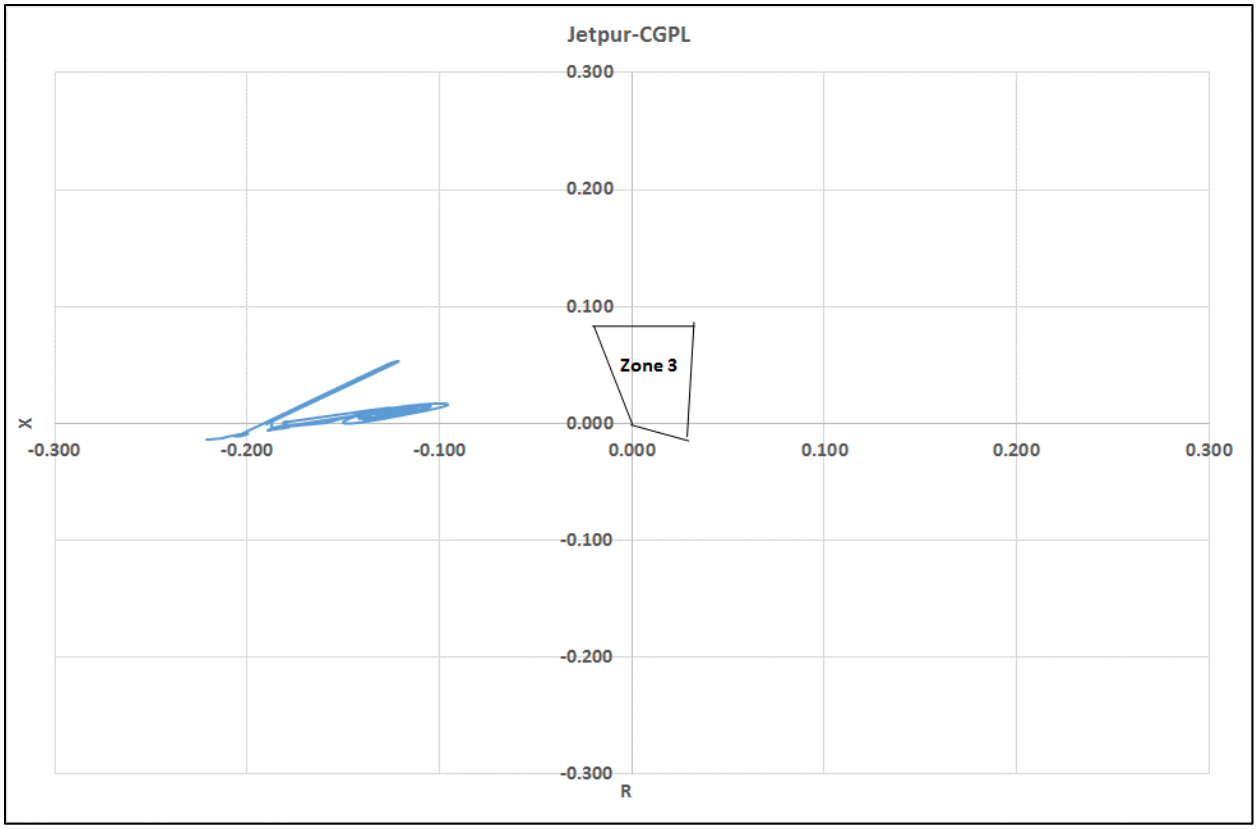

CGPL Choronia
Zone 3
X
R
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200


Choronia-CGPL
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
Zone 3
X
R

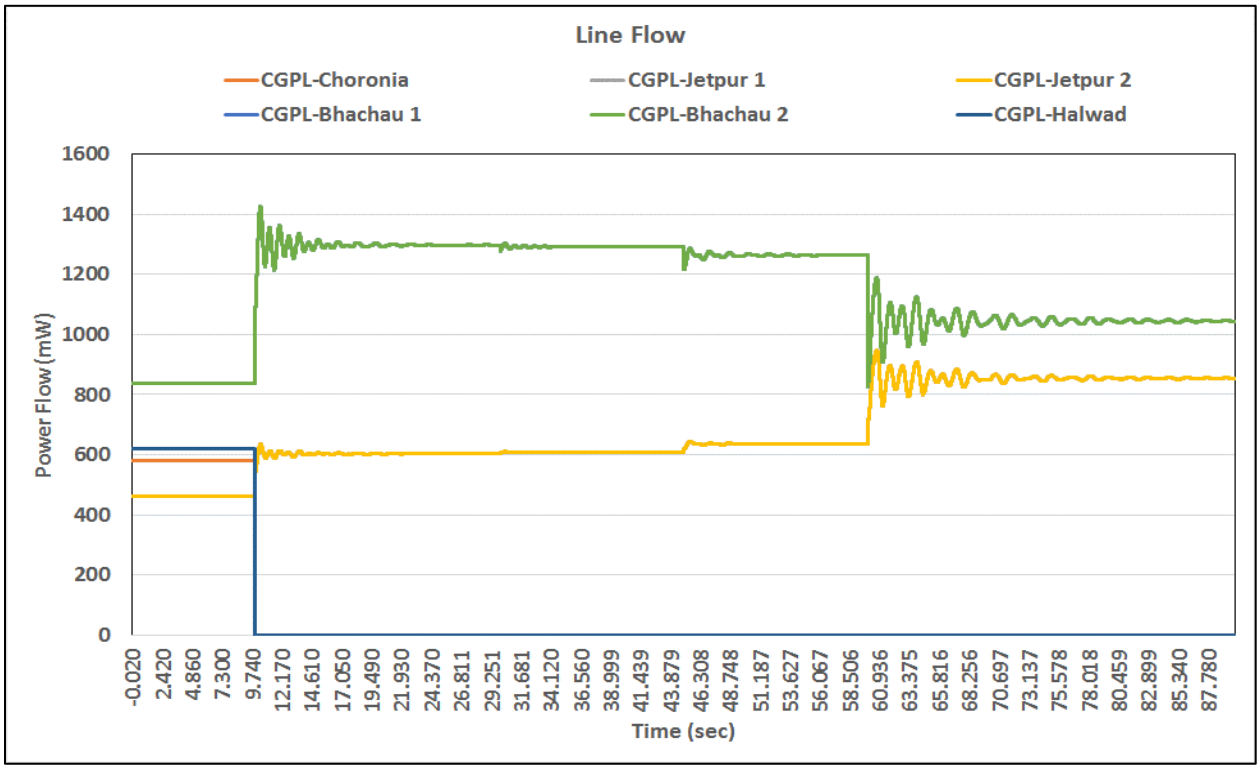

CGPL-Bhachau 1
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
Zone 3
X
R

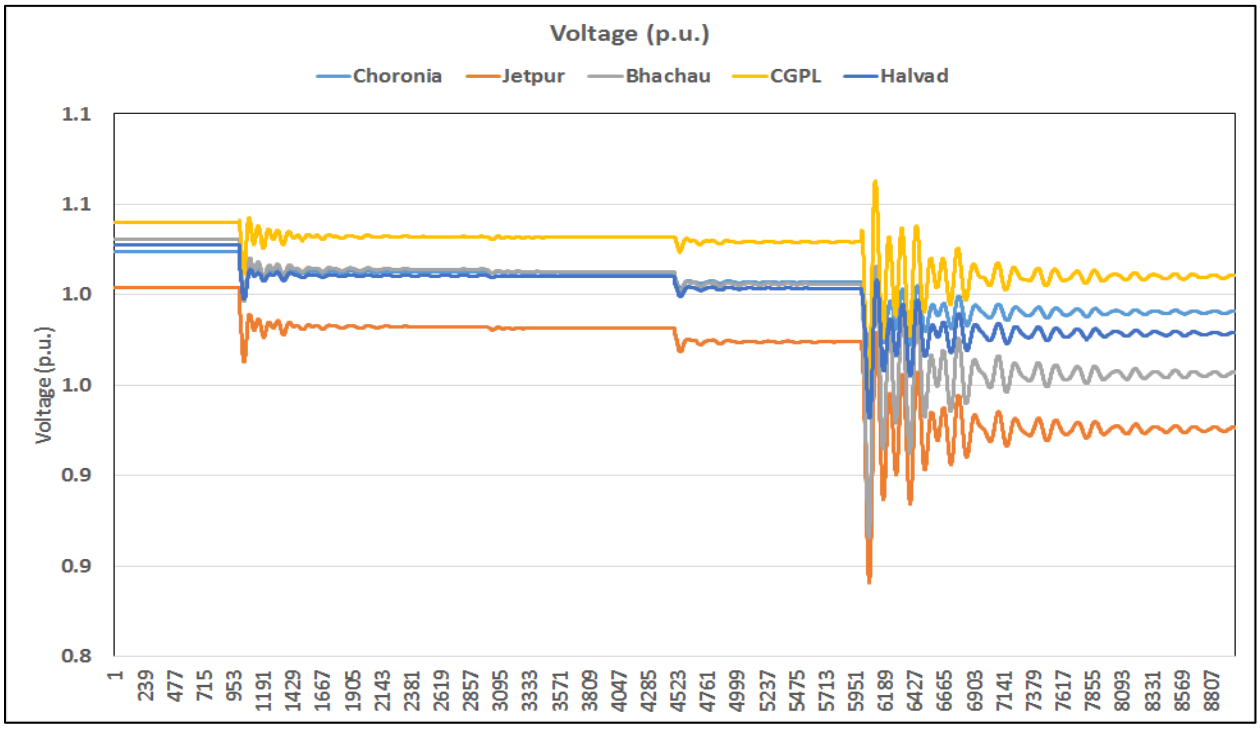

CGPL-Bhachau 2
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
Zone 3
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
R

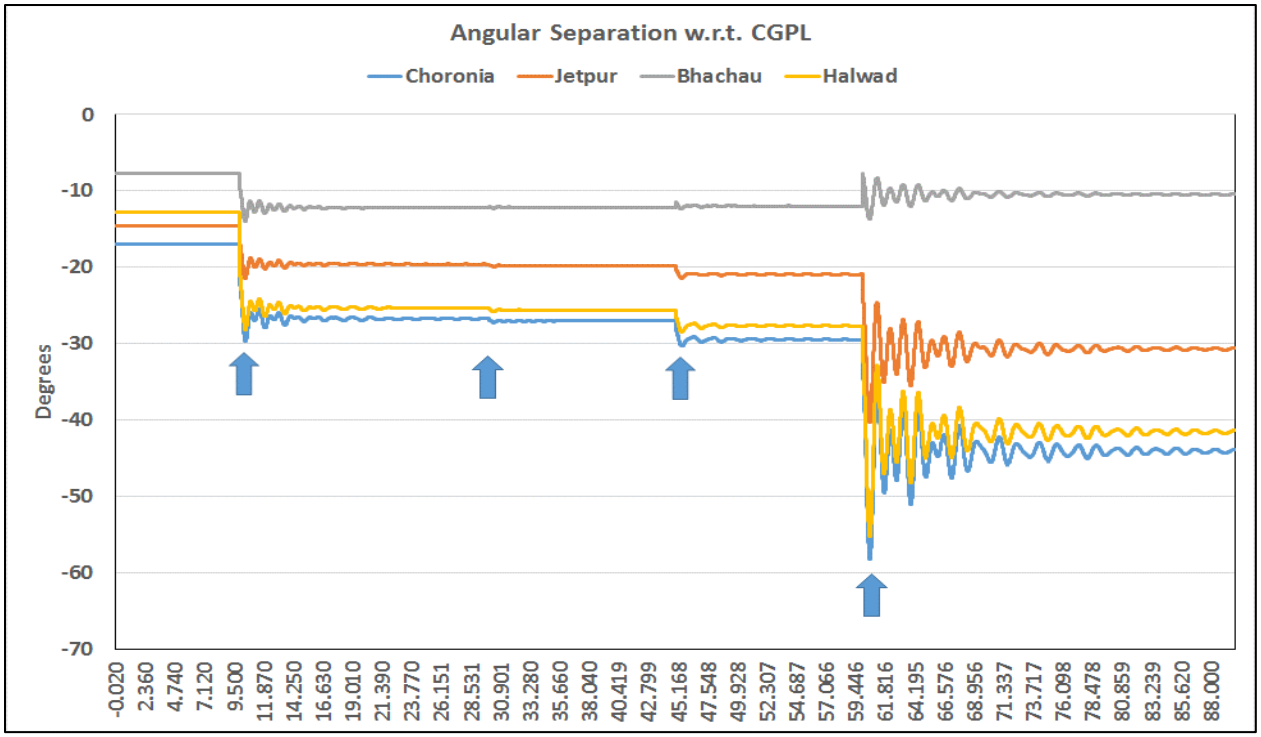

CGPl-Jetpur
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
Zone 3
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R


Jetpur-CGPL
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R
Zone 3

5. **Full generation at CGPL and tripping of 400 kV CGPL-Choronia D/C followed by 400 kV Bhachau-Varsana 1, Bhachau-Ranchodpura 1 and Bhachau-Varsana 2 without any SPS Action**






Angular Separation w.r.t. CGPL
Choronia
Jetpur
Bhachau
Halwad
Degrees
0
-10
-20
-30
-40
-50
-60
-70
-0.020
2.360
4.740
7.120
9.500
11.870
14.250
16.630
19.010
21.390
23.770
26.151
28.531
30.901
33.280
35.660
38.040
40.419
42.799
45.168
47.548
49.928
52.307
54.687
57.066
59.446
61.816
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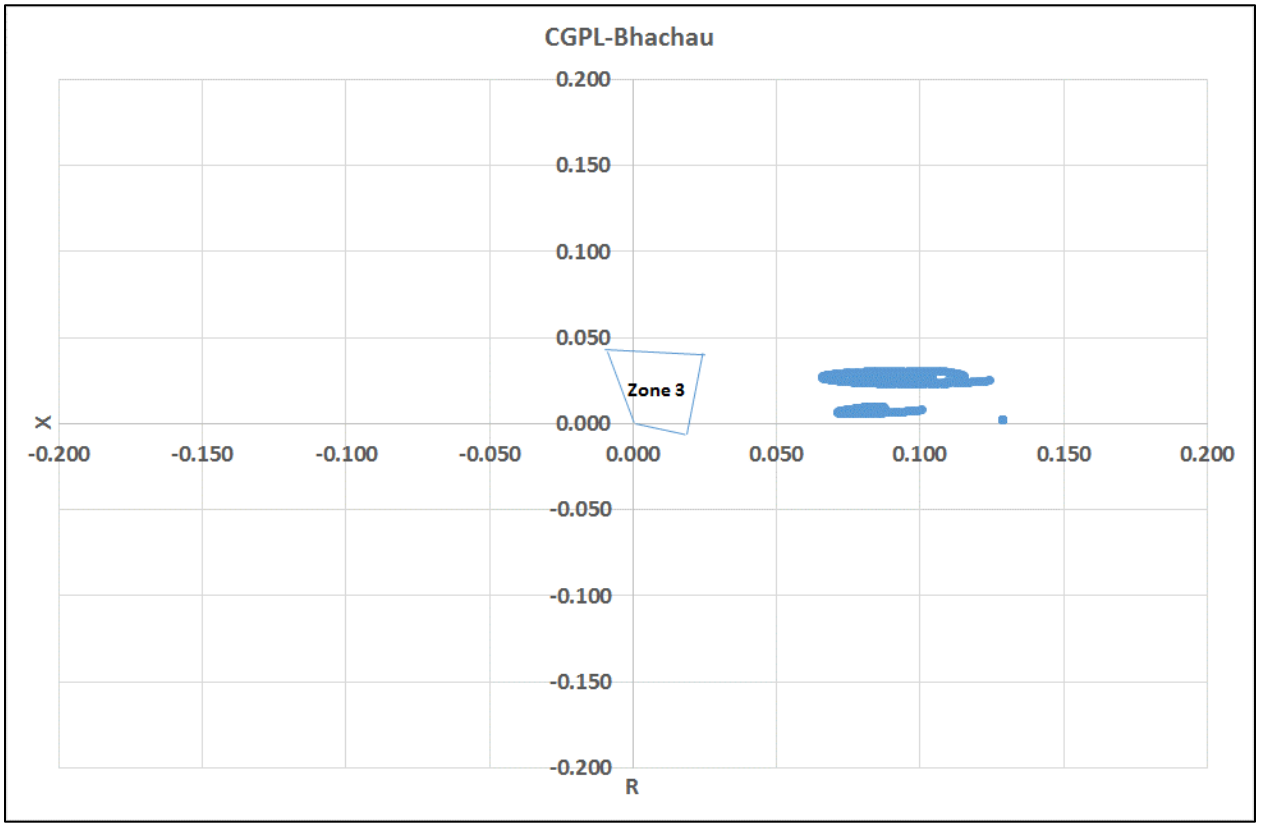
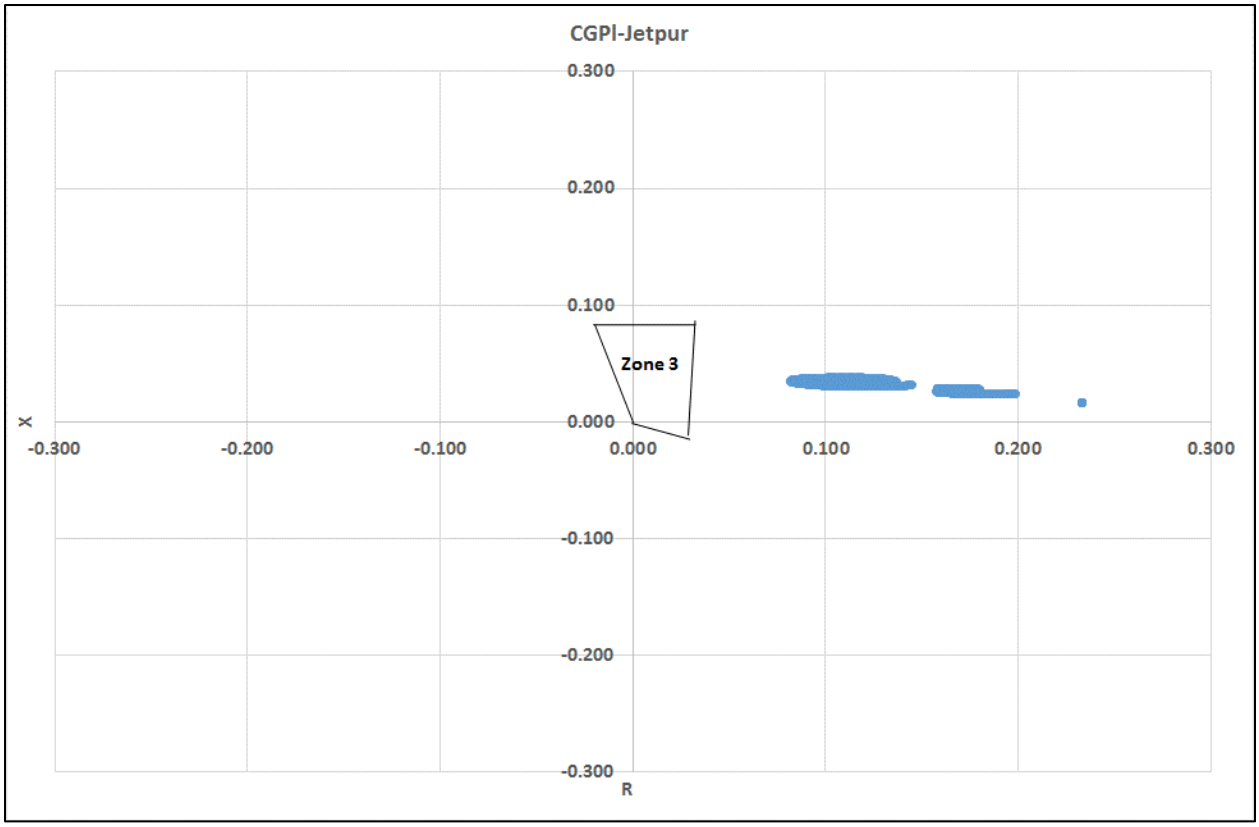
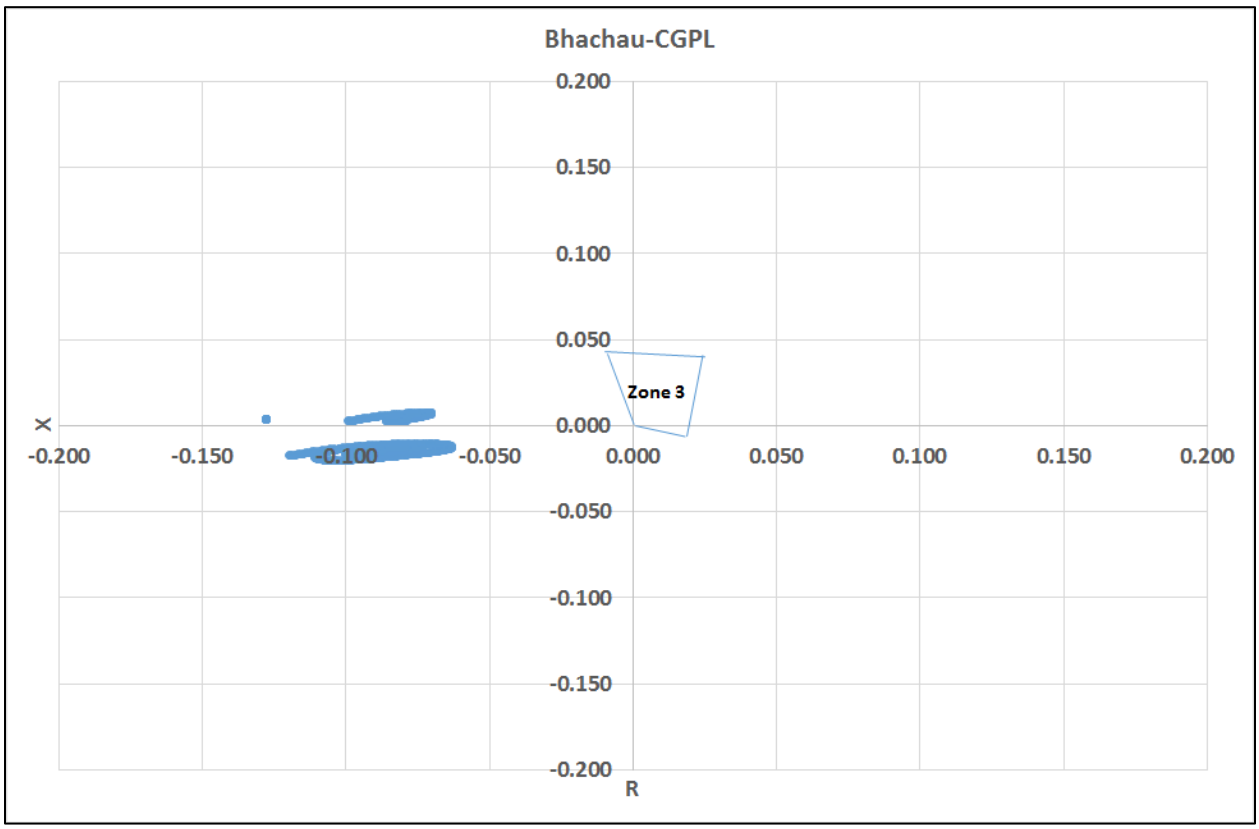
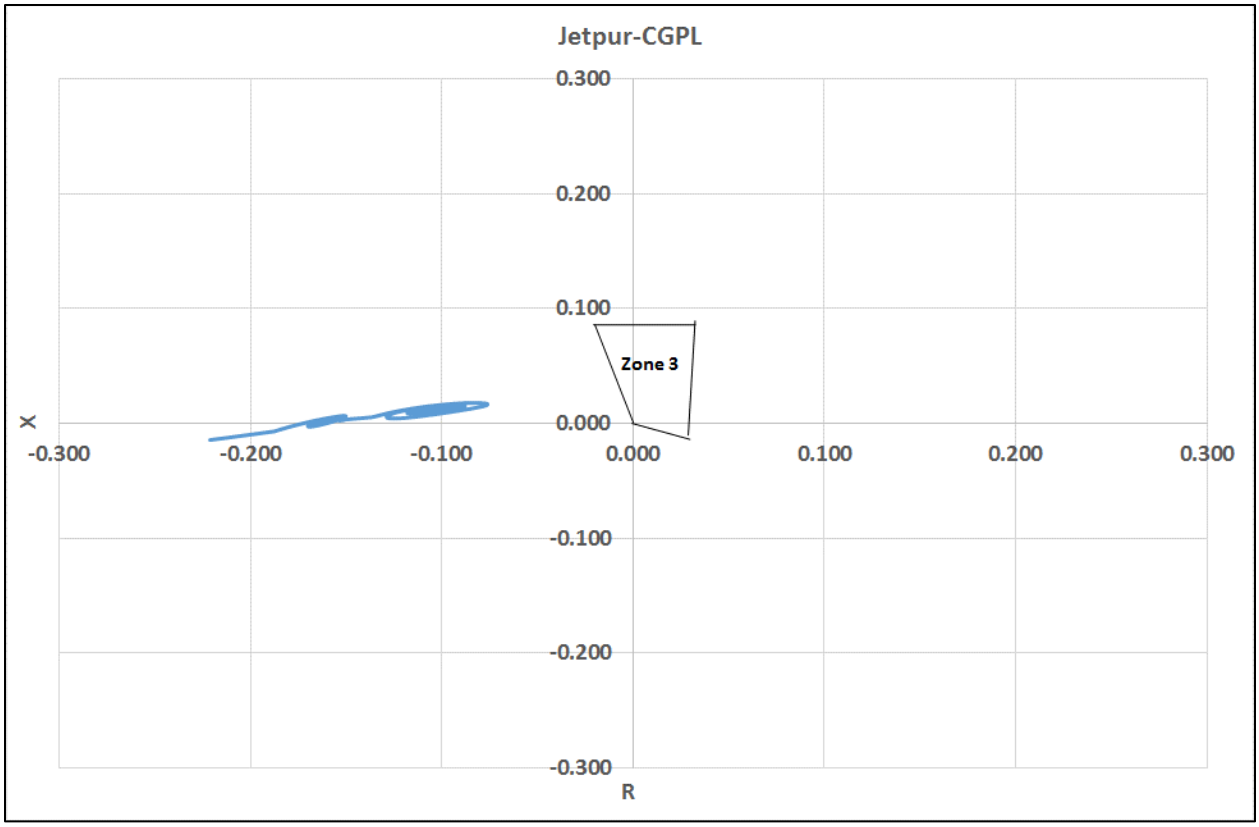
76.098
78.478
80.859
83.239
85.620
88.000


CGPL-Bhachau
Zone 3
X
R
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200

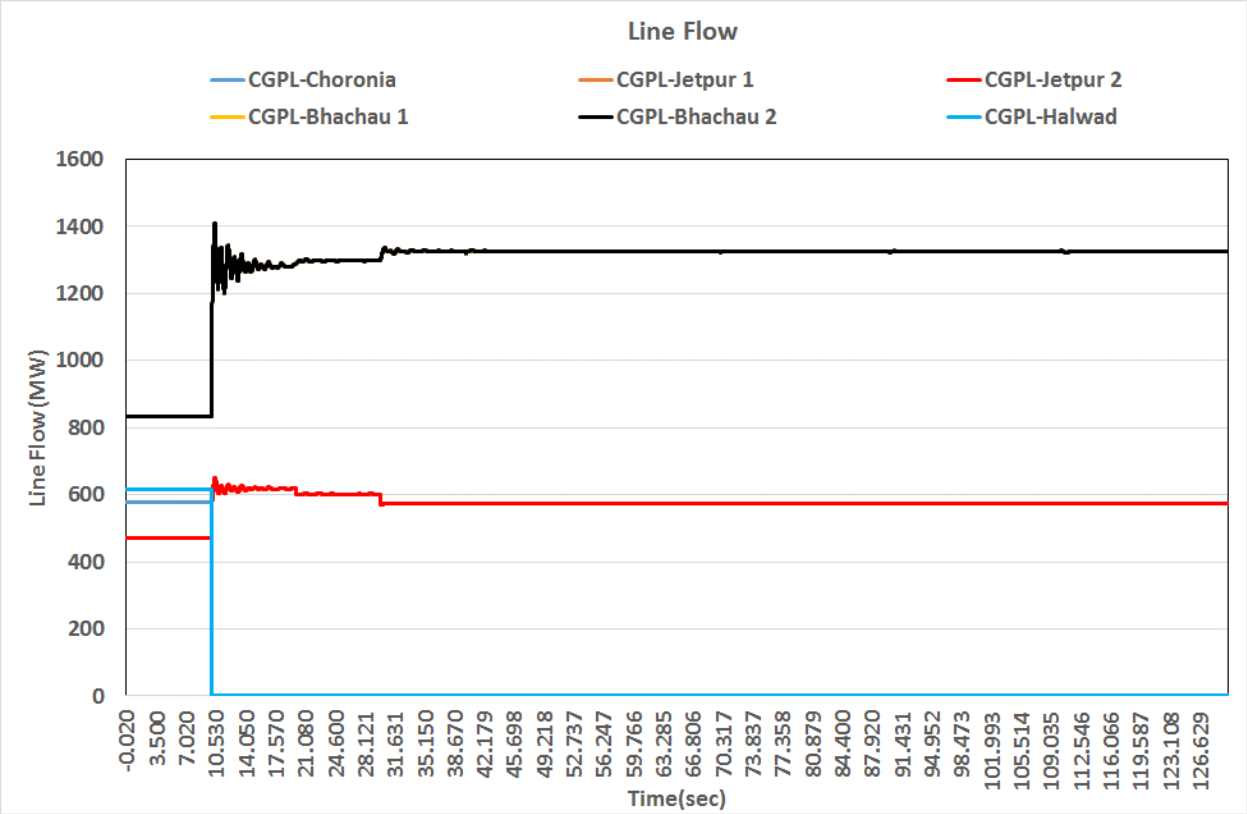

CGPl-Jetpur
0.300
0.200
0.100
Zone 3
0.000
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
-0.100
-0.200
-0.300
R

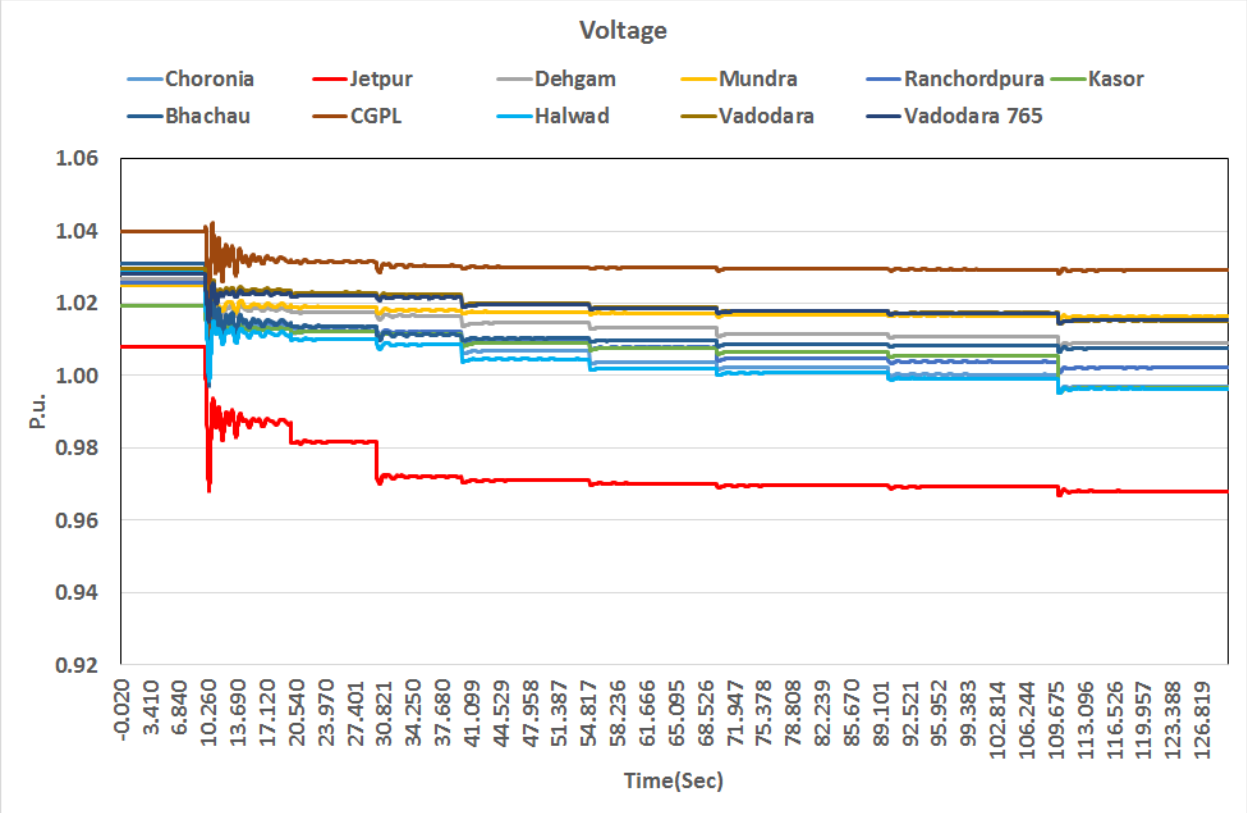

Bhachau-CGPL
0.200
0.150
0.100
0.050
Zone 3
0.000
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
-0.050
-0.100
-0.150
-0.200
R

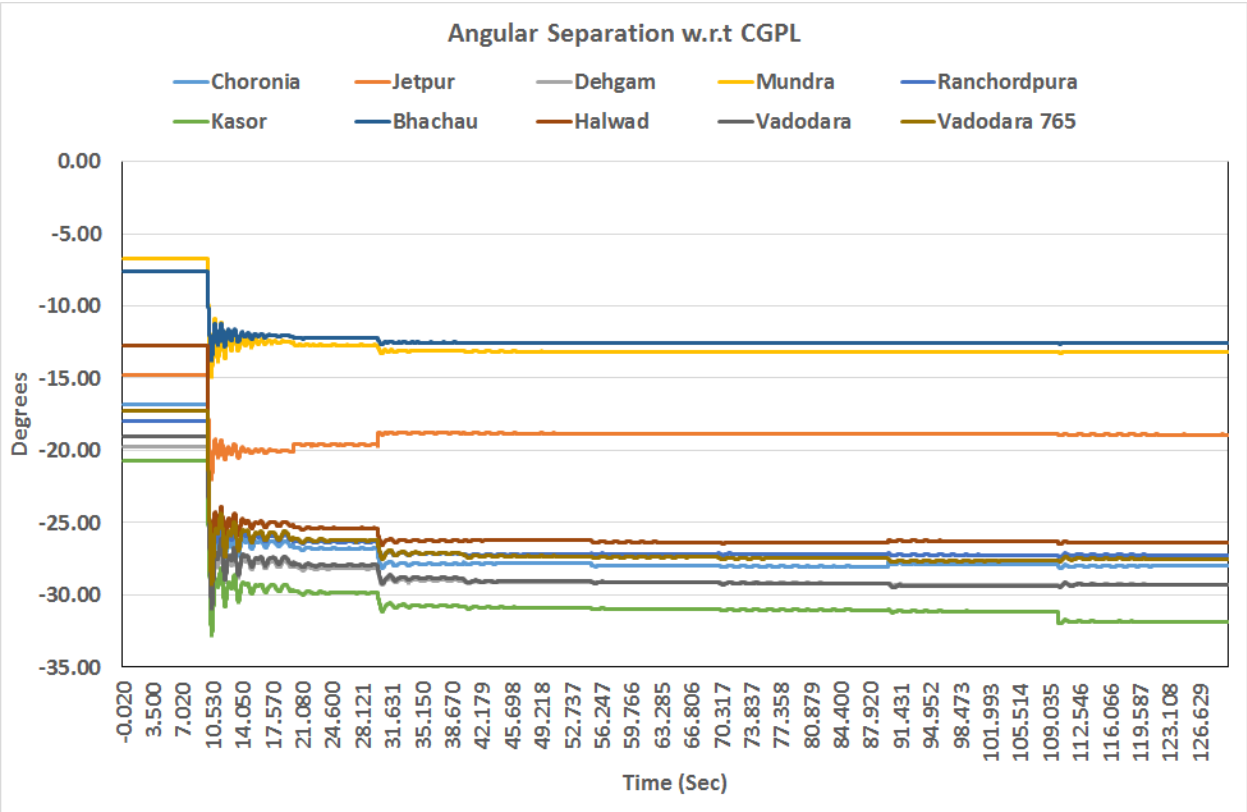

Jetpur-CGPL
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R
Zone 3

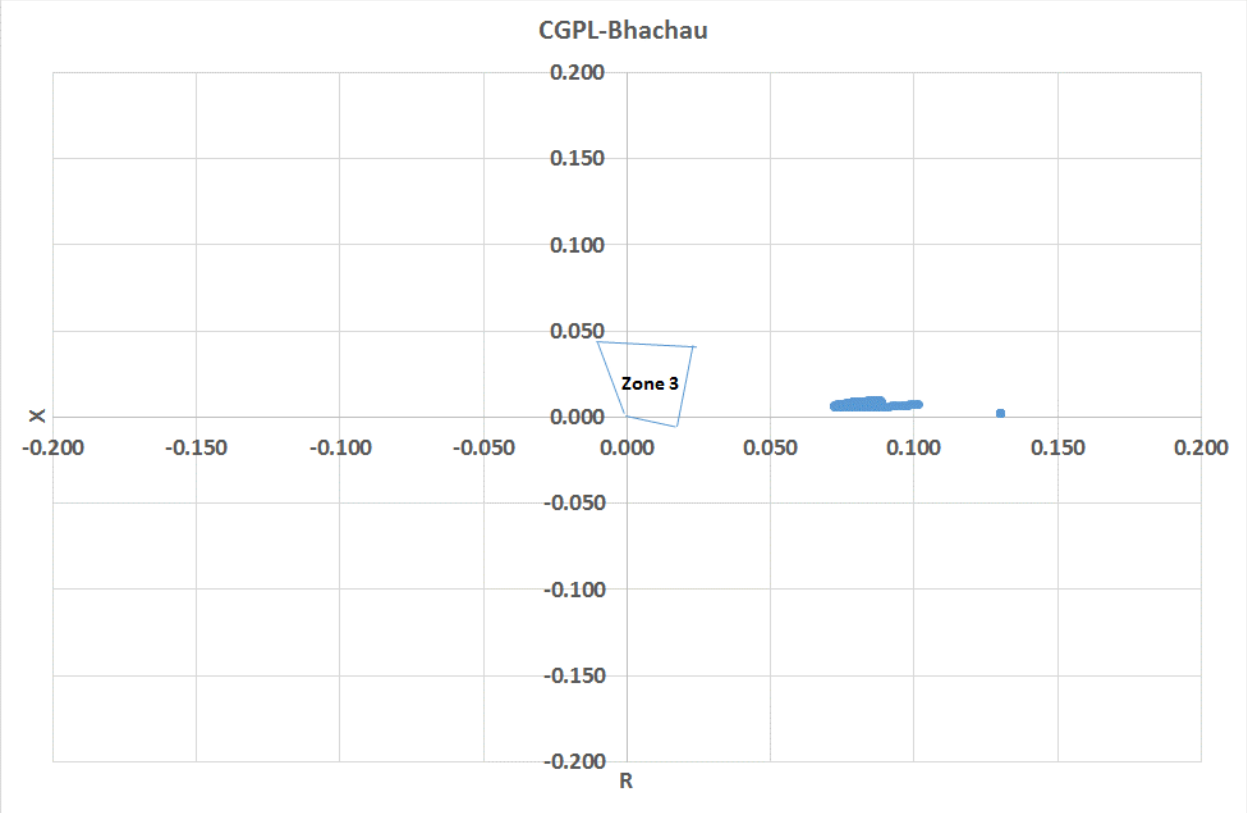
6. **Full generation at CGPL and tripping of 400 kV CGPL-Choronia D/C (10 sec) followed by opening of**
    a. **400 kV Jetpur-Amreli one circuit (20)**
    b. **400 kV Amreli-Choronia (30)**
    c. **400 kV Choronia-Asoj one circuit (40)**
    d. **400 kV Choronia-Ranchodrpura one circuit (55)**
    e. **400 kV Ranchodrpura- Zerda one circuit (70)**
    f. **400 kV Choronia-Kosamba one circuit (90)**
    g. **400 kV Rajgarh -Kasor one circuit (110)**

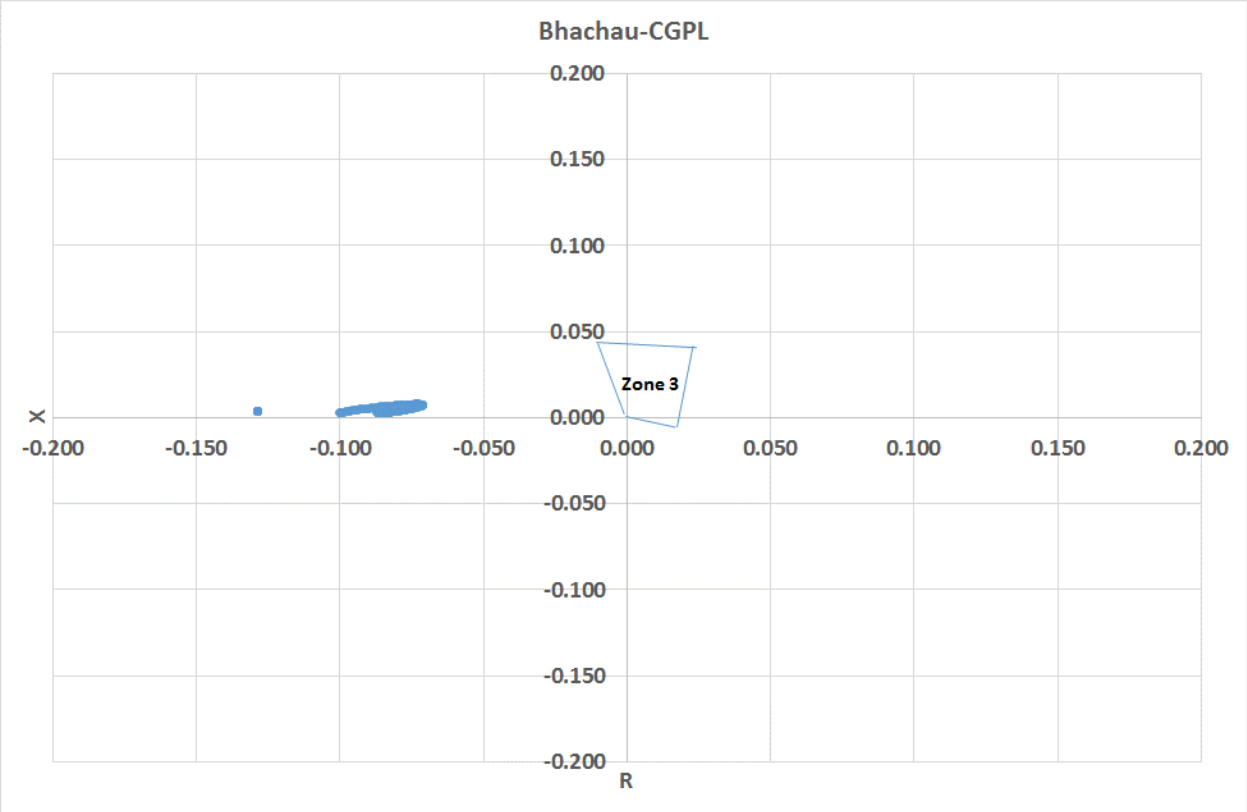
without any SPS Action

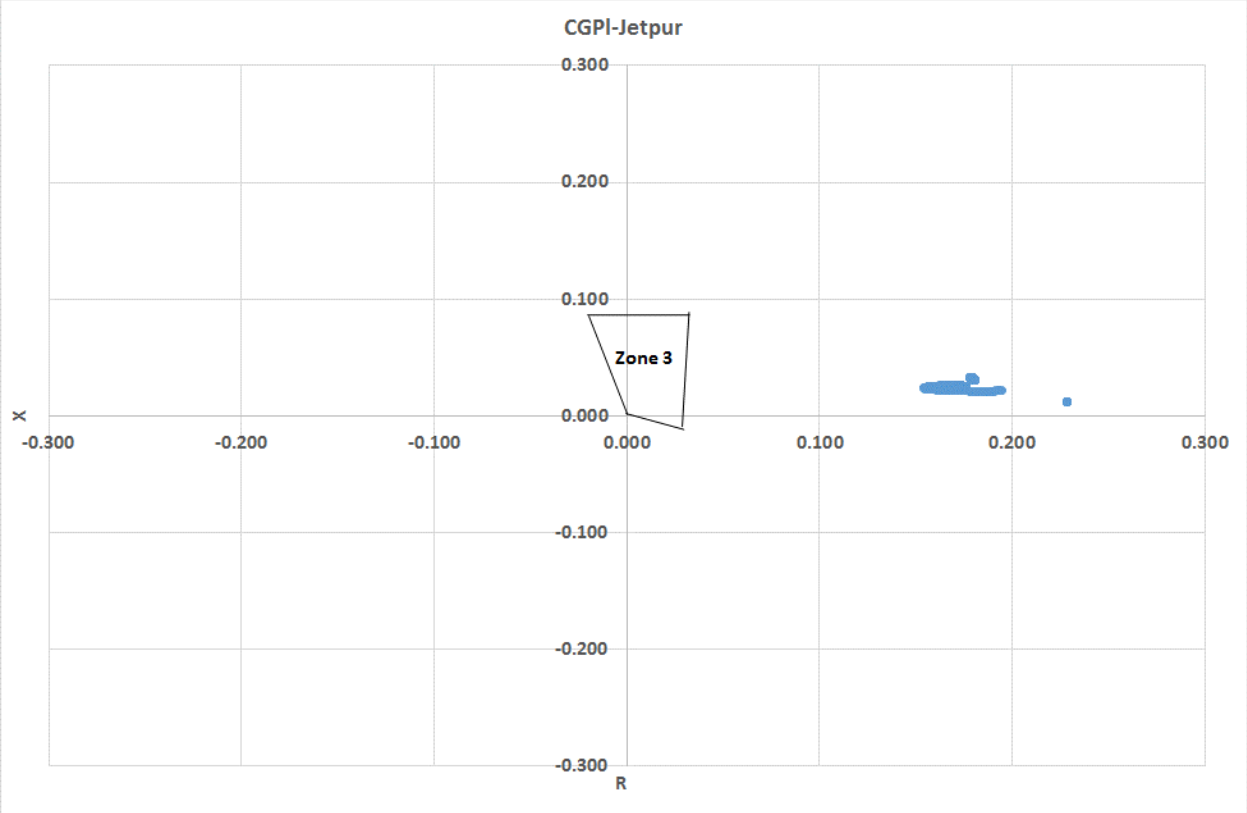


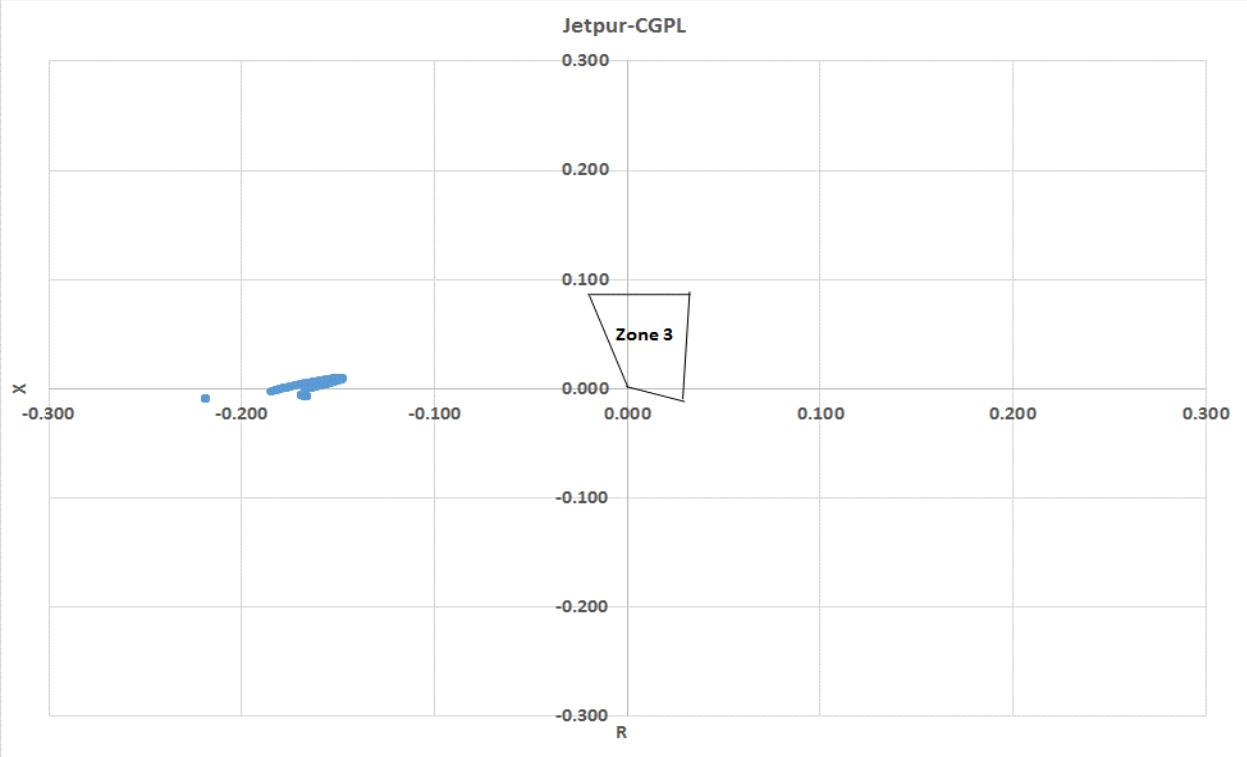

Voltage
Choronia
Jetpur
Dehgam
Mundra
Ranchordpura
Kasor
Bhachau
CGPL
Halwad
Vadodara
Vadodara 765
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
P.u.
-0.020
3.410
6.840
10.260
13.690
17.120
20.540
23.970
27.401
30.821
34.250
37.680
41.099
44.529
47.958
51.387
54.817
58.236
61.666
65.095
68.526
71.947
75.378
78.808
82.239
85.670
89.101
92.521
95.952
99.383
102.814
106.244
109.675
113.096
116.526
119.957
123.388
126.819
Time(Sec)


Angular Separation w.r.t CGPL
Choronia
Jetpur
Dehgam
Mundra
Ranchordpura
Kasor
Bhachau
Halwad
Vadodara
Vadodara 765
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
Degrees
-0.020
3.500
7.020
10.530
14.050
17.570
21.080
24.600
28.121
31.631
35.150
38.670
42.179
45.698
49.218
52.737
56.247
59.766
63.285
66.806
70.317
73.837
77.358
80.879
84.400
87.920
91.431
94.952
98.473
101.993
105.514
109.035
112.546
116.066
119.587
123.108
126.629
Time (Sec)


CGPL-Bhachau
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
R
Zone 3


Bhachau-CGPL
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
X
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
R
Zone 3


CGPl-Jetpur
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
Zone 3
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R


Jetpur-CGPL
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
Zone 3
X
-0.300
-0.200
-0.100
0.000
0.100
0.200
0.300
R

Observation

- **As the Present scenario is the condition where all lines are in service yet under list of contingency without SPS action system is quite vulnerable in terms of Angular stability, Voltage stability, Small signal stability and Relay operation on power swing.**
- **Under the condition of any additional 400 kV line outages from Choronia/Jetpur/Ranchodpura/Bhachau the CGPL becomes more vulnerable from the aspect of security. So, under full generation no line outage from 400 kV remote end substation should not be allowed.**
- **Further, if the tripping is associated with the fault the chances of relay entering swing zone is quite more as observed in the case study.**
- **It can be observed from last case that opening of several line on High voltage and higher generation at CGPL causes relay vulnerability of 400 kV CGPL-Bhachau.**

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
पश्चिम क्षेत्रीय विद्युत समिति
Western Regional Power Committee
एफ -3, एमआयडीसी क्षेत्र, अंधेरी (पूर्व), मुंबई - 400 093
F-3, MIDC Area, Andheri (East),
Mumbai - 400 093
दूरभाष Phone: 022- 28209506, 28200195; 28200196; फैक्स Fax : 022 – 28370193
Website : www.wrpc.gov.in E-mail : **prc-wrpc@nic.in** **protectionwrpc@gmail.com**

आई ए भो : 9001-2008
IS/ISO: 9001-2008

No. : WRPC/Protection/Meetings/2017 1327-3 **Date:** 23 अक्टूबर OCT 2017

To,

1. Smt Pushpa Sheshadri, Assit. GM, WRLDC Mumbai.
2. ED, PGCIL, Vadodara.
3. Shri Janak Pancholi (officer on special duty), GETCO CO, Vadodara.
4. Peeyush Sharma, Superintending Engineer(Protection), PAC Unit Airoli.
5. Shri Uday Trivedi, AVP, M/s APL.
6. Shri G.T. Jawale, M/s TATA Power.
7. Shri Alok Uppal, M/s CGPL.

Subject: Minutes of 2nd meeting of the Expert Group to study the CGPL disturbance of 13th July 2016, held on 10.10.2017 at WRPC Mumbai.

Sir,

Please find enclosed herewith minutes of 2nd meeting of the Expert Group (which was formed as per the decision taken in the 34th WRPC) to study the CGPL disturbance of 13th July 2016, held on 10.10.2017 at WRPC Mumbai, for further needful action please.

Yours' faithfully

Encl. : As above

J.K.Rathod,
SE (Protection) 23/10/17

Record notes of the meeting & recommendation of the Expert Group on CGPL disturbance of 13th July, 2016 held on 10.10.2017 at WRPC Mumbai.

1. The 2nd meeting of the Expert Group (which was formed as per the decision taken in the 34th WRPC) to study the CGPL disturbance of 13th July 2016 and come out with recommendation, was held on 10.10.2017 at WRPC Mumbai. The list of participants is enclosed at **Annexure-1**.
2. In the first meeting of the Expert Group held on 23.8.17, it was recommended that WRLDC may carry out studies, for various scenarios and the CGPL event occurred on 13th July 2016. Based on this decision, WRLDC representative stated that they have carried out the dynamic simulation study in PSS/E (Siemens) software by creating 3 phase bolted fault. However, it is noted that during the disturbance on 13th July 2016, actually the fault was Y-Ph to Earth initially and later on converted to 3-Ph fault.
3. Base Case similar to the CGPL event on 13th July 2016 was simulated (with one Unit of CGPL out) and the results were compared and found to be matching. The recorded parameters from simulation and DR of the actual event were also compared and found to be matching.
    - The schematic diagram of CGPL and nearby area is enclosed at **Annexure 2.**
    - The plots for base case which is the simulation of actual event based on sequence of event is attached as **Annexure 3.**
    - The parameter comparison report for the actual event and its simulation is attached as **Annexure 4**.
4. Based on the recommendation of the Expert Group in the first meeting on 23rd August 2017 and the subsequent email exchanges, total 15 simulation case studies were performed in order to check the various scenarios and finding the root cause of the event. The simulation case study results along with various plots are attached as **Annexure 5.**
5. It was found from the study result carried out by WRLDC, that the major reason for the unstable system condition for CGPL is the three phase fault followed by the tripping of 400 kV Bhachau-Ranchodpura circuits at 300 ms in Zone 2 from Ranchodpura end. It is also observed that if these lines would not have tripped in Zone 2 and if the fault at

Versana is cleared within 370 ms then the system is found to be stable in simulation study.

6. **During this second meeting of the Expert Group (on 10th October 2017), all the case studies and simulation were discussed in details. Based on the study, it is observed that if the 3-Ph fault current contribution from CGPL end for lines emanating from CGPL is around 7-8kA and if any of 400kV Bacchau-Ranchodpura D/C and 400kV CGPL-Bacchau-1 lines senses the fault in Zone 2, from Ranchodpura and CGPL end respectively and if it is persistent for 300 ms, then it is desirable to trip one unit out of the four(4) running units of CGPL.**

   It was noted that during the actual disturbance the fault current recorded for the 400 kV CGPL-Bhachau 2 was around 3.5 kA and is found to be equal to the fault current observed in the simulation study.

7. The Expert group noted that based on the recommendation of the report on CGPL event circulated vide letter dtd. 13.10.2016 submitted by the earlier group, relay coordination of the all the elements nearby CGPL complex has been carried out as decided in the PCM, in order to avoid any unwanted/undesired tripping. Therefore there is no necessity to review the relay setting coordination.

8. **The Expert Group in the first meeting has recommended that line differential protection as Main 1 protection for 400 kV Bhachau-Versana 1 & 2 (short lines having line length 10km/ckt) should be provided.**

   PGCIL informed that these circuits do not have OPGW. There is need of laying of optical fibre. The Expert Group suggested that the OPGW may be laid down to establish fibre optic communication between these two substations which will help in implementation of line differential protection.

9. In the first meeting of the Expert Group, it was decided to perform the simulation for the updated network case with LILO of 400 kV CGPL-Choronia and 400 kV CGPL-Halwad at Bhachau substation. Based on the above, 45 simulations case studies were carried out and as per the Transmission Planning criteria, the network was found to be stable for a fault of 100 ms. However, it was further observed from the study that the system is not stable for any three phase faults at CGPL/Bhachau, if the fault clearance time is more than 150 ms. The detailed study report of the CGPL with the future network is attached as **Annexure 6**.

10. CGPL opined that based on study the above LILO (i.e. LILO of 400 kV CGPL-Choronia and 400 kV CGPL-Halwad at Bhachau substation) is not helping the transient stability at CGPL generating station during delayed fault clearance.

    WRLDC opined that if CGPL is having any apprehension about this study and to implement the recommendation as suggested, they may approach external agency for further studies. However, it was strongly opined by the Expert group that it should be done without much delay and the studies to be completed on priority and suggest preventive measures.

11. The above studies suggest that the fault for full network be cleared within 100 ms. CGPL representative stated that this could be implemented if line differential protection on all the lines emanating from CGPL is installed. However, it is noted that all the lines emanating from CGPL are more than 50 km and therefore do not fall in the category of short transmission lines in general. It was also noted that transmission lines having length more than 100kms have technical difficulties in implementing line differential protection.

12. With this, the Expert group members thanked all the Members and especially WRLDC for carrying out the extensive study based on various inputs given by the members.

-------X--------

List of Participants for special meeting on CGPL Power swing studies held on 10.10.2017 at WRPC, Mumbai

	Name	Designation	Organisation	e-mail	Mobile No.	signature
1	Ratnesh Kumar Yadav	AD-I	WRPC	RatneshKumar[illegible]@gmail.com	9969948089	
2	Vidya Sagar Paladugu	AD-I	WRPC	vidya.paladugu@gmail.com	9930940630	
3	Joydeep Bhaumik	DGM	NTPC-VSTPS	jbhaumik@ntpc.co.in	7490224800	
4	Pradeep Kumar Banodiya	Sr. Engg.	WRLDC-POSOCO	psanodiya@posoco.in	8452045338	
5	चंदन कुमार	एच अधिशेषी	WRLDC-Posoco	chandan@posoco.in	9869251460	
6	Vibhor Mangal	Sr Mgr	NTPC-Kawas	vibhormangal@ntpc.co.in	9426445636	
7	S. A. Patel.	SE (Testing)	GETCO	acetel.getco@gebmail.com	9925211041	
8	Peeyush. S. Sharma	SE (Protection)	MSETCL	seprotection@mahatransco.in	9769213865	
9	P. D Lone	WRPC		prc-wrpc@nic.in	9867622823	
10	J. K. RATHOD	SE(P), WRPC		"	"	
11	A. Balan	MS	WRPC	ms-wrpc@nic.in	9483540528	
12	Abhimanyu Gartia	GM	WRLDC	agartia@POSOCO.in	9869088058	
13	Ankit Vaith	Manager	POWERGRID	ankit_vaith@powergridindia.com	9409305725	
14	V R Shirchande	Chief	Tata Power	vrshirchande@tatapower.com	9223330578	
15	Girish Jawale	Team Lead	Tata Power	gtjawale@tatapower.com	9223311419	
16	Alok Uppal	Head(EM)	CGPL	uppalalok@tatapower.com	9099006436	
17	Pushpa-S	Asst. GM	WRLDC	pushpa@posoco.in	9869404482	
18	Srinivas Chitturi	Sr. Engr	WRLDC	Srinivasch@posoco.in	9869416078	
	Ashish Mehto	Manager	NTPC Vindhyachal	ashishkumarmehto@ntpc.co.in	9424141822	

SLD of the CGPL and Nearby area.

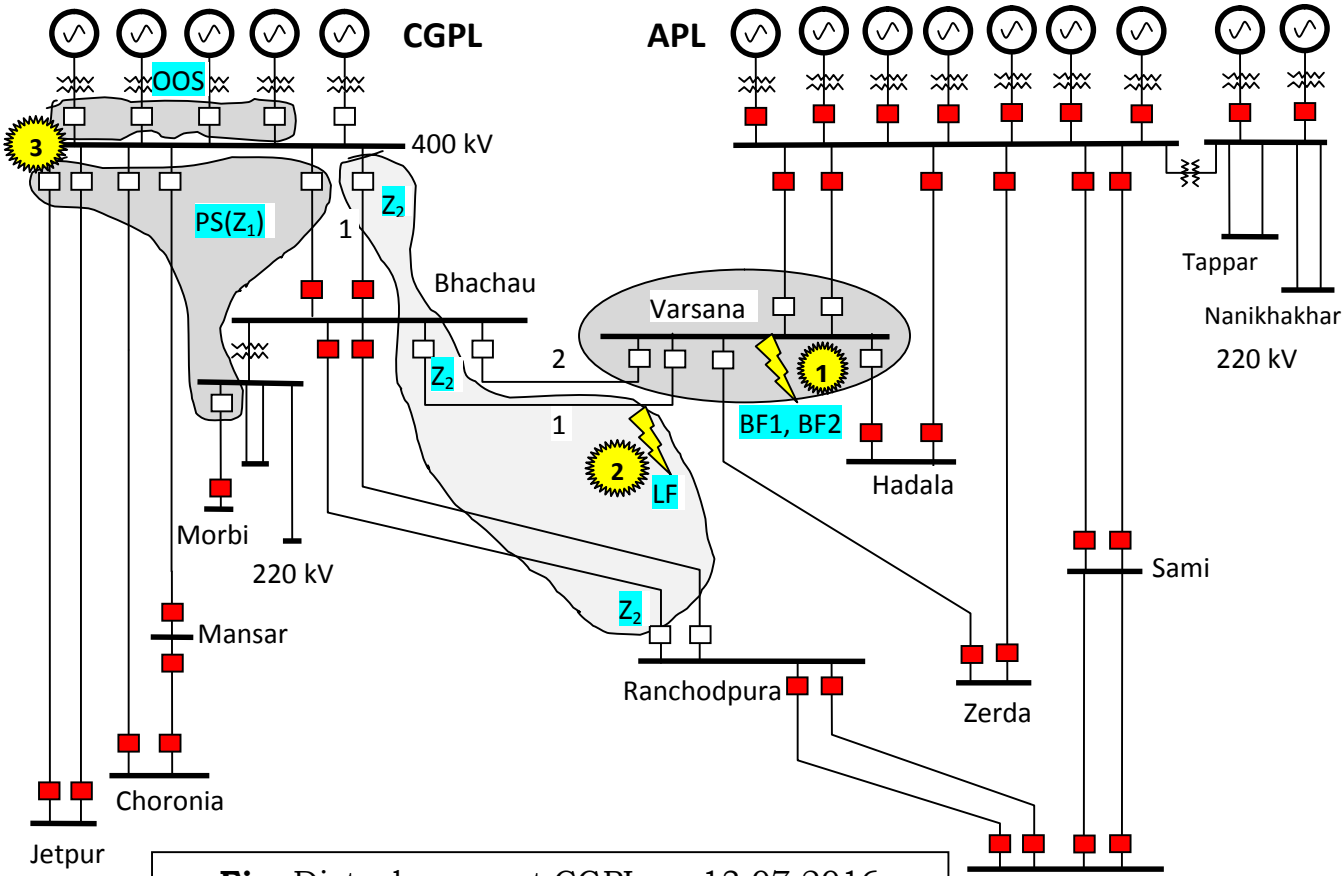


Fig: Disturbances at CGPL on 13.07.2016

Simulation Plots for Base case.

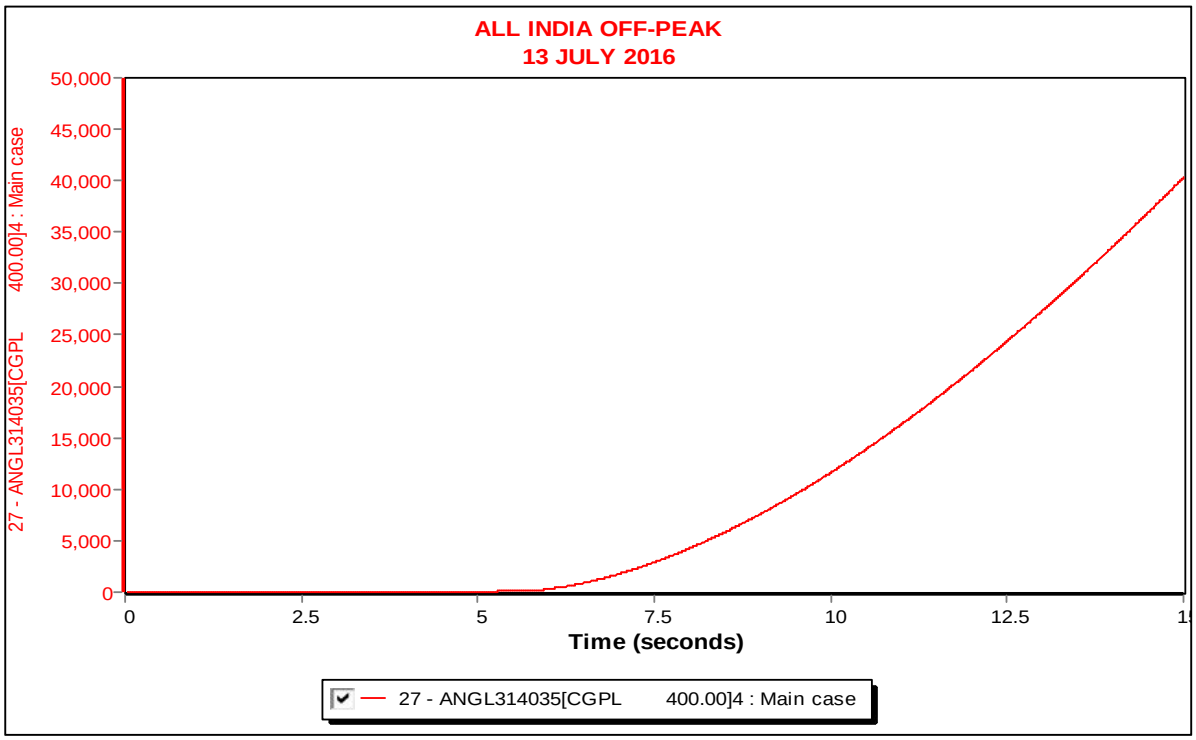


Fig: CGPL Unit 1 Machine Angle

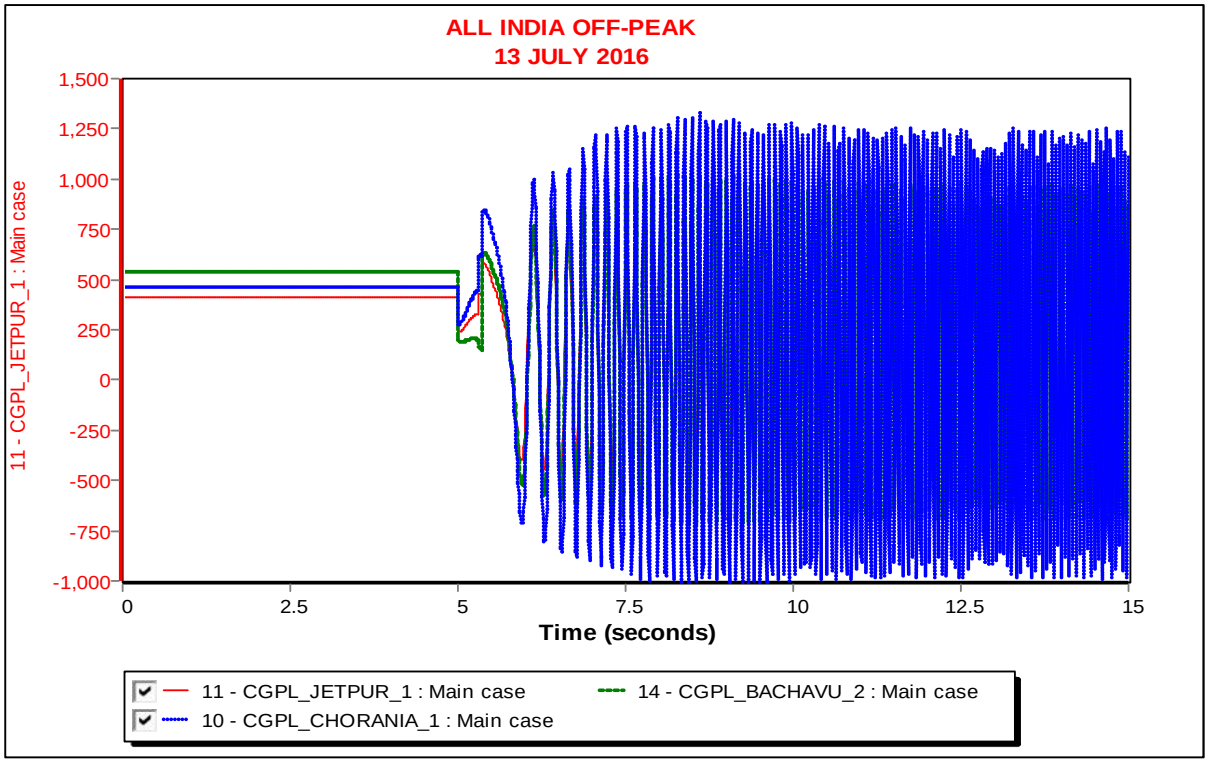


Fig: Power flow on 400 kV lines connected to CGPL Mundra

Annexure: 4

Comparison of Base Case Plots with actual recording from DR files

Based on the discussion of PCM Forum, the Voltage and Active and reactive power of 400 kV CGPL-Bhachau 2 obtained from simulation (which was done based on sequence of event) and obtained from the CGPL Disturbance recorder file during the event. The parameters obtained from simulation and actual event were found to be similar and matching.

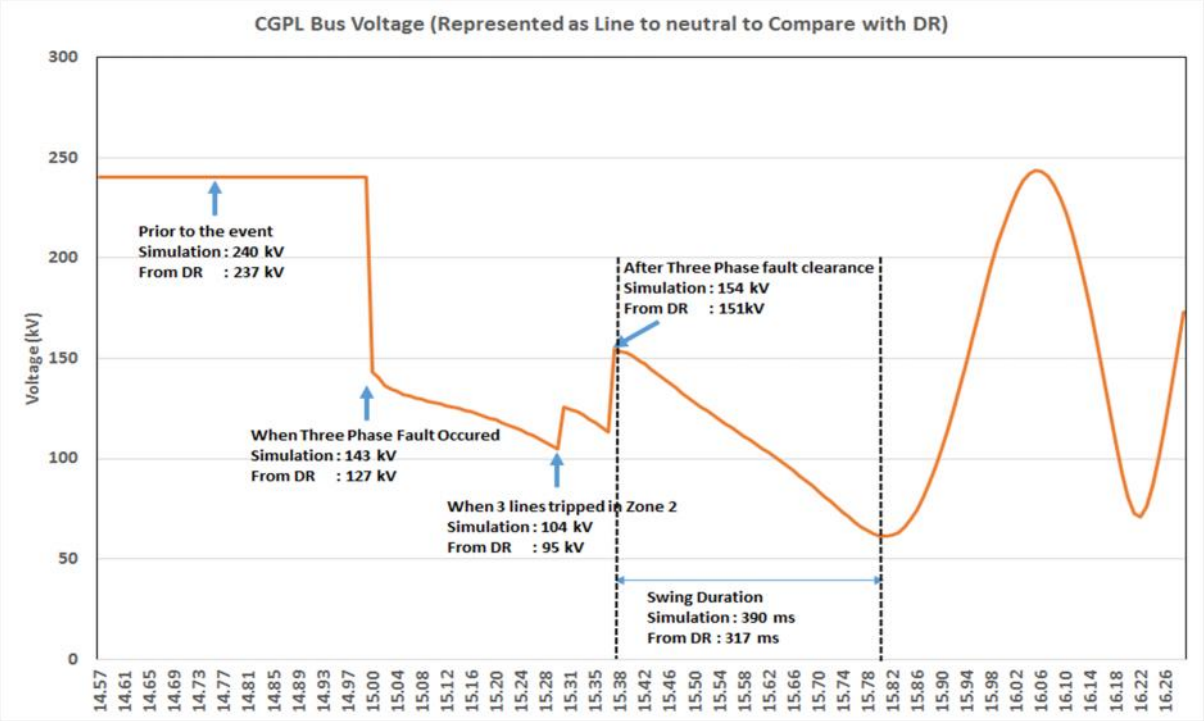


Fig: CGPL Voltage from Simulation

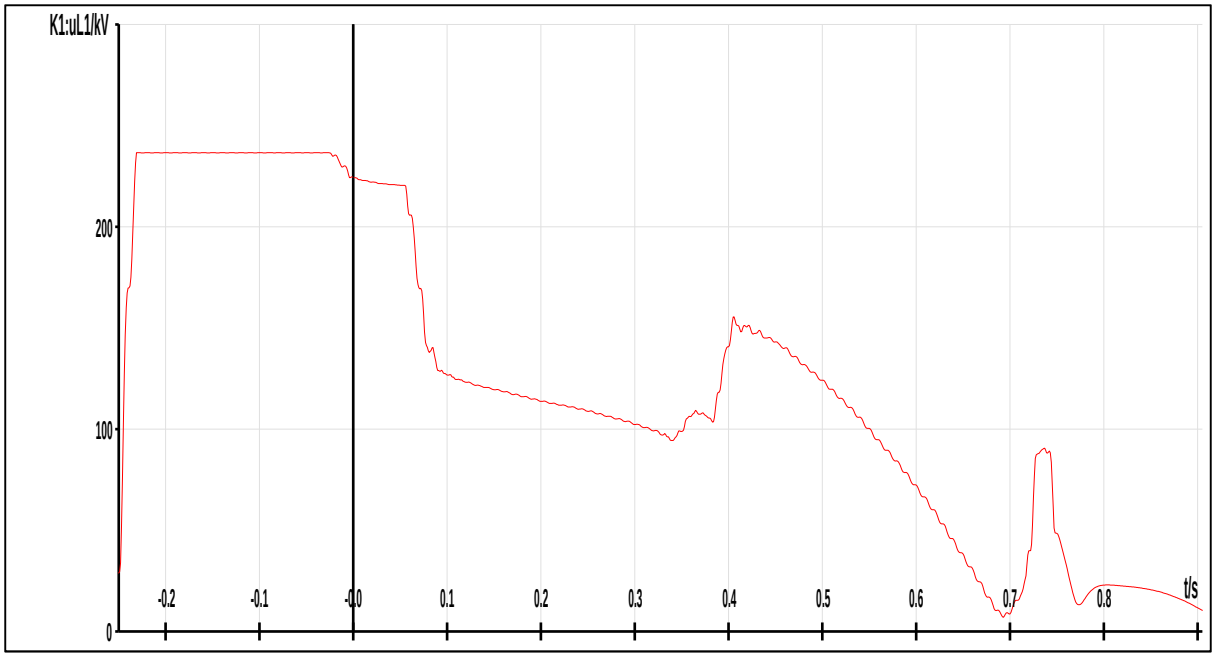


Fig: CGPL Voltage from DR of 400 kV CGPL-Bhachau from CGPL end.

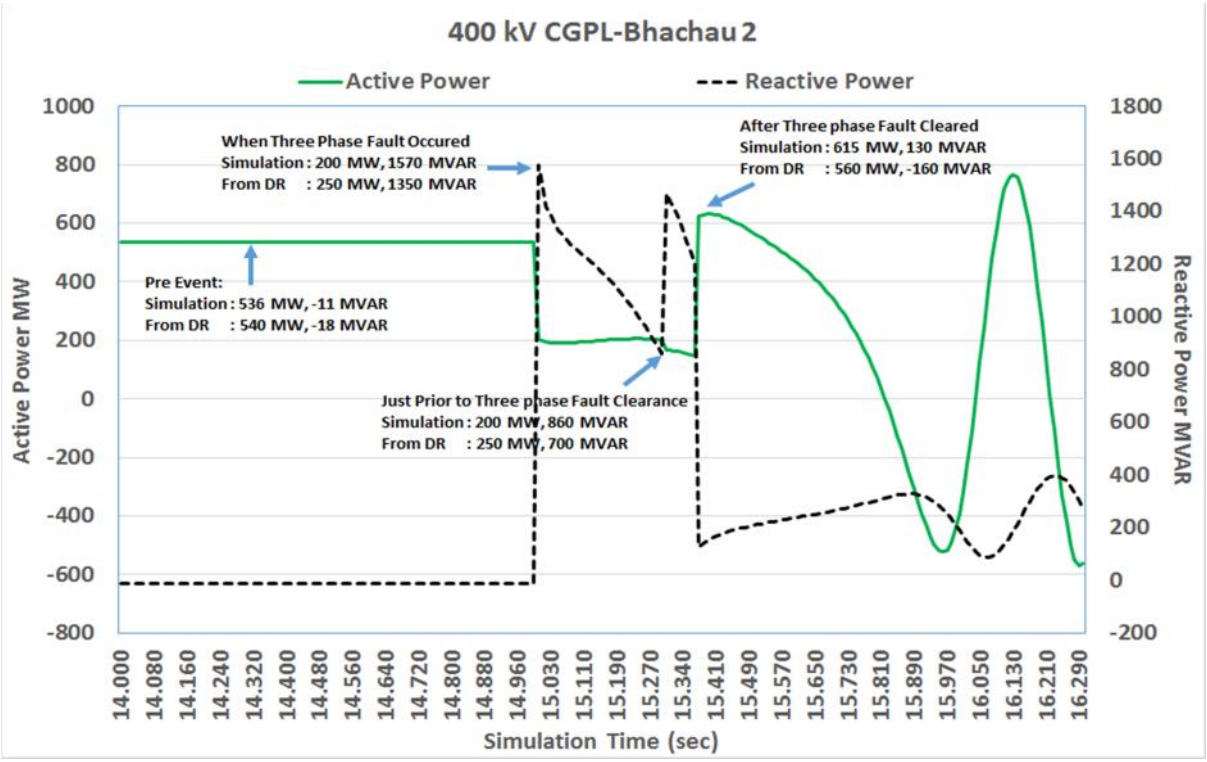


Fig: 400 kV CGPL-Bhachau 2 Active and Reactive Power from Simulation compared with actual recording during the event from the DR at different interval

Apart from these, current on various circuits during the various instant in the course of event were compared from the simulation and actual event Disturbance recorder file and found to matching as shown in the given below table 1.

Table 1: Comparison of Current from Simulation and as recorded during event from the Disturbance recorder

Current Comparison	Prior to event (kA)		At the start of 3 Phase Fault at Varsana (kA)		After 300 ms Three Phase fault at Varsana (kA)	
Circuit Name	Simulation	Actual	Simulation	Actual	Simulation	Actual
Bhachau-Versana	0.008	0.012	11.8	12.0	9.02	8.88
CGPL-Bhachau	0.745	0.790	3.45	3.30	2.81	2.50
CGPL-Jetpur	0.574	NA	0.66	0.67	1.03	0.98
CGPL-Halwad	0.705	NA	0.848	NA	1.51	1.64
CGPL-Choronia	0.647	NA	0.842	NA	1.43	1.35
Bhachau-Ranchodpura	0.541	0.51	1.77	1.83	1.79	1.77

***NA: Not Available as DR do not contain information for that interval.**

Study report for Submission to the Expert Group on CGPL with Future Network and Full Generation

In order to study the impact of future network modification of network near CGPL complex along with full generation of CGPL, the base case was setup with 400 kV CGPL-Mansar (Halwad) and CGPL-Choronia LILO at Bhachau substation along with Full generation at CGPL and APL complex.

After that an extensive study of N-1, N-1-1 and N-2 has been studied for the CGPL complex. Along with this, various N-1 case with different durations of faults has also been studied. So, a total of 45 case studies has been done and the summary of the case studies along with plots are given in the end of this report. The major observation from these case studies are found to be:

1. System is stable for N-1, N-1-1 and N-2 combination of line tripping without any fault.
2. System is also stable for N-1 cases for 100 ms duration 3 phase fault.
3. System is not stable for a N-1 case with a three phase fault of more than 150 ms duration at CGPL/Bhachau substation.
4. System is stable for N-1 and N-1-1 of 400 kV Bhachau-Versana D/C however swings are large. This may be due to the reason that these lines tripping increases the electrical distances between CGPL and APL generating complex to a large extent.

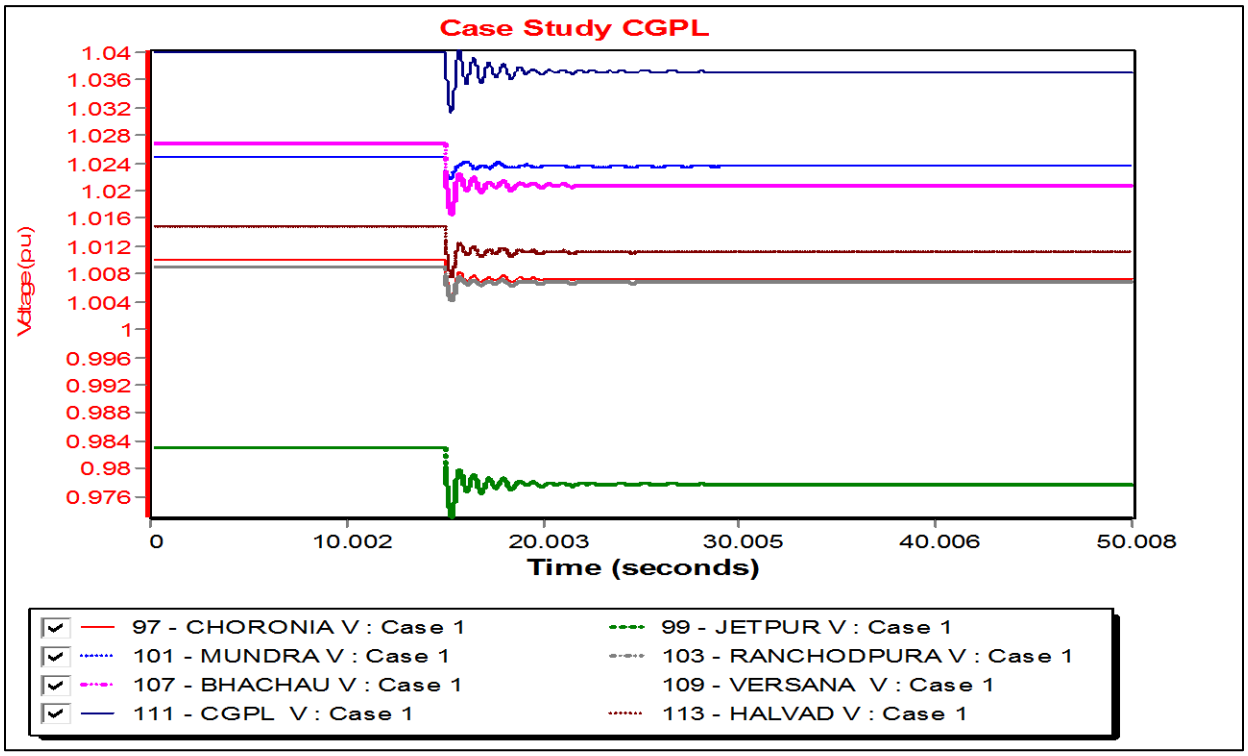
Table 1 : Summary of case studies

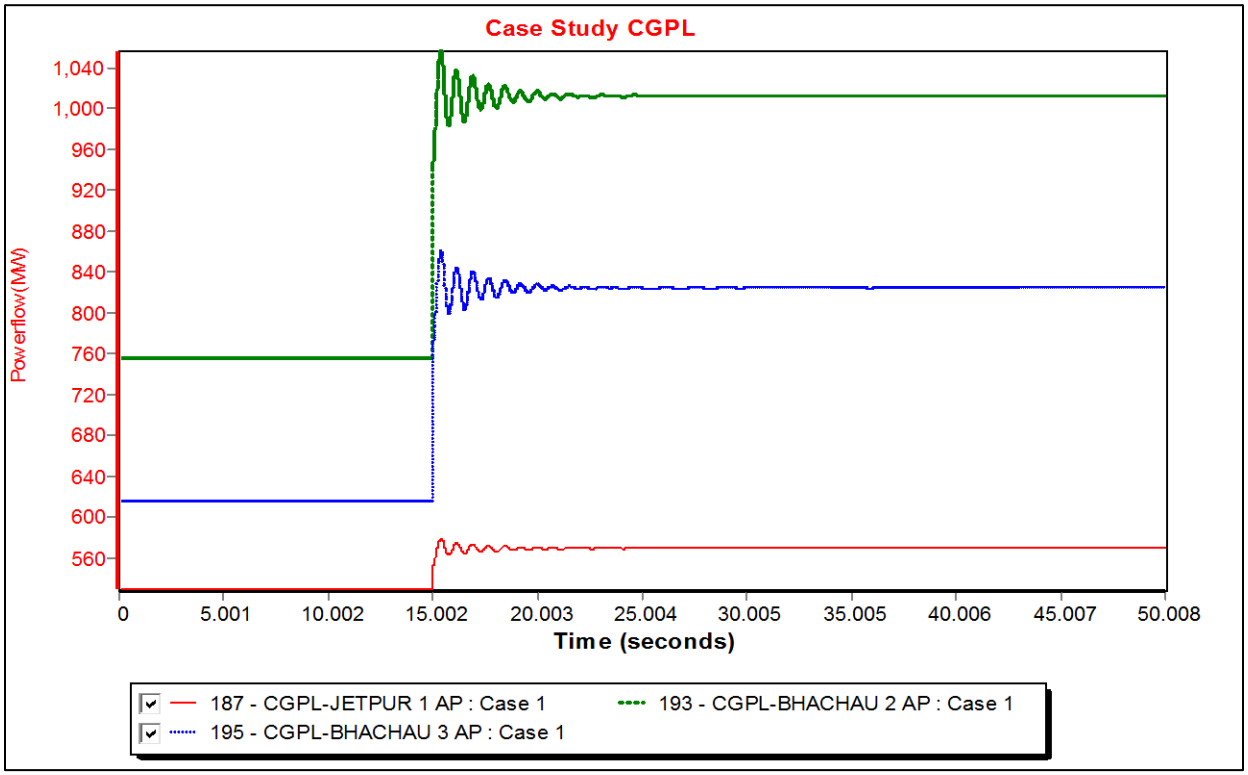
Case Study	Name	Result
Case 1	N-1 of CGPL-Bhachau 1	Stable
Case 2	N-1 of CGPL-Bhachau 3	Stable
Case 3	N-1 of CGPL-Jetpur 1	Stable
Case 4	N-1 of Bhachau-Ranchodpura 1	Stable
Case 5	Case 1 + N-1-1 of CGPL Bhachau 2 (After 5 second)	Stable
Case 6	Case 1 + N-2 of CGPL-Bhachau 2	Stable
Case 7	Case 1 + N-1-1 of CGPL-Jetpur 1 (After 5 second)	Stable
Case 8	Case 1 + N-2 of CGPL-Jetpur 1	Stable
Case 9	Case 3 + N-1-1 of CGPL-Jetpur 2 (After 5 second)	Stable
Case 10	Case 3 + N-2 of CGPL-Jetpur 2	Stable
Case 11	N-1 of Bhachau-Ranchodpura 1 + N-1 -1 of Bhachau-Ranchodpura 2 (After 5 second)	Stable
Case 12	N-1 of Bhachau-Ranchodpura 1 + N-1 -1 of Bhachau-Versana 1 (After 5 second)	Stable
Case 13	N-1 of Bhachau-Ranchodpura 1 + N-1 -1 of Bhachau-Choronia (After 5 second)	Stable
Case 14	N-1 of Bhachau-Choronia 1 + N-1 -1 of Bhachau-Halwad (After 5 second)	Stable
Case 15	N-1 of Bhachau-Versana 1 + N-1 -1 of Bhachau-Versana 2 (After 5 second)	Stable
Case 16	N-1 of Bhachau-Ranchodpura 1 + N-2 of Bhachau-Ranchodpura 2	Stable
Case 17	N-1 of Bhachau-Versana 1 + N-2 of Bhachau-Versana 2	Stable
Case 18	N-1 of Bhachau-Choronia 1 + N-2 of Bhachau-Halwad	Stable
Fault 1	N-1 of CGPL-Bhachau 1 with 100 ms Fault at CGPL	Stable
Fault 2	N-1 of CGPL-Bhachau 1 with 100 ms Fault at Bhachau	Stable
Fault 3	N-1 of CGPL-Jetpur 1 with 100 ms Fault at CGPL	Stable
Fault 4	N-1 of CGPL-Bhachau 1 with 150 ms Fault at CGPL	Stable
Fault 5	N-1 of CGPL-Bhachau 1 with 200 ms Fault at CGPL	Unstable
Fault 6	N-1 of CGPL-Jetpur 1 with 150 ms Fault at CGPL	Stable
Fault 7	N-1 of CGPL-Jetpur 1 with 200 ms Fault at CGPL	Unstable
Fault 8	N-1 of CGPL-Bhachau 1 with 200 ms Fault at Bhachau	Unstable
Fault 9	N-1 of CGPL-Bhachau 1 with 150 ms Fault at Bhachau	Stable
Fault 10	N-1 of CGPL-Jetpur 1 with 150 ms Fault at Jetpur	Stable
Fault 11	N-1 of CGPL-Jetpur 1 with 200 ms Fault at Jetpur	Stable
Fault 12	N-1 of CGPL-Jetpur 1 with 250 ms Fault at Jetpur	Stable
Fault 13	N-1 of CGPL-Jetpur 1 with 300 ms Fault at Jetpur	Stable
Fault 14	N-1 of CGPL-Jetpur 1 with 400 ms Fault at Jetpur	Stable
Fault 15	N-1 of CGPL-Jetpur 1 with 500 ms Fault at Jetpur	Stable
Fault 16	N-1 of CGPL-Jetpur 1 with 600 ms Fault at Jetpur	Stable

Fault 17	N-1 of CGPL-Jetpur 1 with 800 ms Fault at Jetpur	Stable
Fault 18	N-1 of CGPL-Jetpur 1 with 1000 ms Fault at Jetpur	Stable
Fault 19	N-1 of CGPL-Jetpur 1 with 1500 ms Fault at Jetpur	Unstable
Fault 20	N-1 of Bhachau-Ranchodpura 1 with 100 ms Fault at Bhachau end	Stable
Fault 21	N-1 of Bhachau-Ranchodpura 1 with 200 ms Fault at Bhachau end	Unstable
Fault 22	N-1 of Bhachau-Halvad with 100 ms Fault at Bhachau end	Stable
Fault 23	N-1 of Bhachau-Halvad with 200 ms Fault at Bhachau end	Unstable
Fault 24	N-1 of Bhachau-Choronia with 100 ms Fault at Bhachau end	Stable
Fault 25	N-1 of Bhachau-Choronia with 200 ms Fault at Bhachau end	Unstable
Fault 26	N-1 of Bhachau-Versana 1 with 100 ms Fault at Bhachau end	Stable
Fault 27	N-1 of Bhachau-Versana 1 with 200 ms Fault at Bhachau end	Unstable

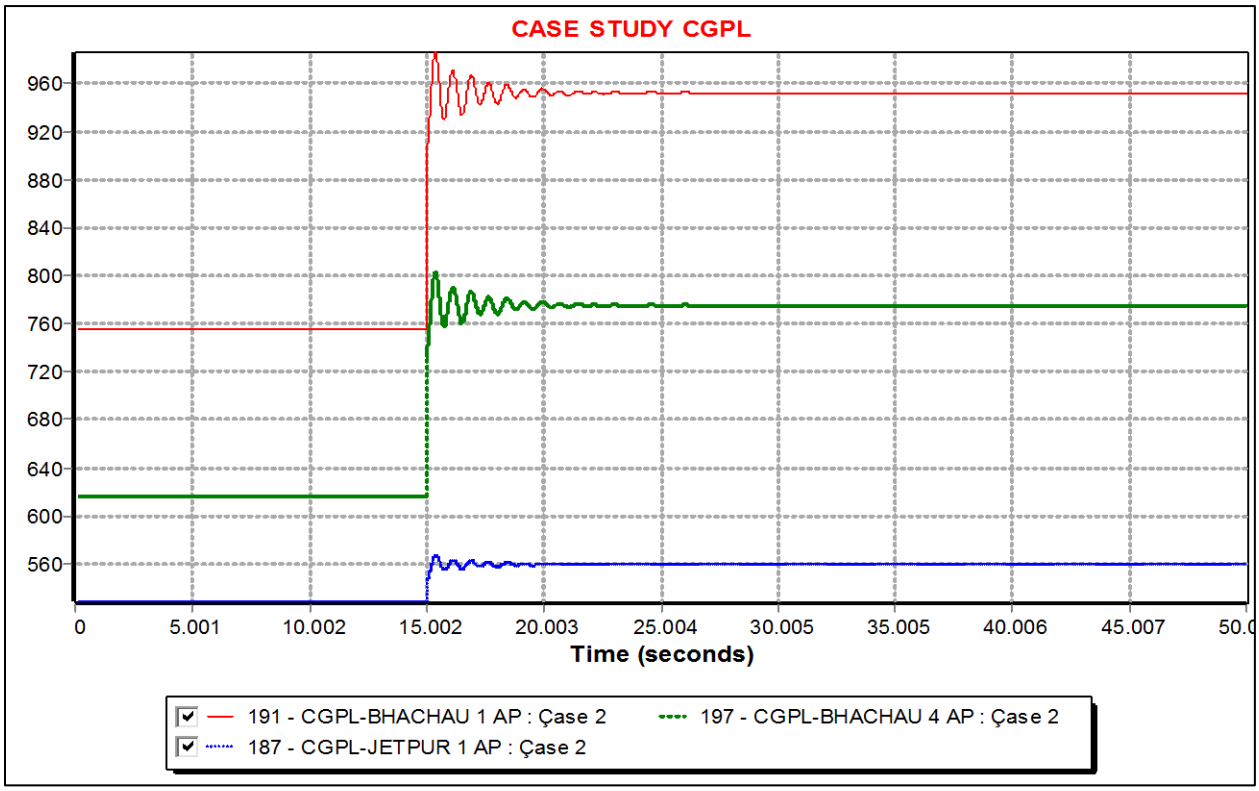
Simulation plots

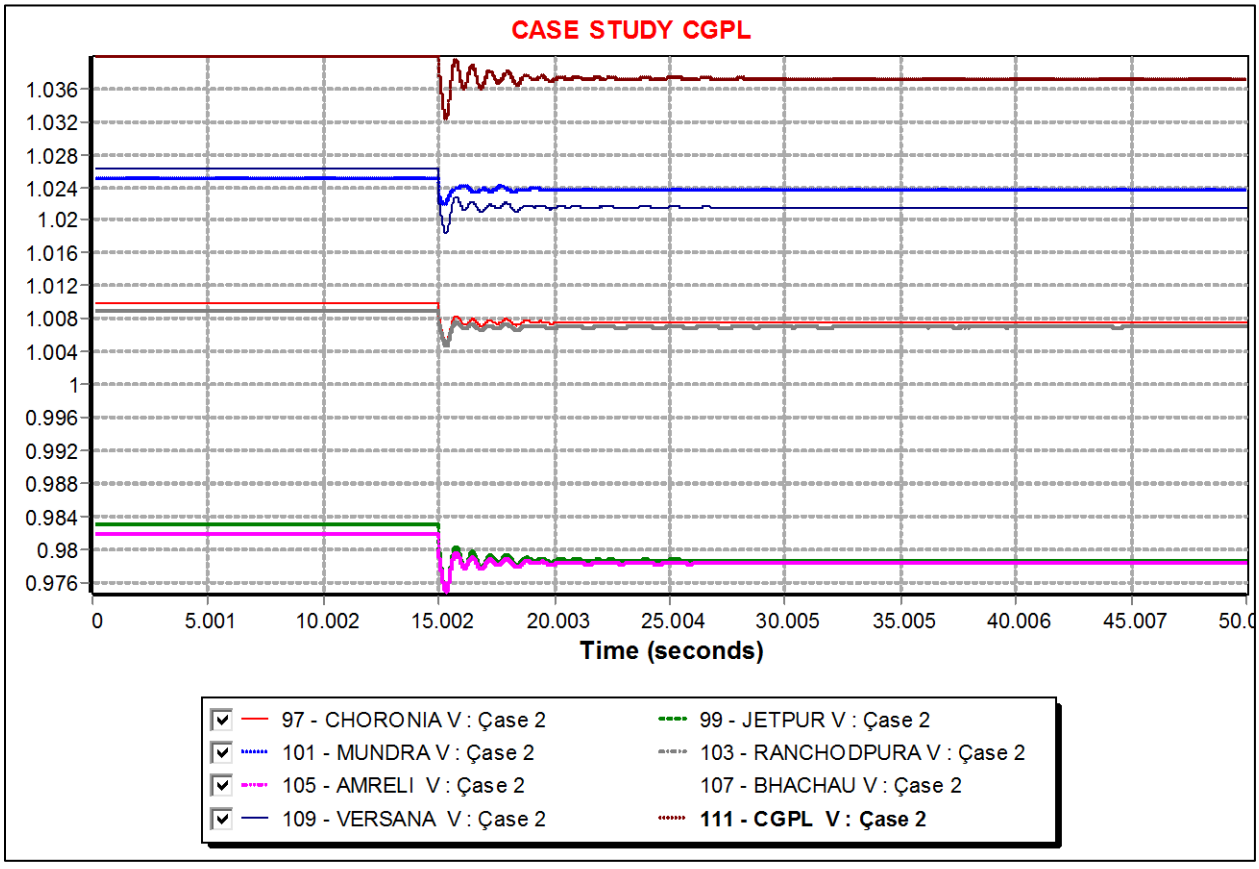
Case 1:



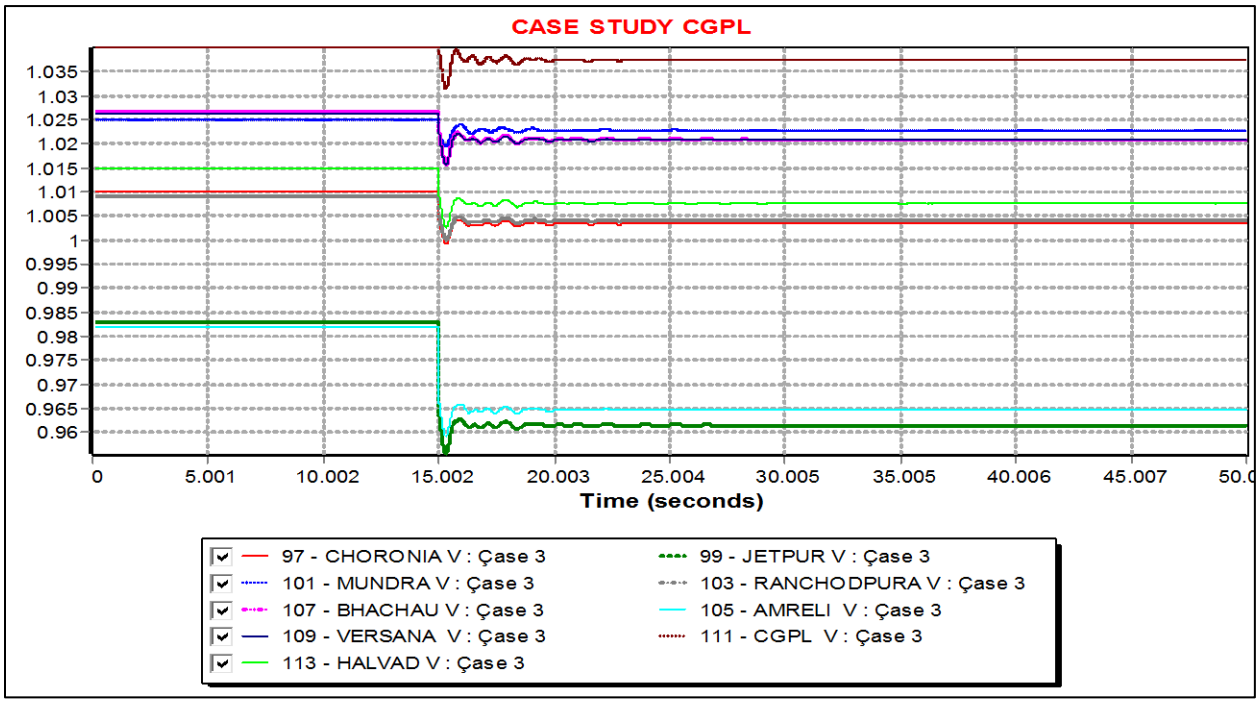


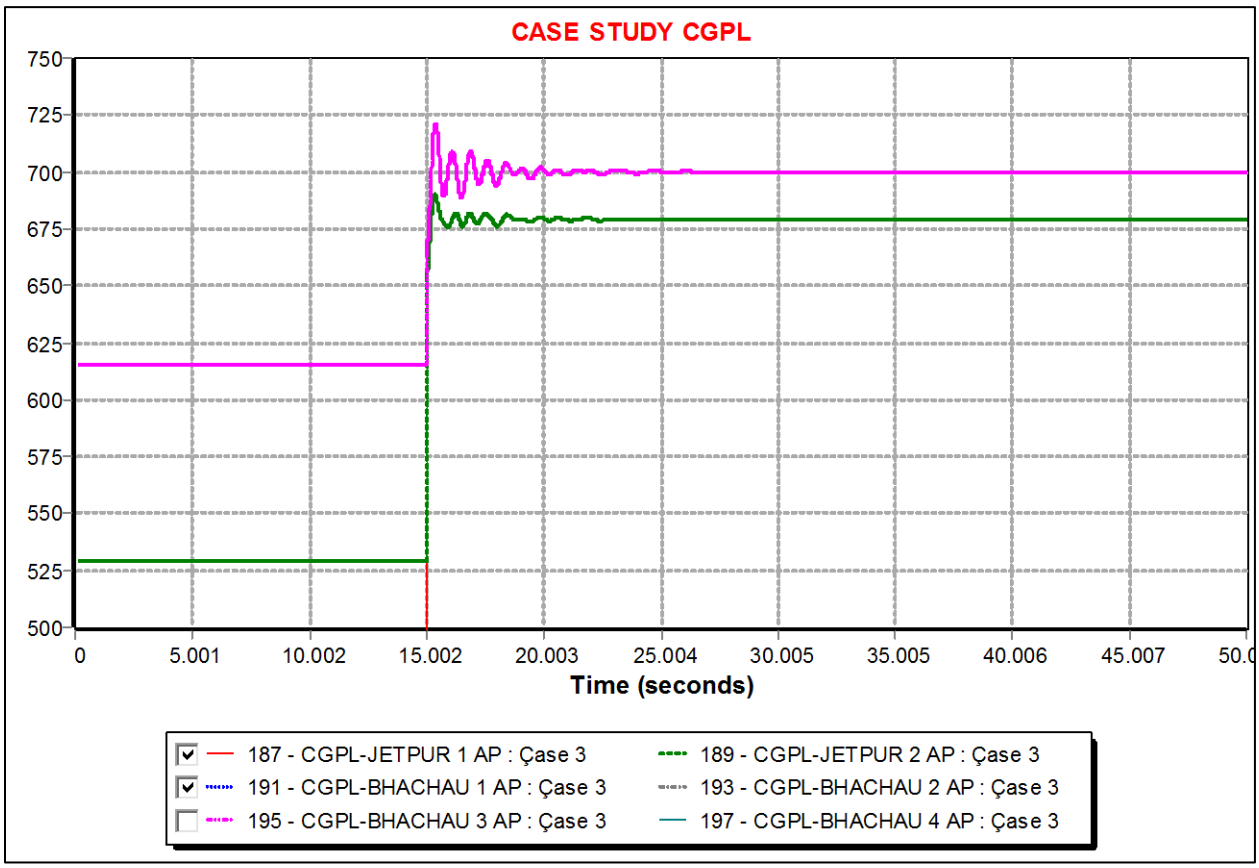
Case 2

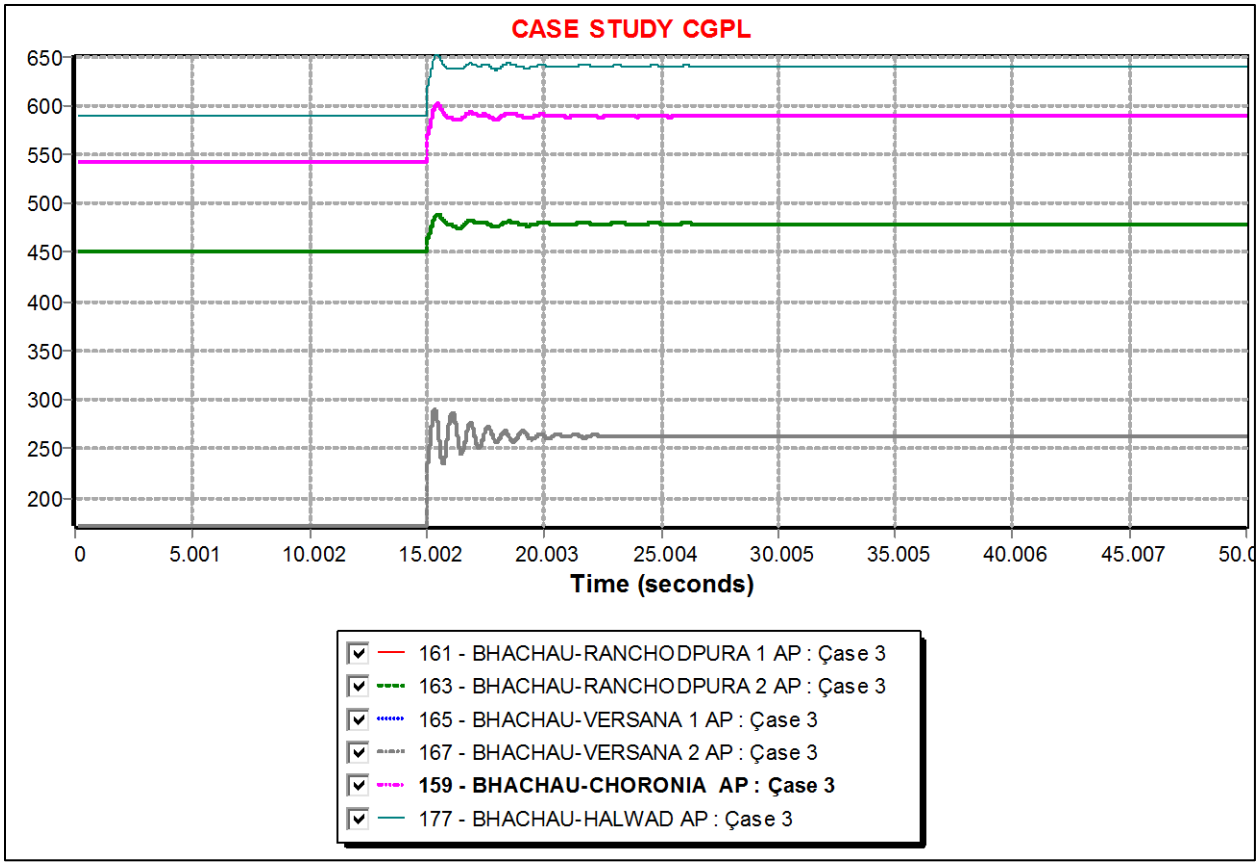

CASE STUDY CGPL
960
920
880
840
800
760
720
680
640
600
560
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
191 - CGPL-BHACHAU 1 AP : Case 2
187 - CGPL-JETPUR 1 AP : Case 2
197 - CGPL-BHACHAU 4 AP : Case 2


CASE STUDY CGPL
1.036
1.032
1.028
1.024
1.02
1.016
1.012
1.008
1.004
1
0.996
0.992
0.988
0.984
0.98
0.976
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 2
101 - MUNDRA V : Case 2
105 - AMRELI V : Case 2
109 - VERSANA V : Case 2
99 - JETPUR V : Case 2
103 - RANCHODPURA V : Case 2
107 - BHACHAU V : Case 2
111 - CGPL V : Case 2

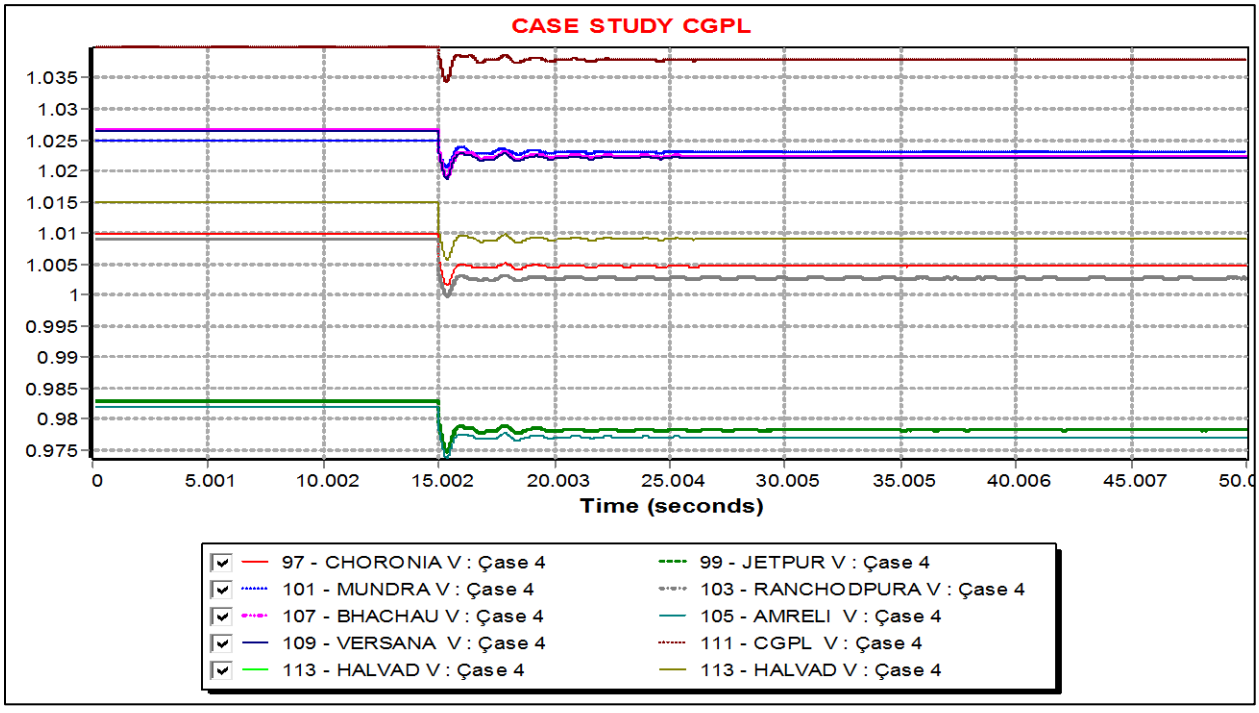
Case 3:

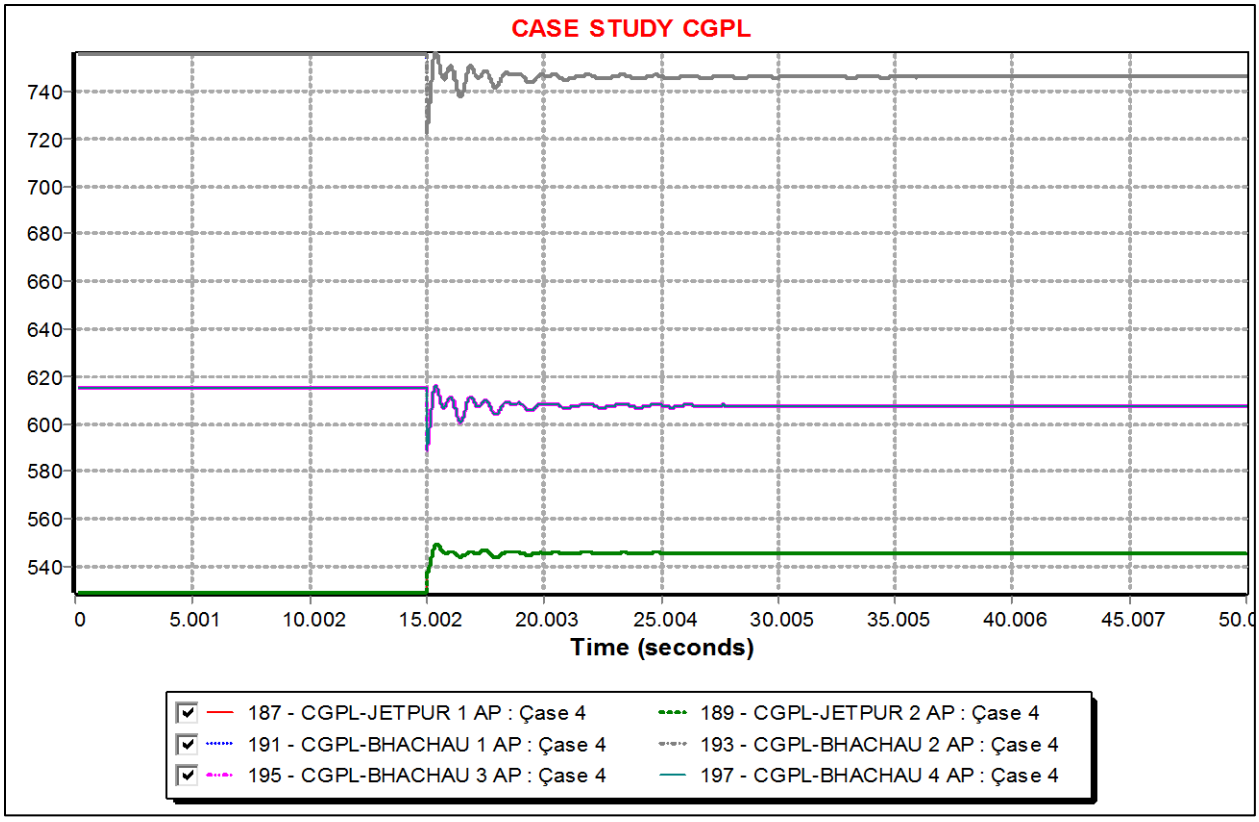

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 3
99 - JETPUR V : Çase 3
101 - MUNDRA V : Çase 3
103 - RANCHODPURA V : Çase 3
107 - BHACHAU V : Çase 3
105 - AMRELI V : Çase 3
109 - VERSANA V : Çase 3
111 - CGPL V : Çase 3
113 - HALVAD V : Çase 3

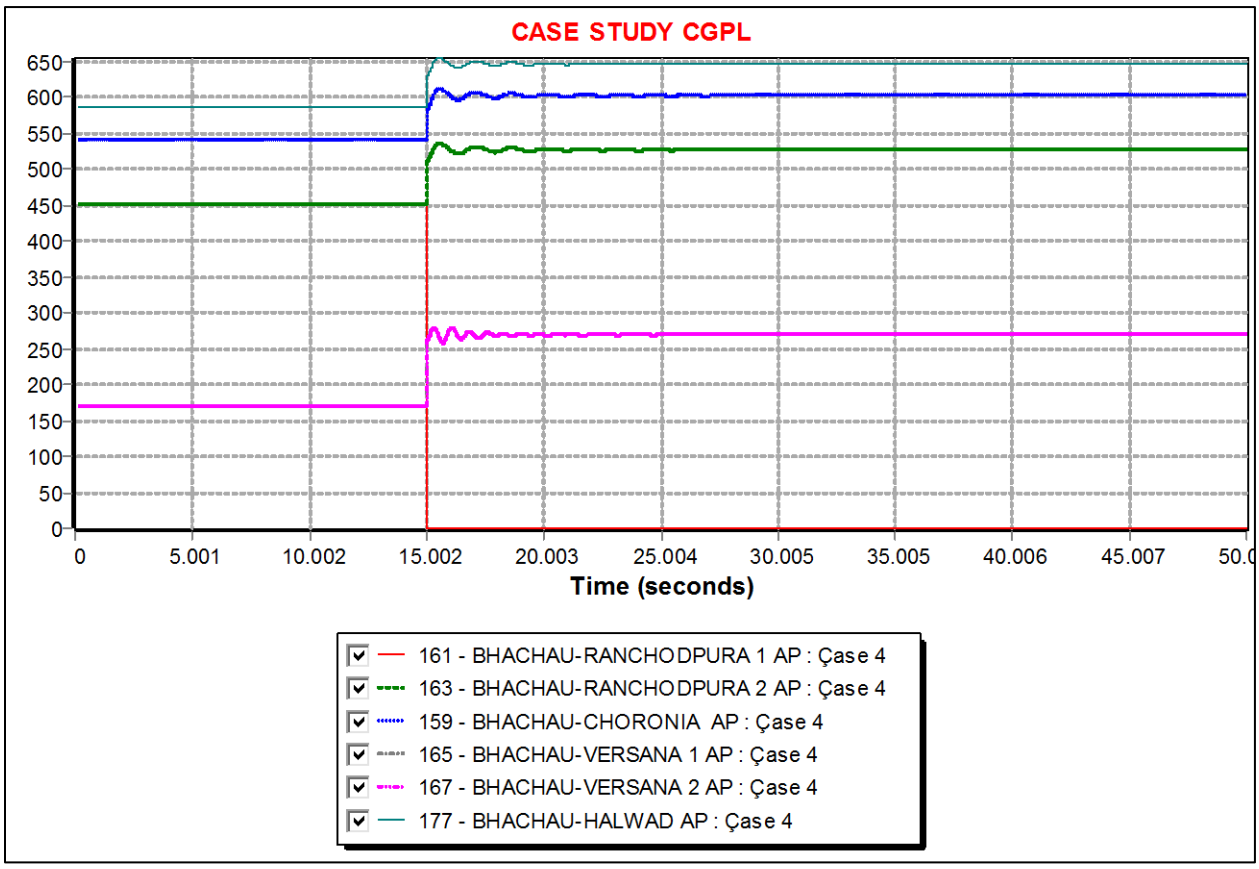

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
525
500
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 3
189 - CGPL-JETPUR 2 AP : Çase 3
191 - CGPL-BHACHAU 1 AP : Çase 3
193 - CGPL-BHACHAU 2 AP : Çase 3
195 - CGPL-BHACHAU 3 AP : Çase 3
197 - CGPL-BHACHAU 4 AP : Çase 3


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 3
163 - BHACHAU-RANCHODPURA 2 AP : Çase 3
165 - BHACHAU-VERSANA 1 AP : Çase 3
167 - BHACHAU-VERSANA 2 AP : Çase 3
159 - BHACHAU-CHORONIA AP : Çase 3
177 - BHACHAU-HALWAD AP : Çase 3

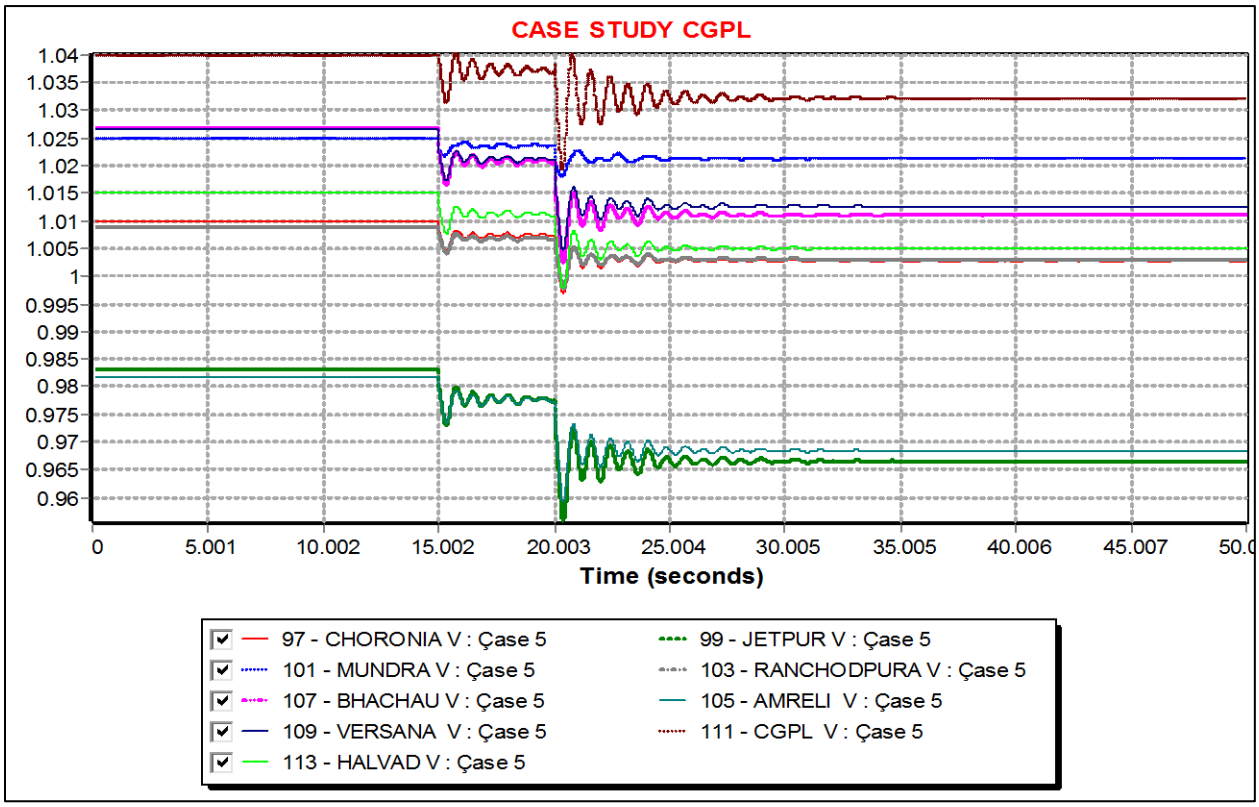
Case 4:

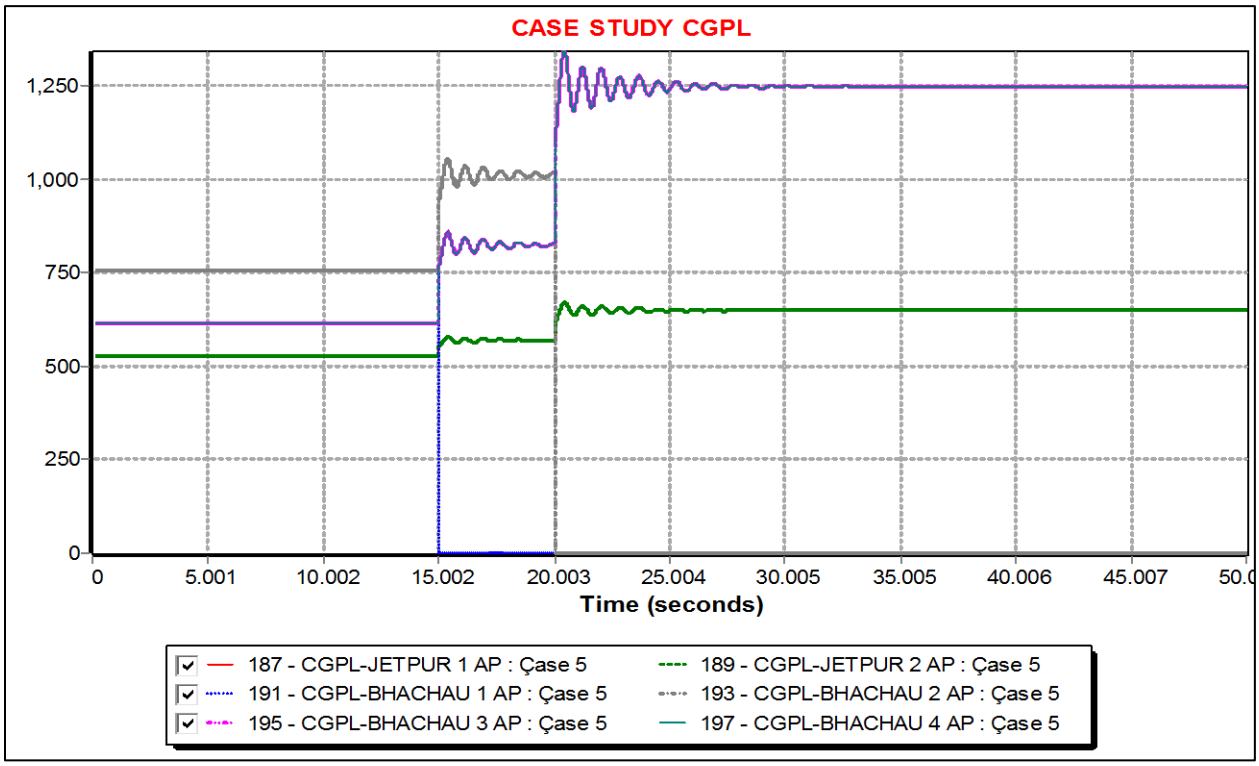

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 4
101 - MUNDRA V : Çase 4
107 - BHACHAU V : Çase 4
109 - VERSANA V : Çase 4
113 - HALVAD V : Çase 4
99 - JETPUR V : Çase 4
103 - RANCHODPURA V : Çase 4
105 - AMRELI V : Çase 4
111 - CGPL V : Çase 4
113 - HALVAD V : Çase 4

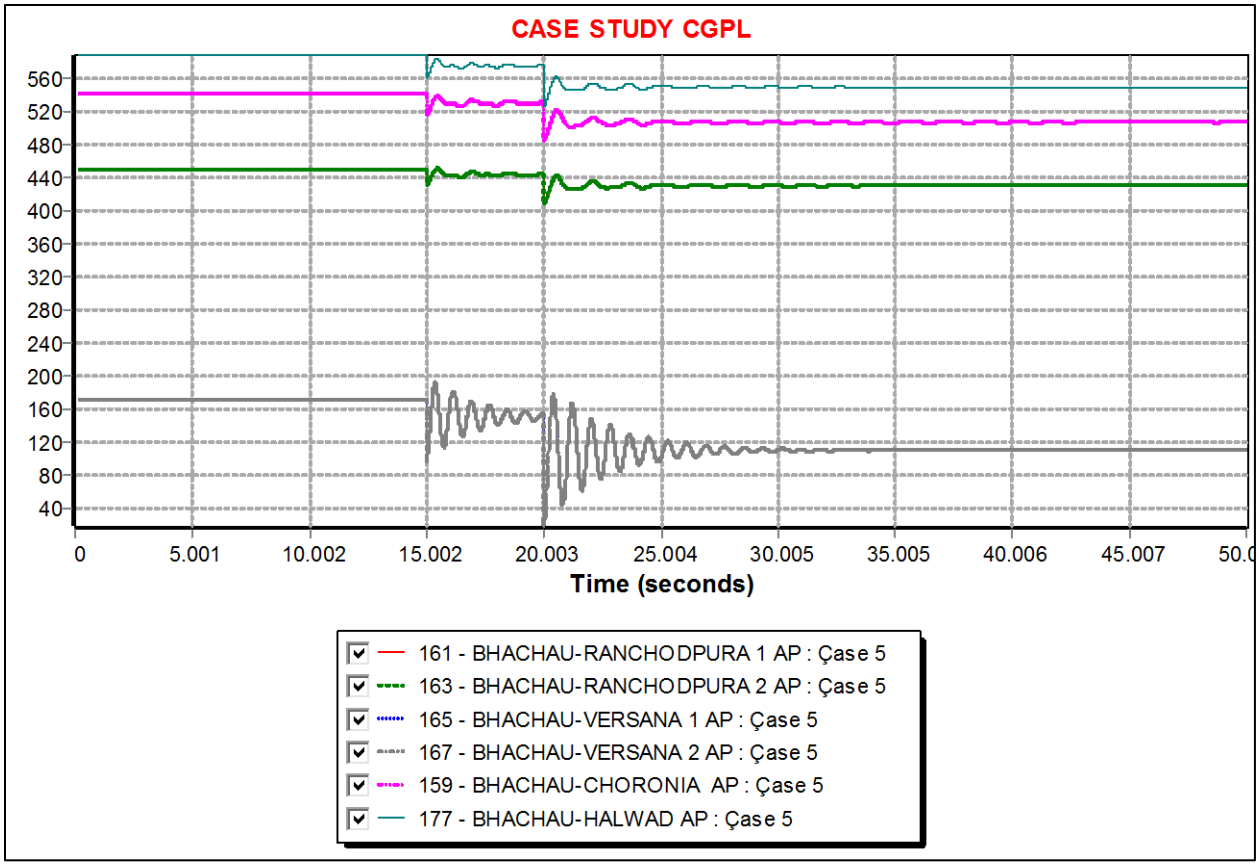

CASE STUDY CGPL
740
720
700
680
660
640
620
600
580
560
540
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 4
189 - CGPL-JETPUR 2 AP : Case 4
191 - CGPL-BHACHAU 1 AP : Case 4
193 - CGPL-BHACHAU 2 AP : Case 4
195 - CGPL-BHACHAU 3 AP : Case 4
197 - CGPL-BHACHAU 4 AP : Case 4


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 4
163 - BHACHAU-RANCHODPURA 2 AP : Case 4
159 - BHACHAU-CHORONIA AP : Case 4
165 - BHACHAU-VERSANA 1 AP : Case 4
167 - BHACHAU-VERSANA 2 AP : Case 4
177 - BHACHAU-HALWAD AP : Case 4

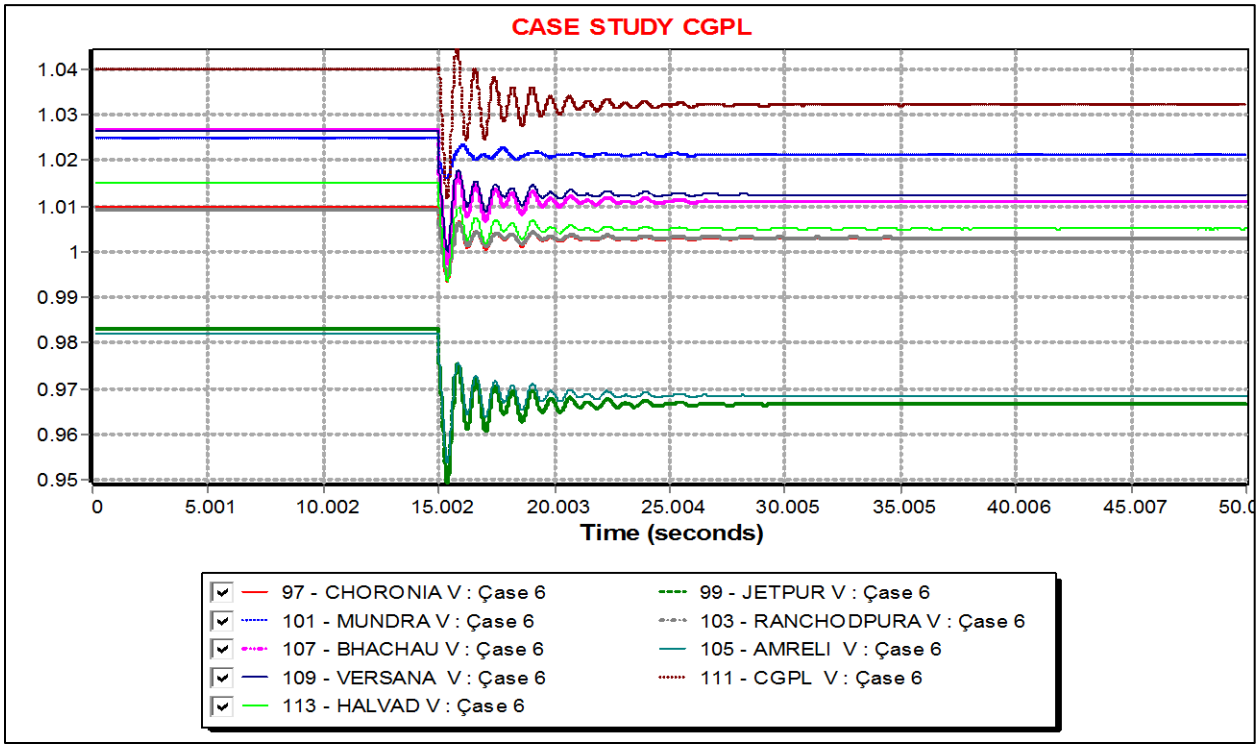
Case 5:

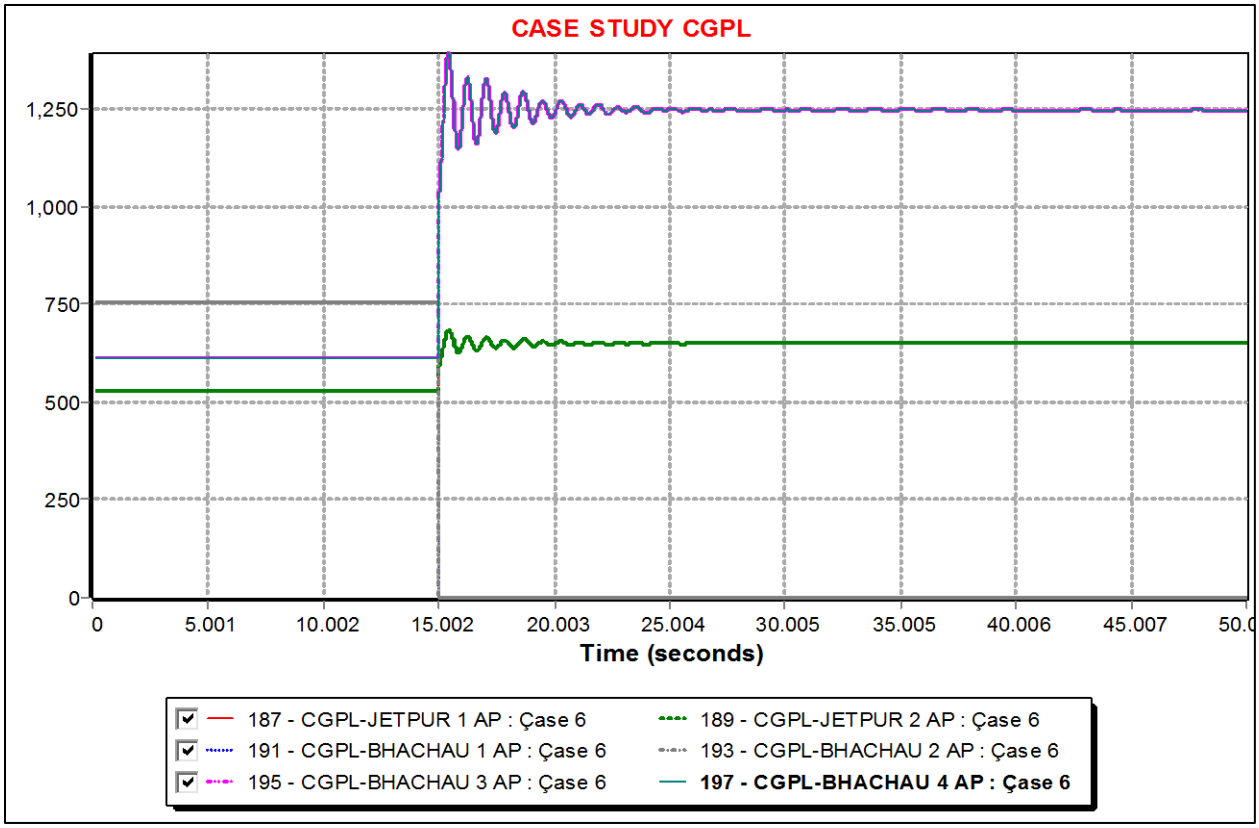

CASE STUDY CGPL
1.04
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 5
101 - MUNDRA V : Case 5
107 - BHACHAU V : Case 5
109 - VERSANA V : Case 5
113 - HALVAD V : Case 5
99 - JETPUR V : Case 5
103 - RANCHODPURA V : Case 5
105 - AMRELI V : Case 5
111 - CGPL V : Case 5

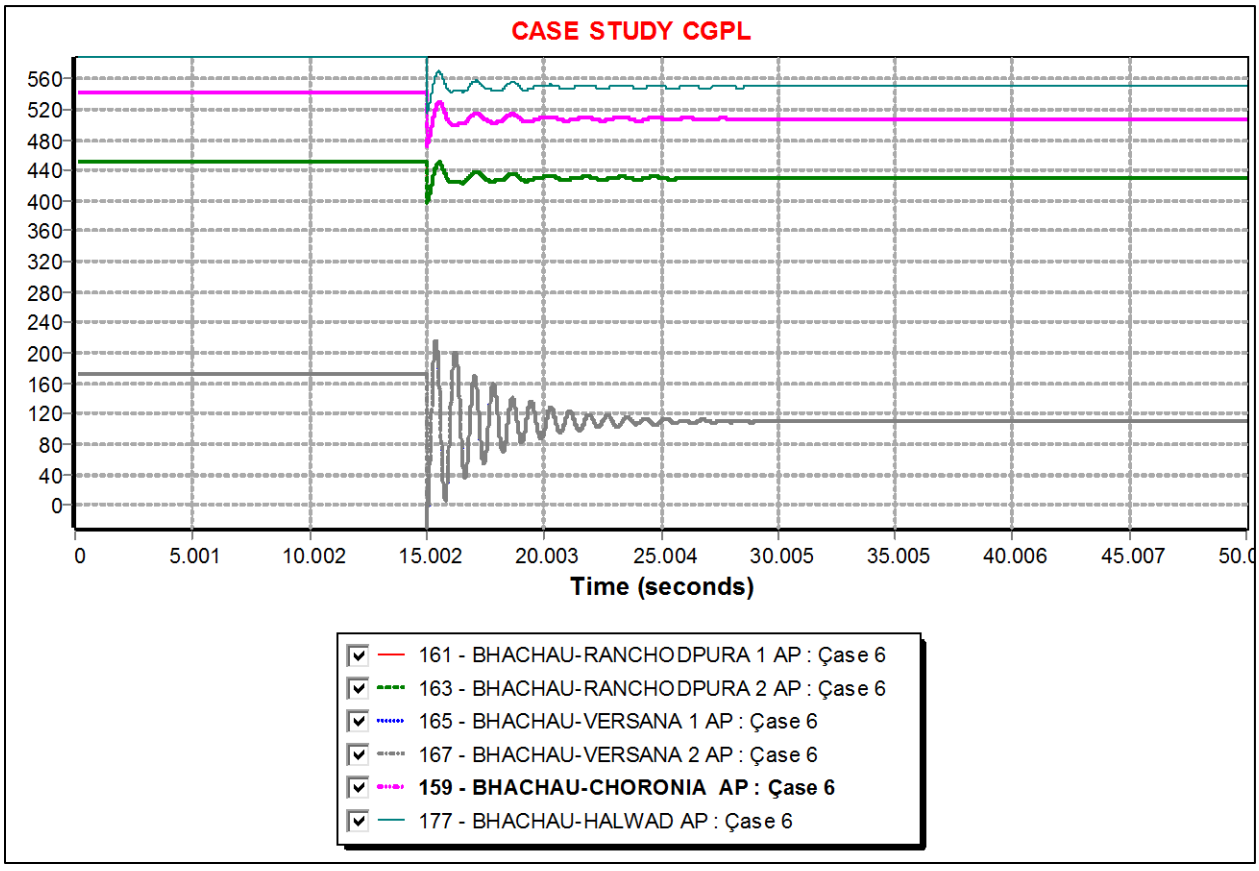

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 5
191 - CGPL-BHACHAU 1 AP : Case 5
195 - CGPL-BHACHAU 3 AP : Case 5
189 - CGPL-JETPUR 2 AP : Case 5
193 - CGPL-BHACHAU 2 AP : Case 5
197 - CGPL-BHACHAU 4 AP : Case 5


CASE STUDY CGPL
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 5
163 - BHACHAU-RANCHODPURA 2 AP : Çase 5
165 - BHACHAU-VERSANA 1 AP : Çase 5
167 - BHACHAU-VERSANA 2 AP : Çase 5
159 - BHACHAU-CHORONIA AP : Çase 5
177 - BHACHAU-HALWAD AP : Çase 5

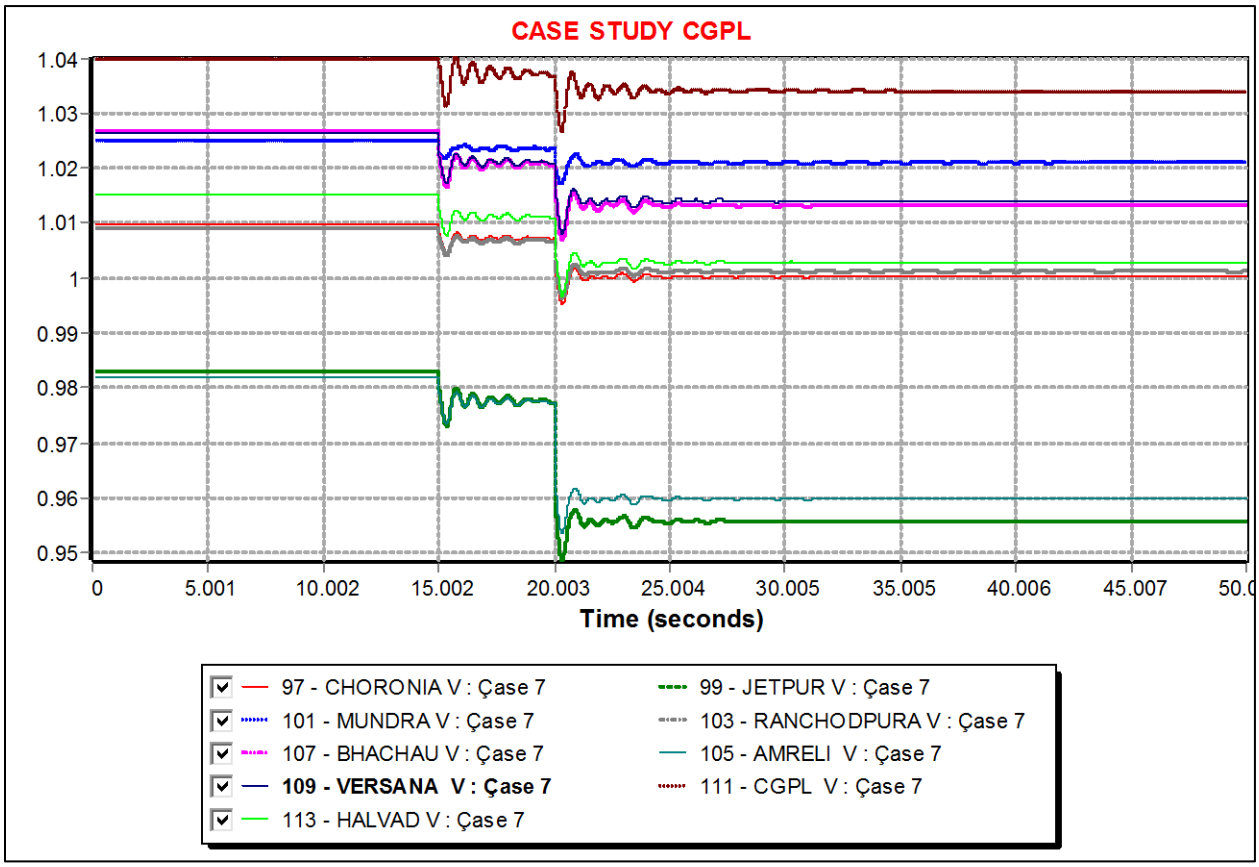
Case 6 :

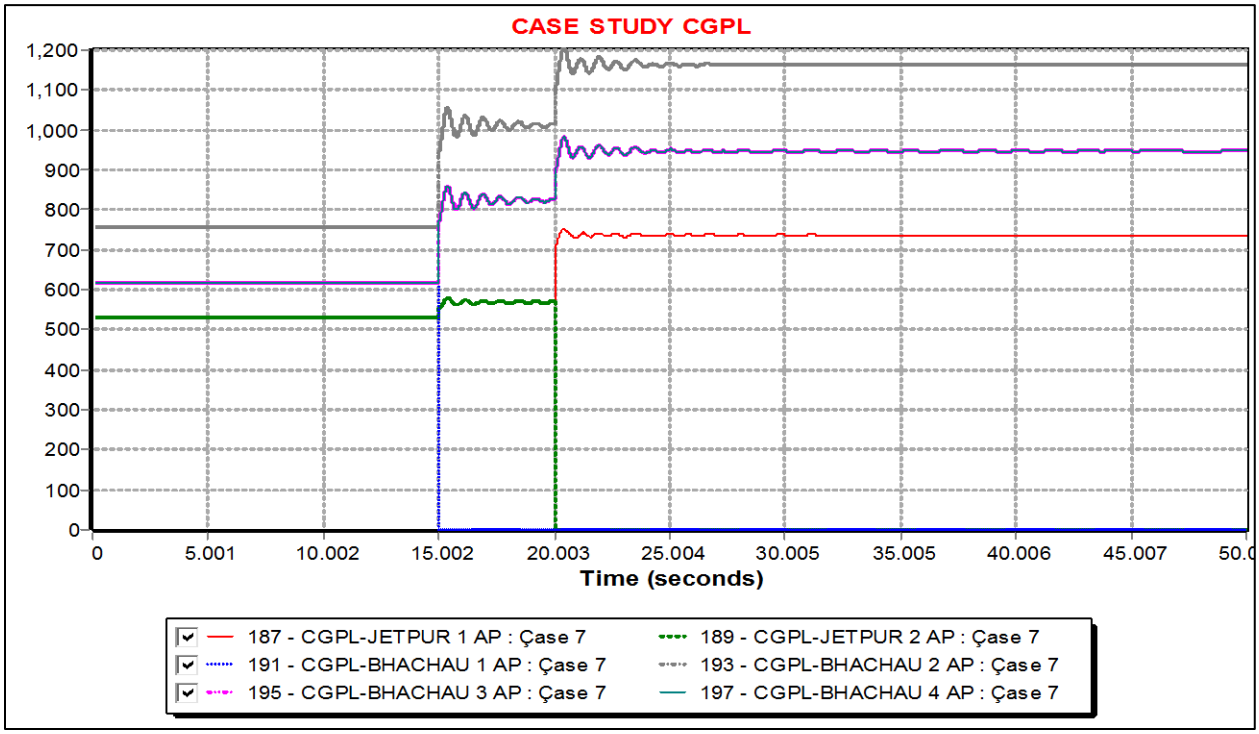

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 6
101 - MUNDRA V : Çase 6
107 - BHACHAU V : Çase 6
109 - VERSANA V : Çase 6
113 - HALVAD V : Çase 6
99 - JETPUR V : Çase 6
103 - RANCHODPURA V : Çase 6
105 - AMRELI V : Çase 6
111 - CGPL V : Çase 6

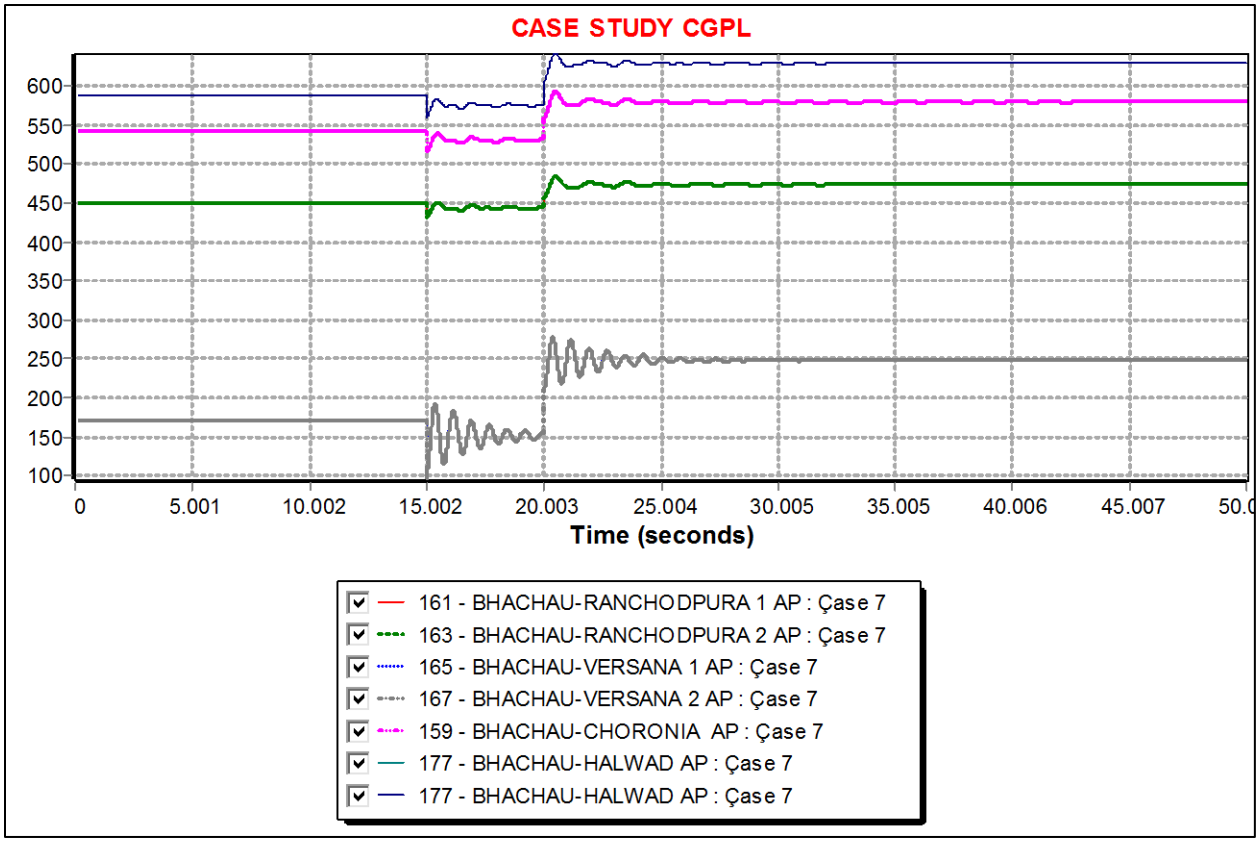

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 6
189 - CGPL-JETPUR 2 AP : Çase 6
191 - CGPL-BHACHAU 1 AP : Çase 6
193 - CGPL-BHACHAU 2 AP : Çase 6
195 - CGPL-BHACHAU 3 AP : Çase 6
197 - CGPL-BHACHAU 4 AP : Çase 6


CASE STUDY CGPL
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 6
163 - BHACHAU-RANCHODPURA 2 AP : Çase 6
165 - BHACHAU-VERSANA 1 AP : Çase 6
167 - BHACHAU-VERSANA 2 AP : Çase 6
159 - BHACHAU-CHORONIA AP : Çase 6
177 - BHACHAU-HALWAD AP : Çase 6

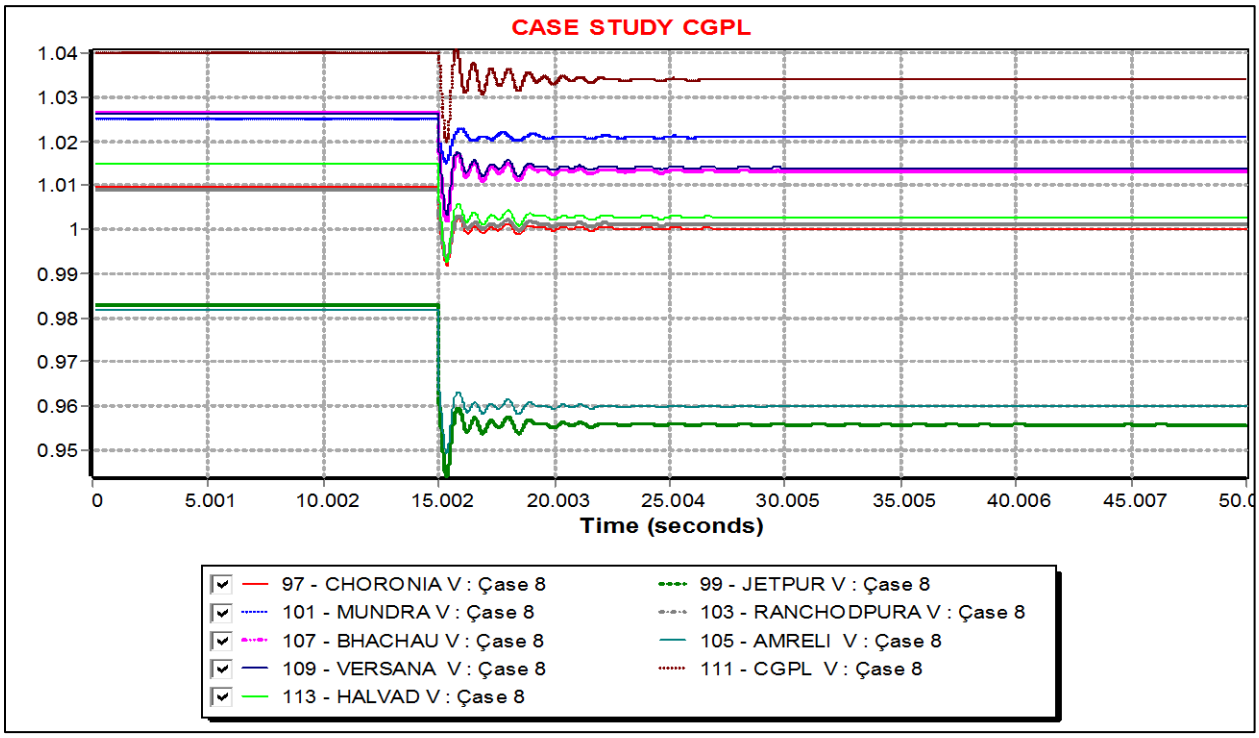
Case 7:

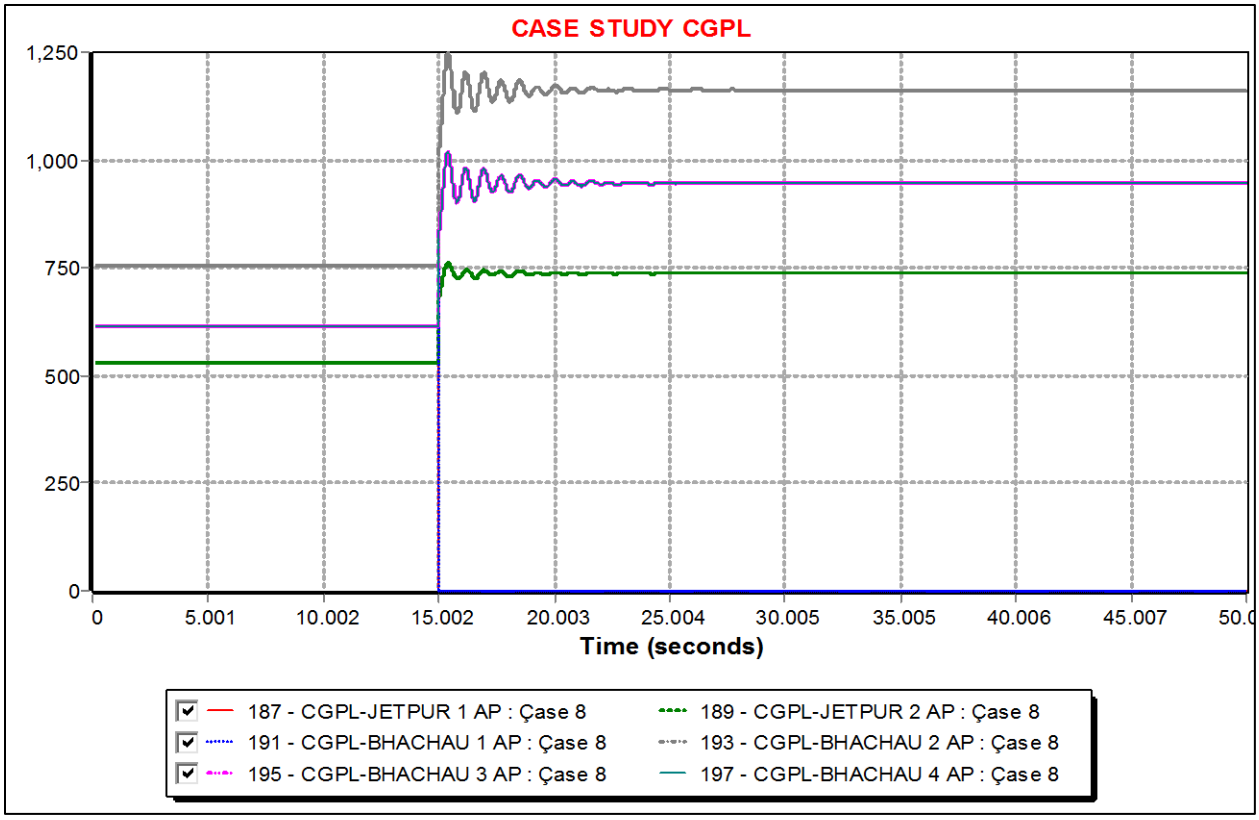

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 7
99 - JETPUR V : Case 7
101 - MUNDRA V : Case 7
103 - RANCHODPURA V : Case 7
107 - BHACHAU V : Case 7
105 - AMRELI V : Case 7
109 - VERSANA V : Case 7
111 - CGPL V : Case 7
113 - HALVAD V : Case 7

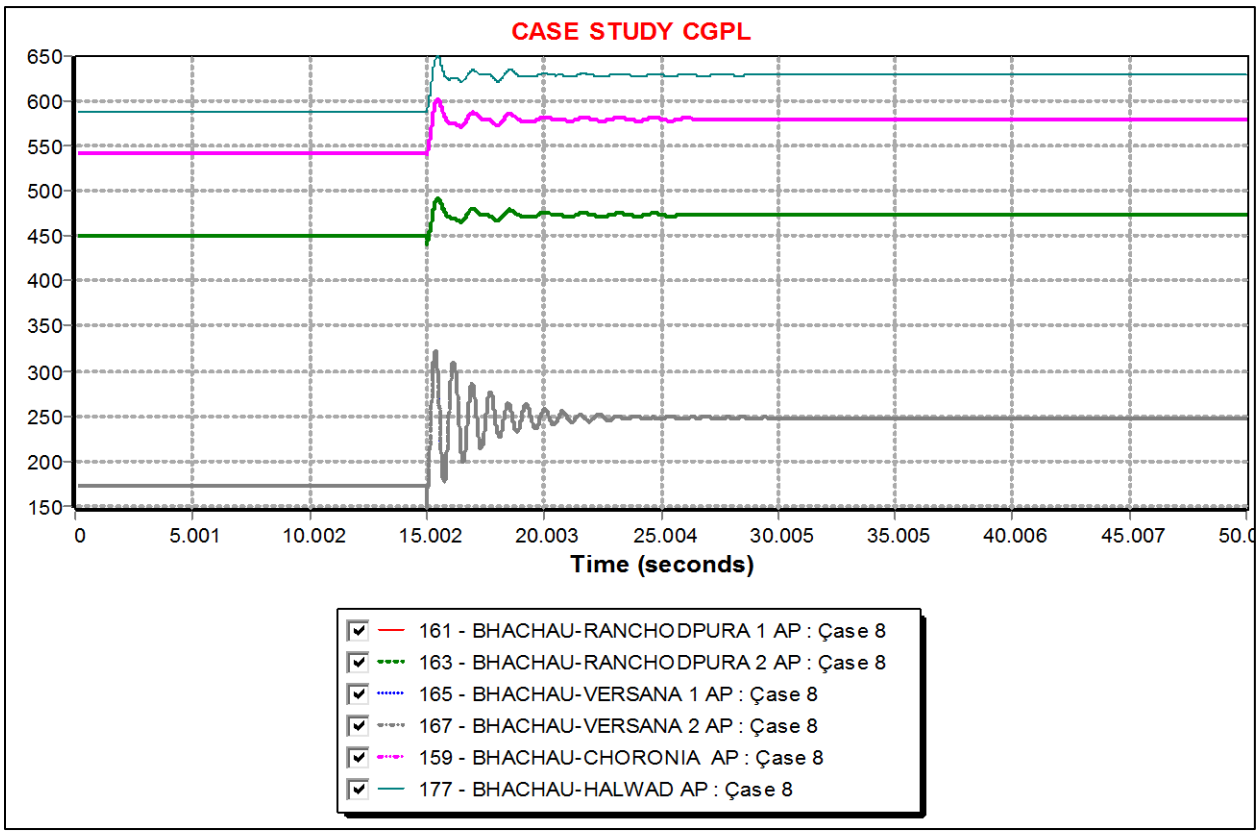

CASE STUDY CGPL
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 7
189 - CGPL-JETPUR 2 AP : Case 7
191 - CGPL-BHACHAU 1 AP : Case 7
193 - CGPL-BHACHAU 2 AP : Case 7
195 - CGPL-BHACHAU 3 AP : Case 7
197 - CGPL-BHACHAU 4 AP : Case 7


CASE STUDY CGPL
600
550
500
450
400
350
300
250
200
150
100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 7
163 - BHACHAU-RANCHODPURA 2 AP : Case 7
165 - BHACHAU-VERSANA 1 AP : Case 7
167 - BHACHAU-VERSANA 2 AP : Case 7
159 - BHACHAU-CHORONIA AP : Case 7
177 - BHACHAU-HALWAD AP : Case 7
177 - BHACHAU-HALWAD AP : Case 7

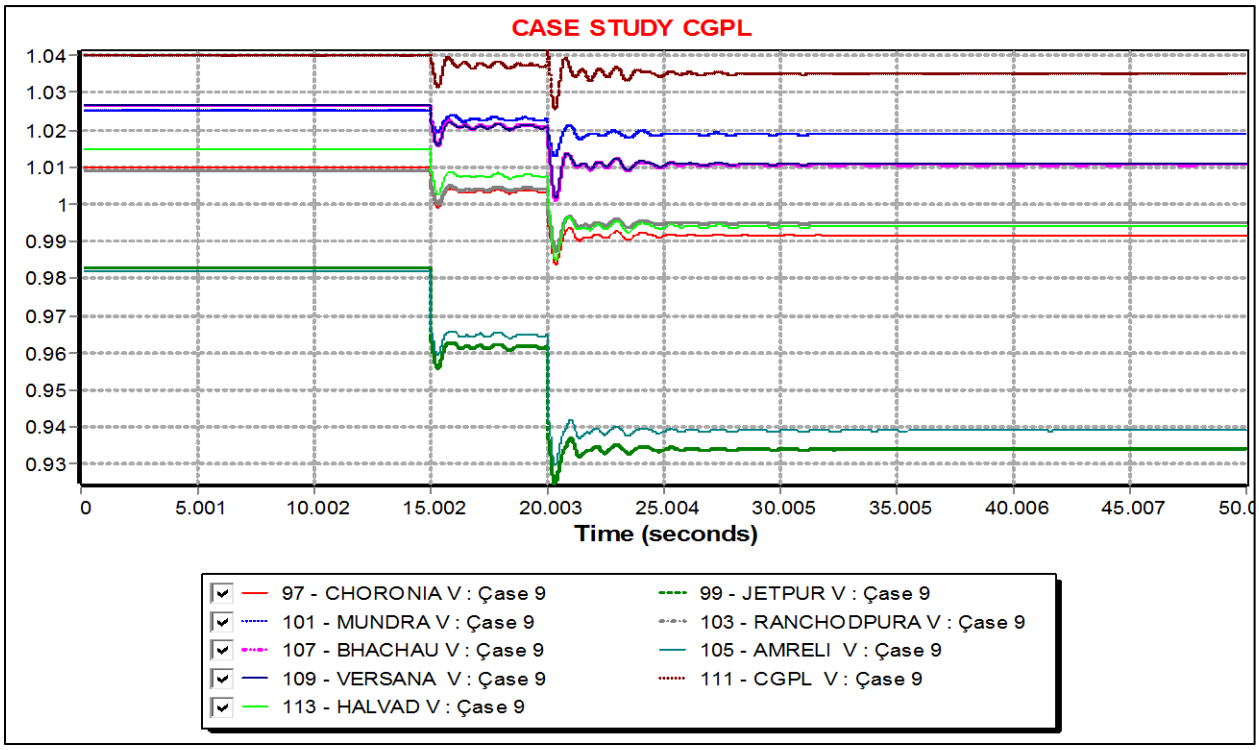
Case 8 :

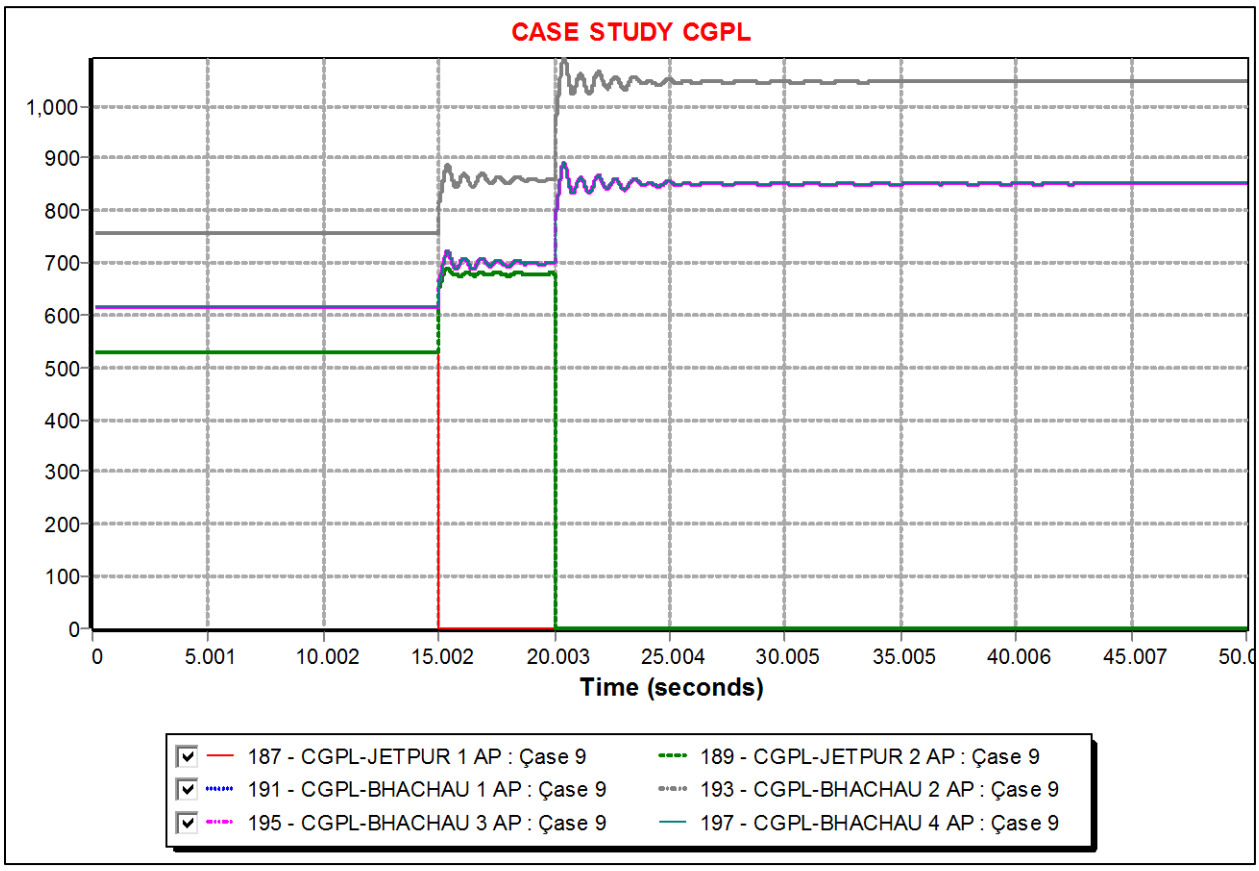

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 8
101 - MUNDRA V : Case 8
107 - BHACHAU V : Case 8
109 - VERSANA V : Case 8
113 - HALVAD V : Case 8
99 - JETPUR V : Case 8
103 - RANCHODPURA V : Case 8
105 - AMRELI V : Case 8
111 - CGPL V : Case 8

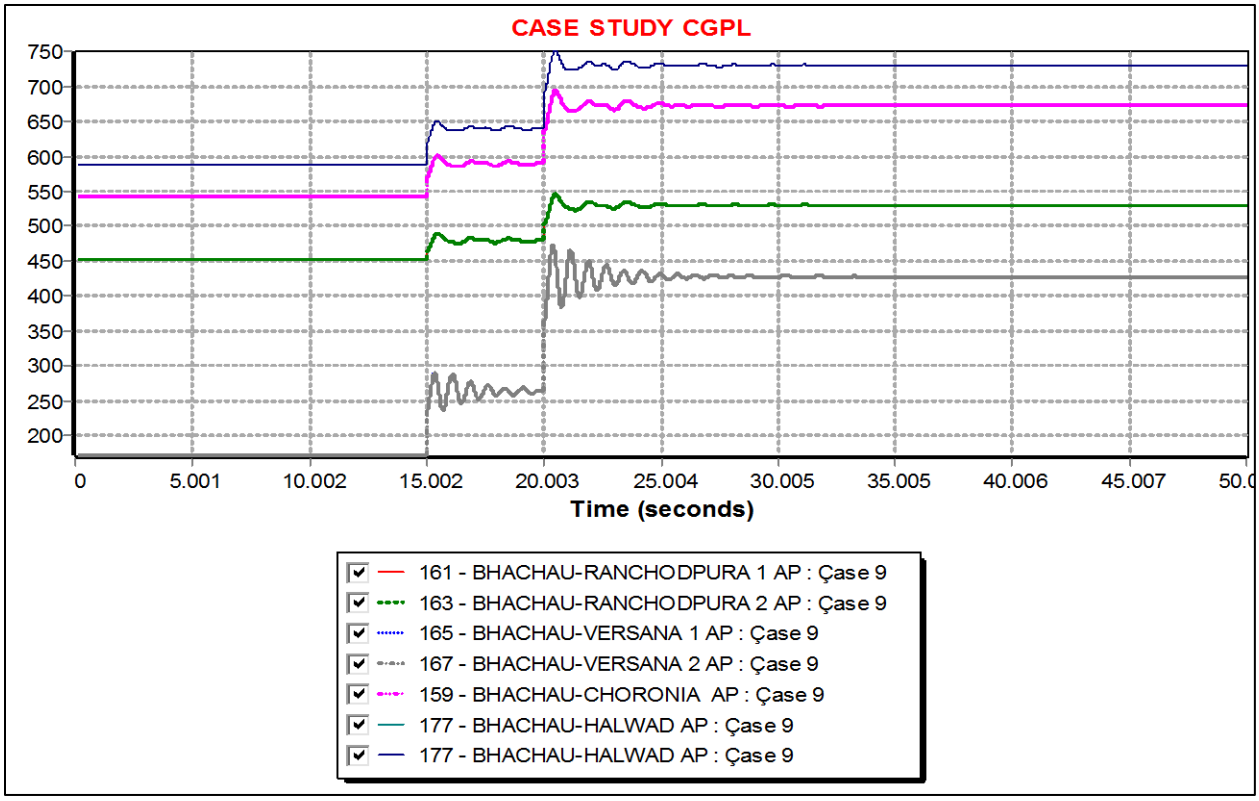

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 8
189 - CGPL-JETPUR 2 AP : Case 8
191 - CGPL-BHACHAU 1 AP : Case 8
193 - CGPL-BHACHAU 2 AP : Case 8
195 - CGPL-BHACHAU 3 AP : Case 8
197 - CGPL-BHACHAU 4 AP : Case 8


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 8
163 - BHACHAU-RANCHODPURA 2 AP : Case 8
165 - BHACHAU-VERSANA 1 AP : Case 8
167 - BHACHAU-VERSANA 2 AP : Case 8
159 - BHACHAU-CHORONIA AP : Case 8
177 - BHACHAU-HALWAD AP : Case 8

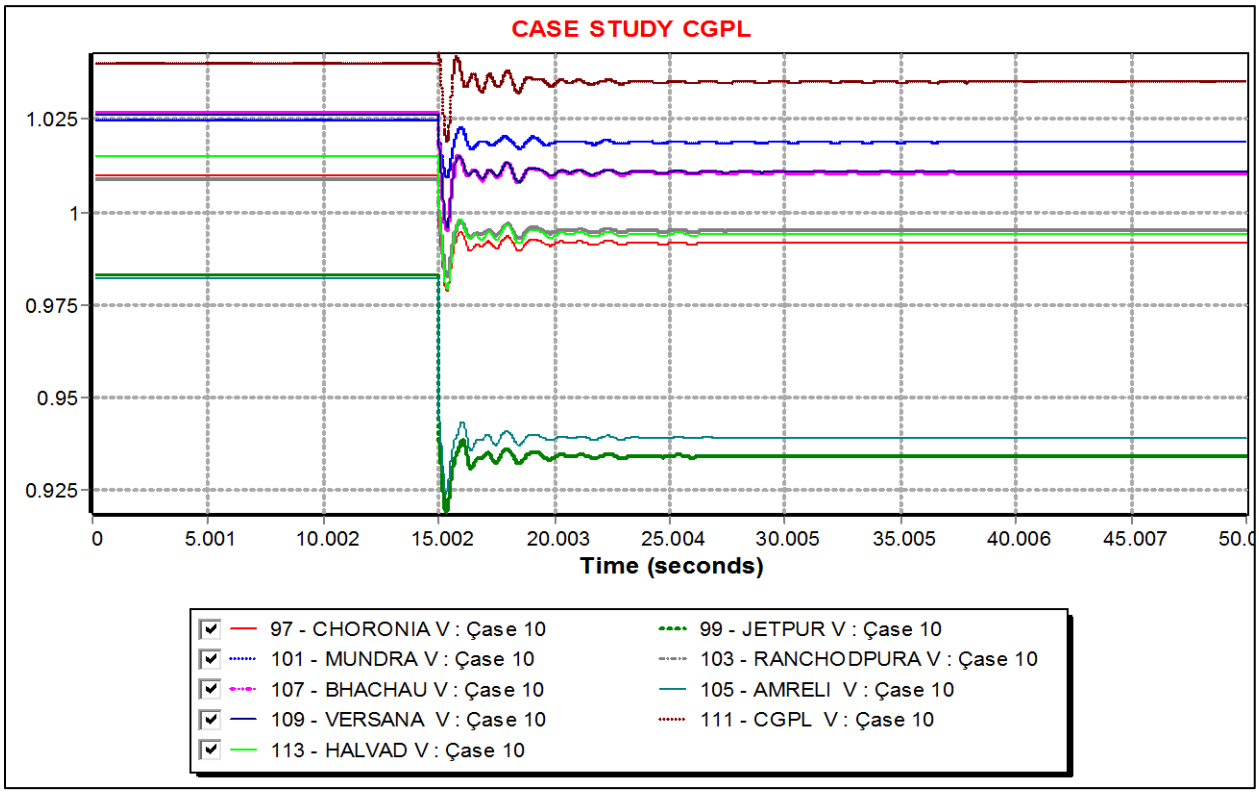
Case 9 :

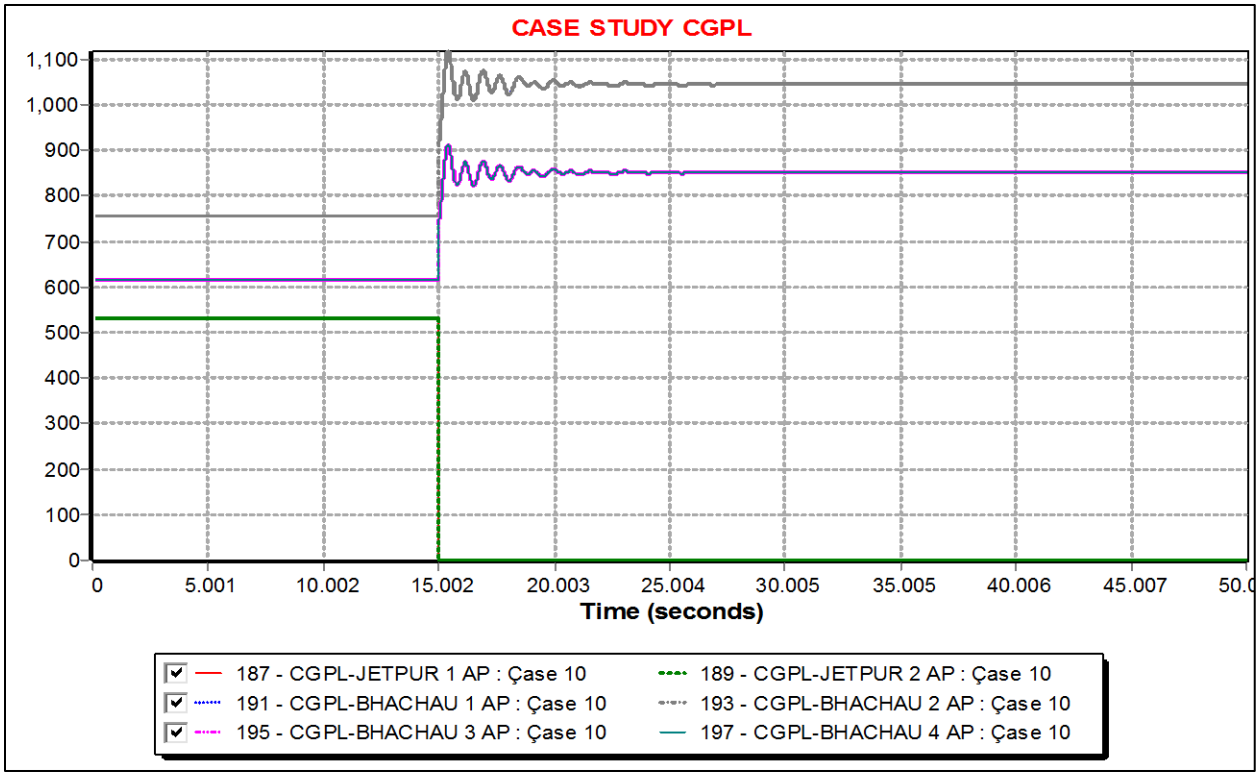

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 9
99 - JETPUR V : Case 9
101 - MUNDRA V : Case 9
103 - RANCHODPURA V : Case 9
107 - BHACHAU V : Case 9
105 - AMRELI V : Case 9
109 - VERSANA V : Case 9
111 - CGPL V : Case 9
113 - HALVAD V : Case 9

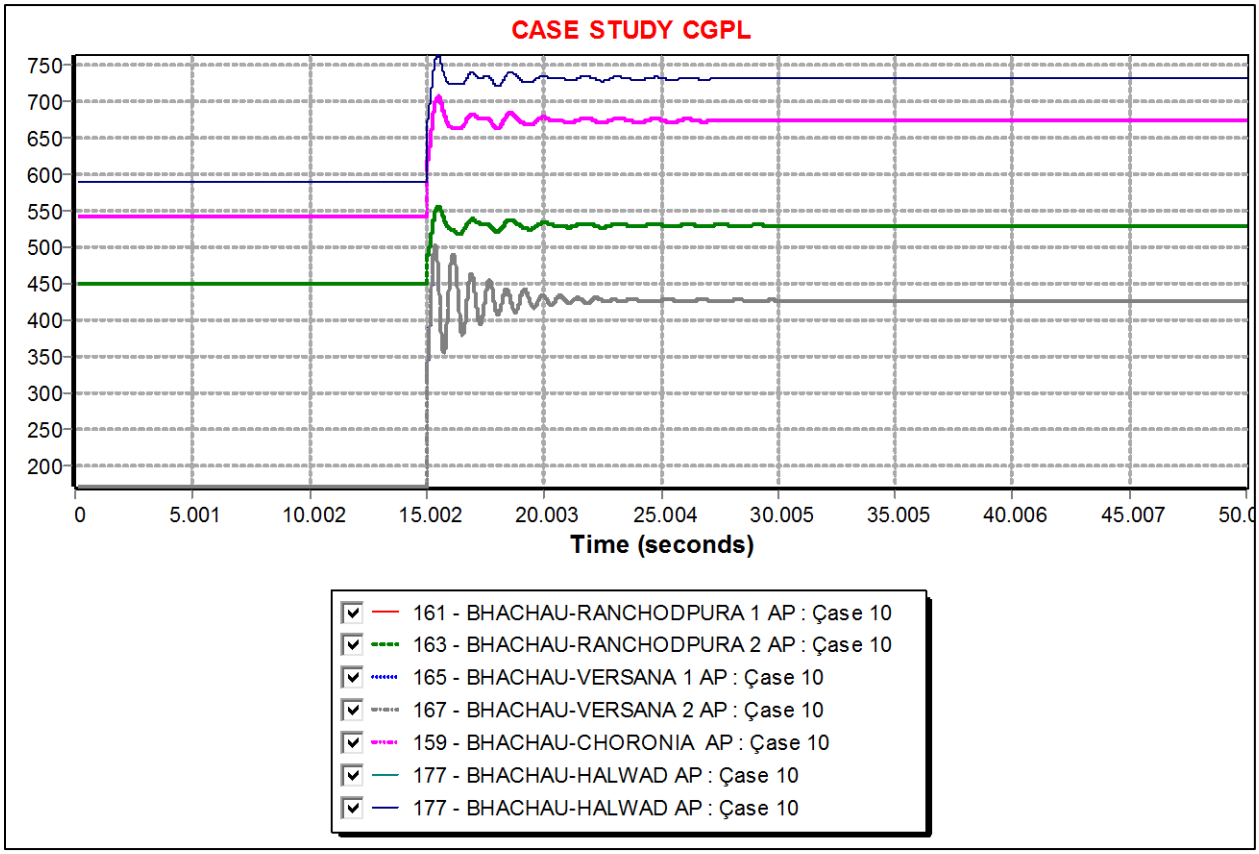

CASE STUDY CGPL
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 9
189 - CGPL-JETPUR 2 AP : Case 9
191 - CGPL-BHACHAU 1 AP : Case 9
193 - CGPL-BHACHAU 2 AP : Case 9
195 - CGPL-BHACHAU 3 AP : Case 9
197 - CGPL-BHACHAU 4 AP : Case 9


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 9
163 - BHACHAU-RANCHODPURA 2 AP : Çase 9
165 - BHACHAU-VERSANA 1 AP : Çase 9
167 - BHACHAU-VERSANA 2 AP : Çase 9
159 - BHACHAU-CHORONIA AP : Çase 9
177 - BHACHAU-HALWAD AP : Çase 9
177 - BHACHAU-HALWAD AP : Çase 9

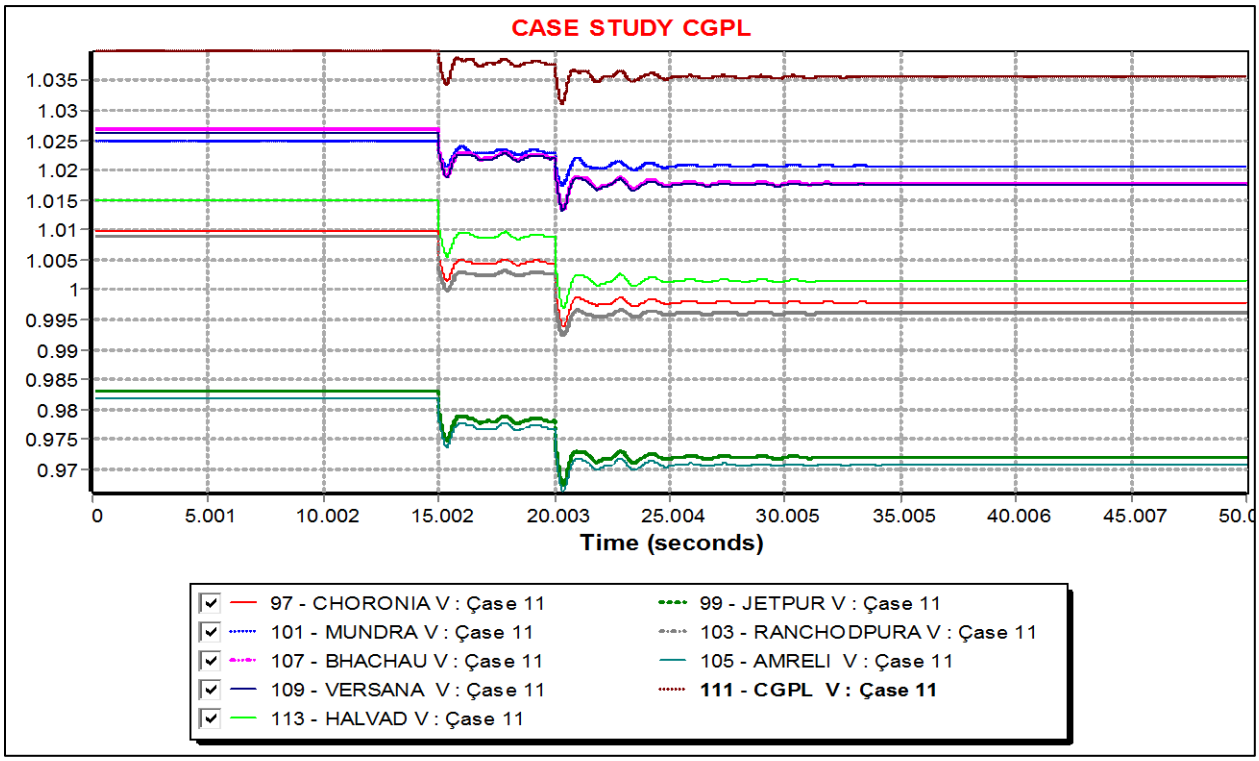
Case 10:

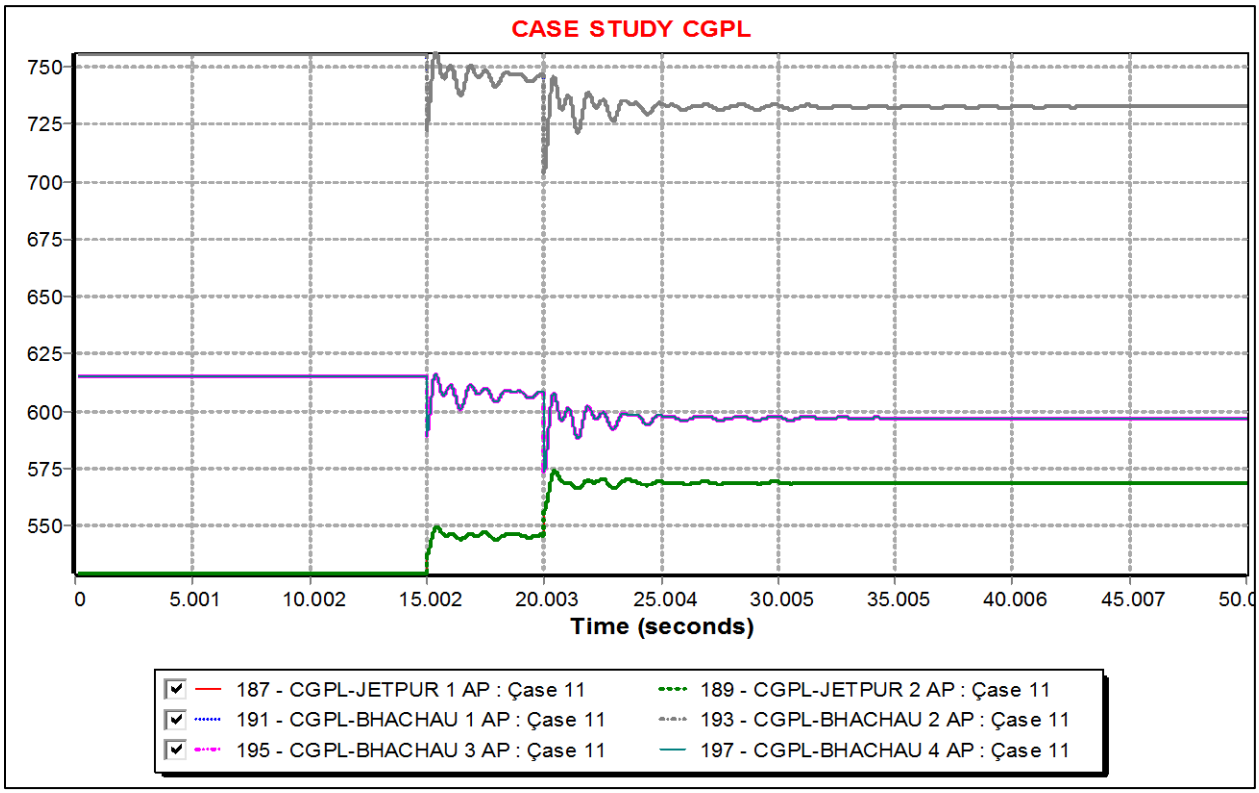

CASE STUDY CGPL
1.025
1
0.975
0.95
0.925
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 10
99 - JETPUR V : Çase 10
101 - MUNDRA V : Çase 10
103 - RANCHODPURA V : Çase 10
107 - BHACHAU V : Çase 10
105 - AMRELI V : Çase 10
109 - VERSANA V : Çase 10
111 - CGPL V : Çase 10
113 - HALVAD V : Çase 10

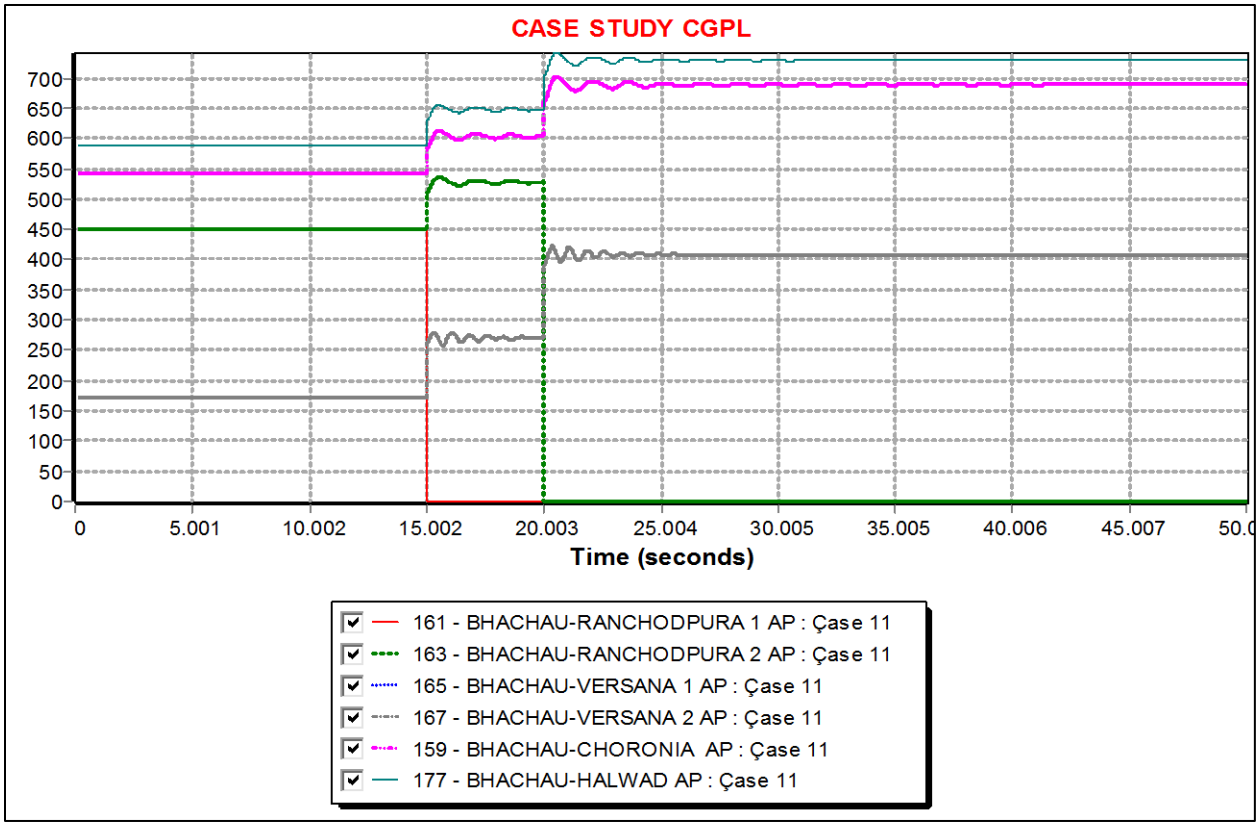

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 10
189 - CGPL-JETPUR 2 AP : Çase 10
191 - CGPL-BHACHAU 1 AP : Çase 10
193 - CGPL-BHACHAU 2 AP : Çase 10
195 - CGPL-BHACHAU 3 AP : Çase 10
197 - CGPL-BHACHAU 4 AP : Çase 10


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 10
163 - BHACHAU-RANCHODPURA 2 AP : Çase 10
165 - BHACHAU-VERSANA 1 AP : Çase 10
167 - BHACHAU-VERSANA 2 AP : Çase 10
159 - BHACHAU-CHORONIA AP : Çase 10
177 - BHACHAU-HALWAD AP : Çase 10
177 - BHACHAU-HALWAD AP : Çase 10

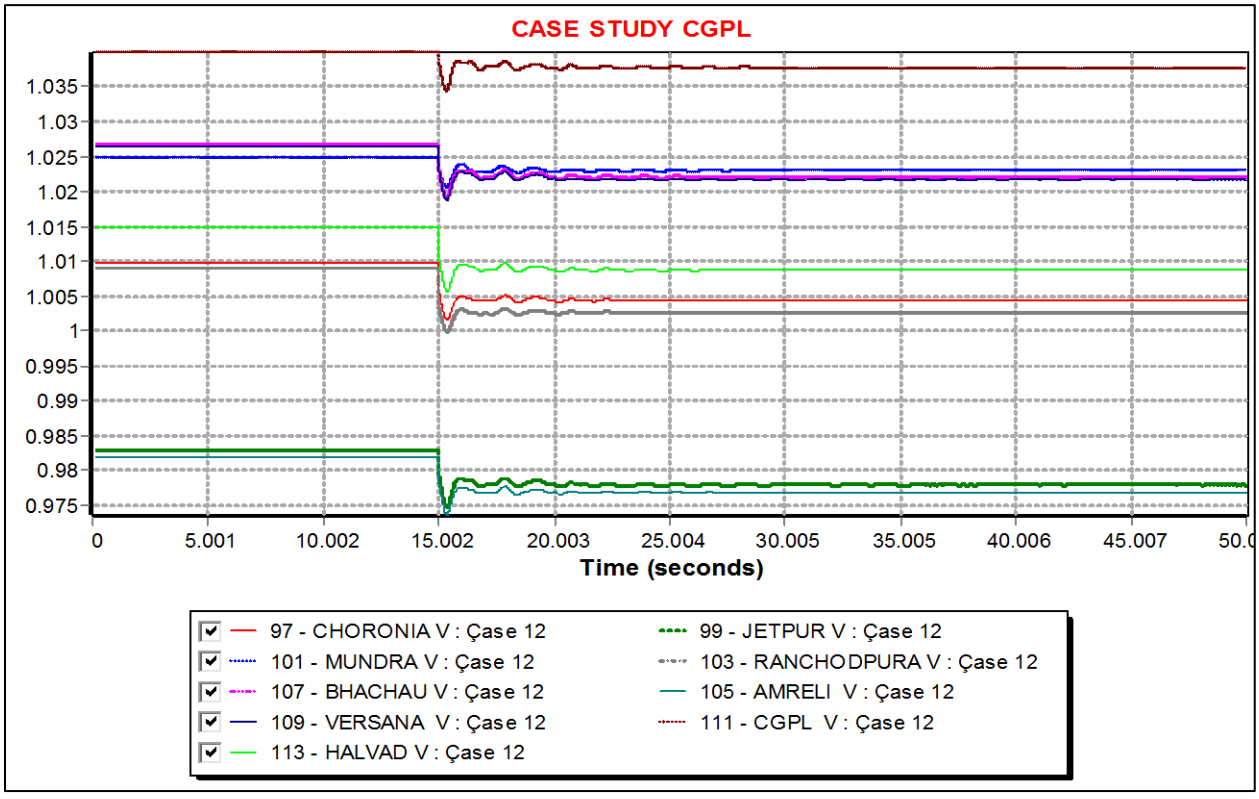
Case 11:

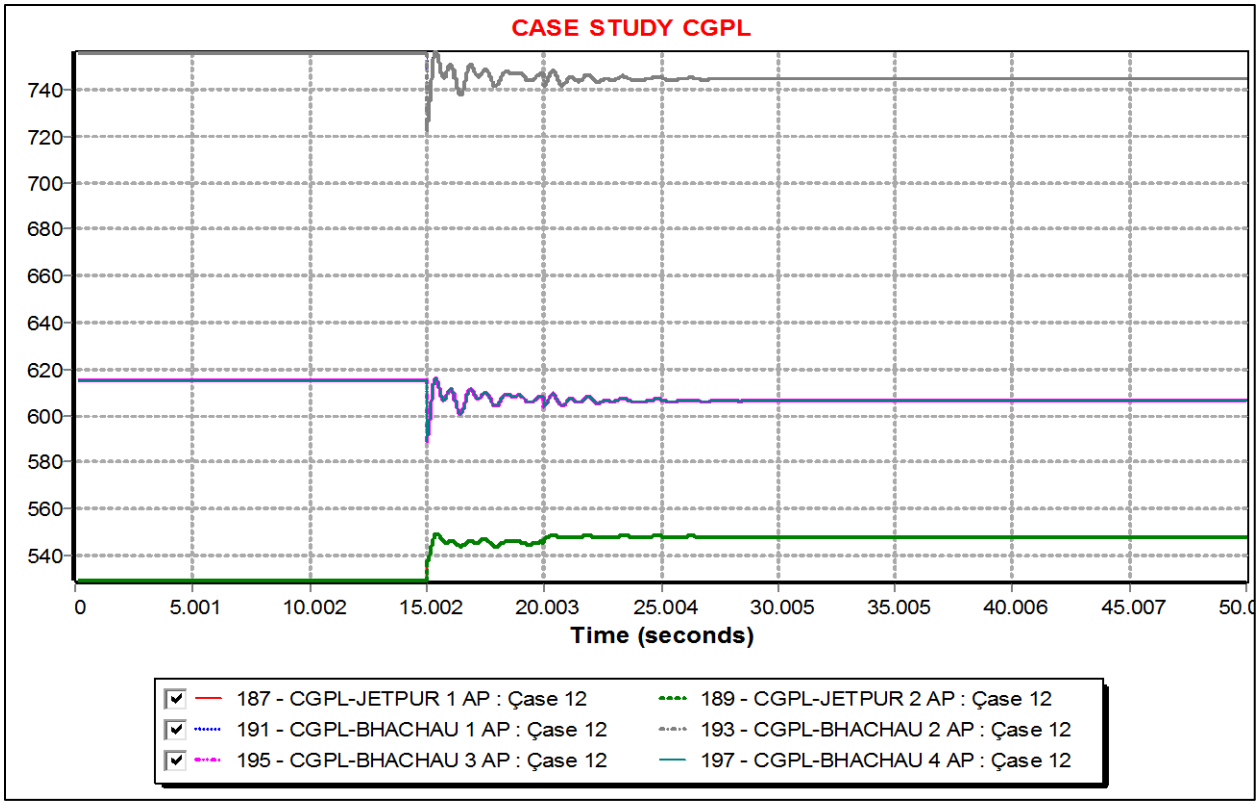

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 11
101 - MUNDRA V : Çase 11
107 - BHACHAU V : Çase 11
109 - VERSANA V : Çase 11
113 - HALVAD V : Çase 11
99 - JETPUR V : Çase 11
103 - RANCHODPURA V : Çase 11
105 - AMRELI V : Çase 11
111 - CGPL V : Çase 11

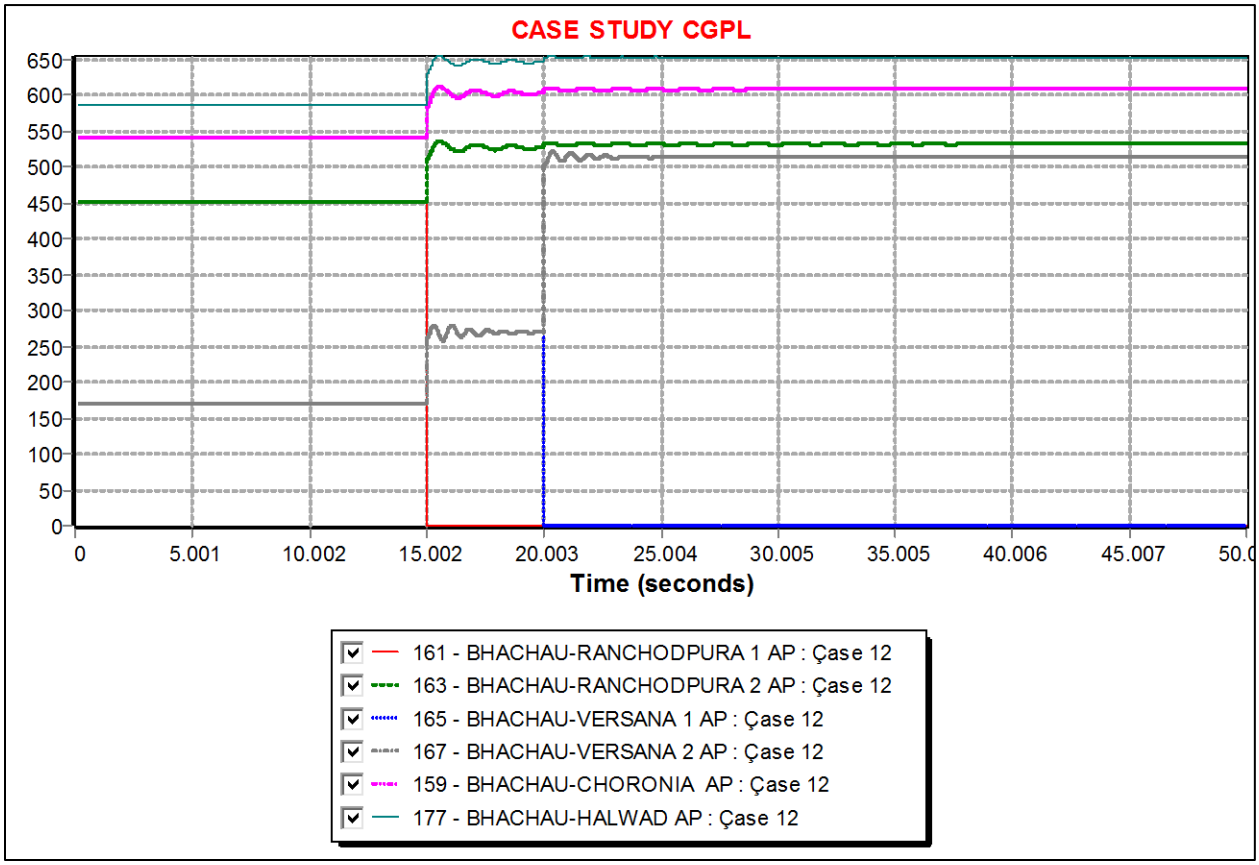

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 11
191 - CGPL-BHACHAU 1 AP : Çase 11
195 - CGPL-BHACHAU 3 AP : Çase 11
189 - CGPL-JETPUR 2 AP : Çase 11
193 - CGPL-BHACHAU 2 AP : Çase 11
197 - CGPL-BHACHAU 4 AP : Çase 11


CASE STUDY CGPL
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 11
163 - BHACHAU-RANCHODPURA 2 AP : Çase 11
165 - BHACHAU-VERSANA 1 AP : Çase 11
167 - BHACHAU-VERSANA 2 AP : Çase 11
159 - BHACHAU-CHORONIA AP : Çase 11
177 - BHACHAU-HALWAD AP : Çase 11

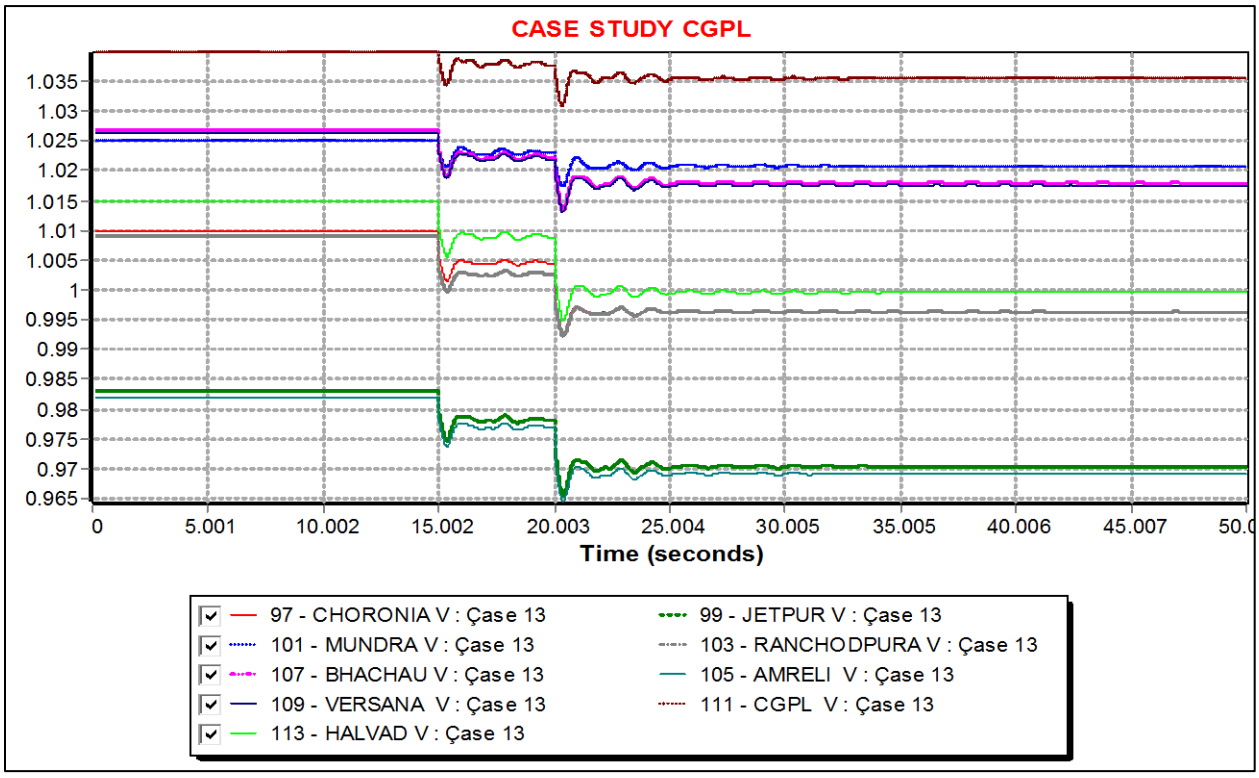
Case 12 :

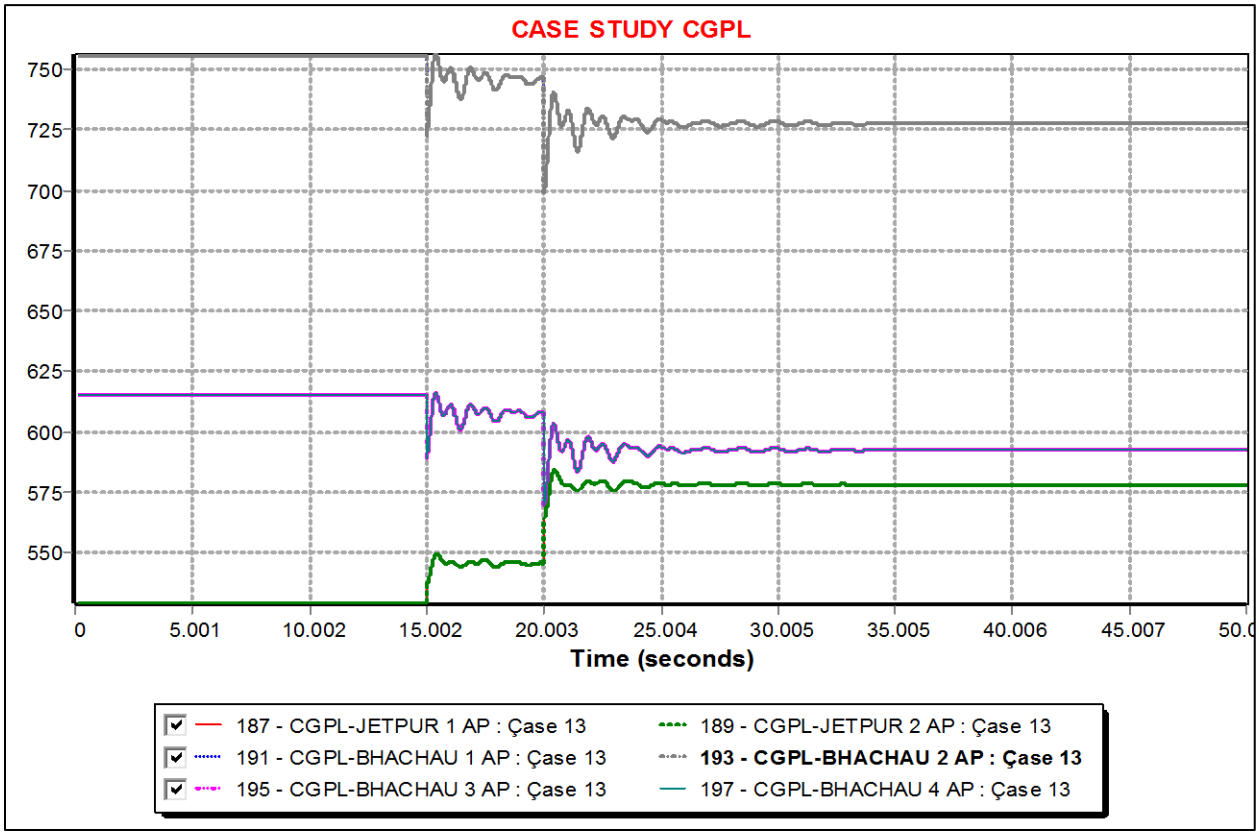

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 12
99 - JETPUR V : Çase 12
101 - MUNDRA V : Çase 12
103 - RANCHODPURA V : Çase 12
107 - BHACHAU V : Çase 12
105 - AMRELI V : Çase 12
109 - VERSANA V : Çase 12
111 - CGPL V : Çase 12
113 - HALVAD V : Çase 12

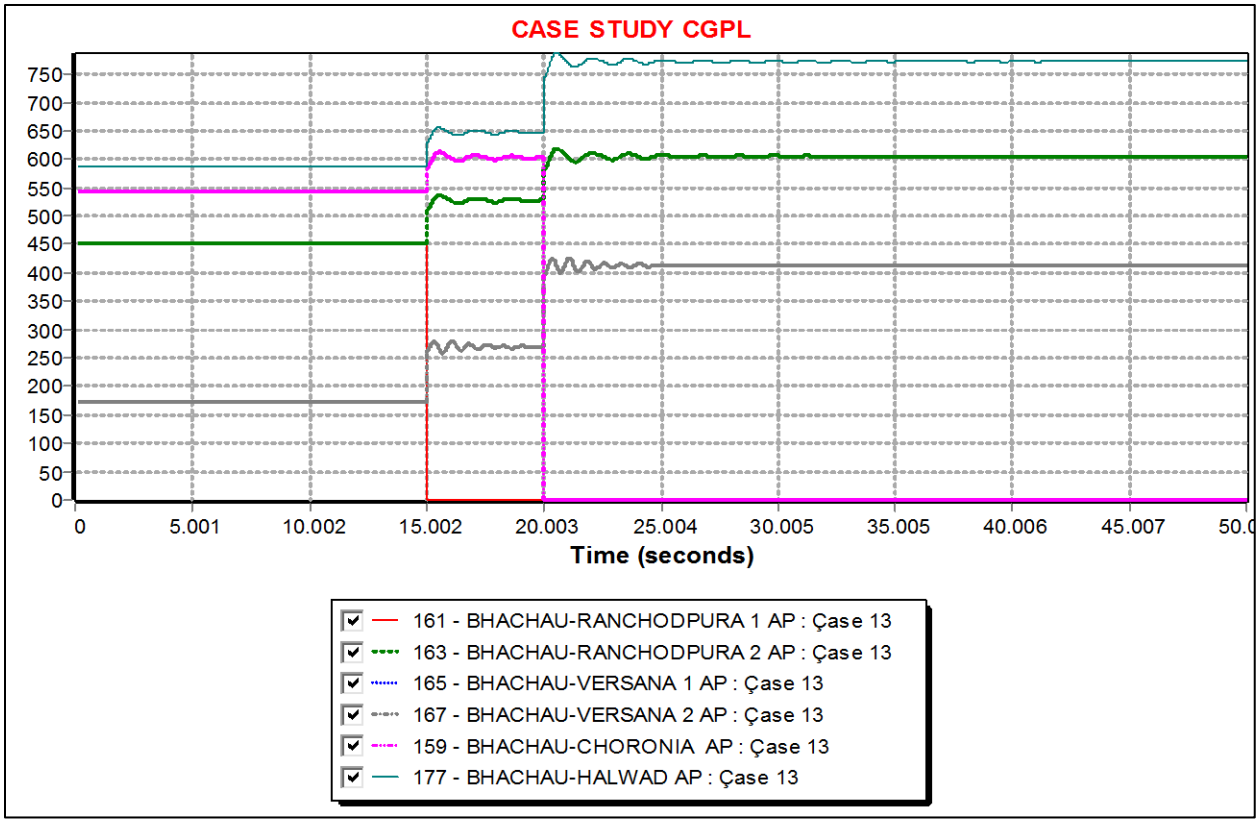

CASE STUDY CGPL
740
720
700
680
660
640
620
600
580
560
540
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 12
189 - CGPL-JETPUR 2 AP : Çase 12
191 - CGPL-BHACHAU 1 AP : Çase 12
193 - CGPL-BHACHAU 2 AP : Çase 12
195 - CGPL-BHACHAU 3 AP : Çase 12
197 - CGPL-BHACHAU 4 AP : Çase 12


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 12
163 - BHACHAU-RANCHODPURA 2 AP : Çase 12
165 - BHACHAU-VERSANA 1 AP : Çase 12
167 - BHACHAU-VERSANA 2 AP : Çase 12
159 - BHACHAU-CHORONIA AP : Çase 12
177 - BHACHAU-HALWAD AP : Çase 12

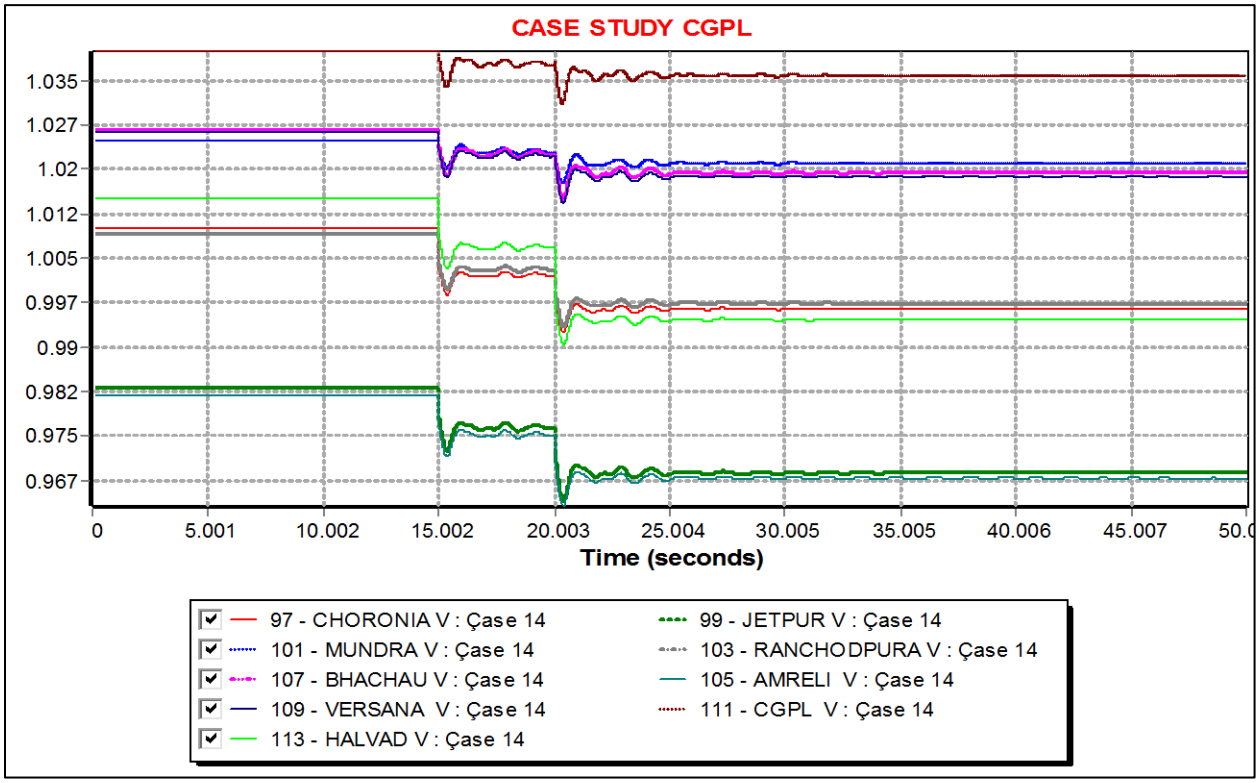
Case 13 :

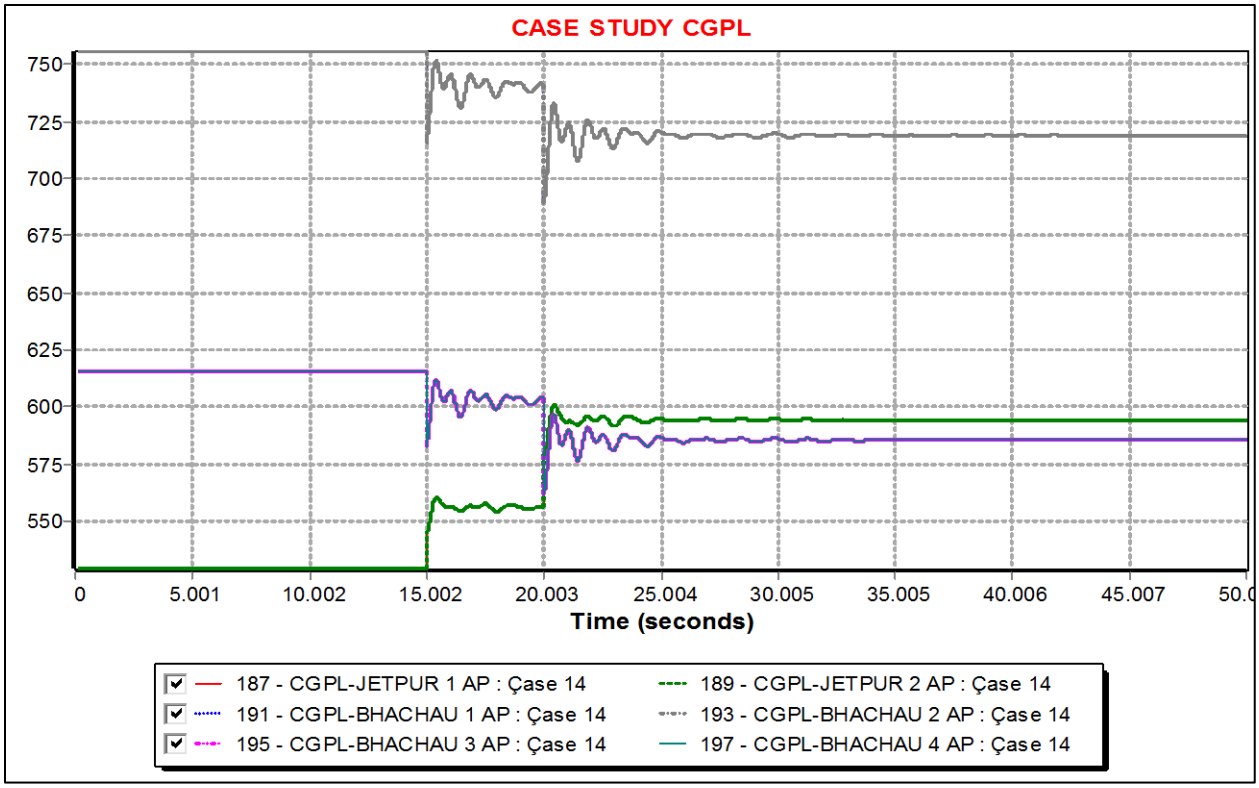

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 13
101 - MUNDRA V : Case 13
107 - BHACHAU V : Case 13
109 - VERSANA V : Case 13
113 - HALVAD V : Case 13
99 - JETPUR V : Case 13
103 - RANCHODPURA V : Case 13
105 - AMRELI V : Case 13
111 - CGPL V : Case 13

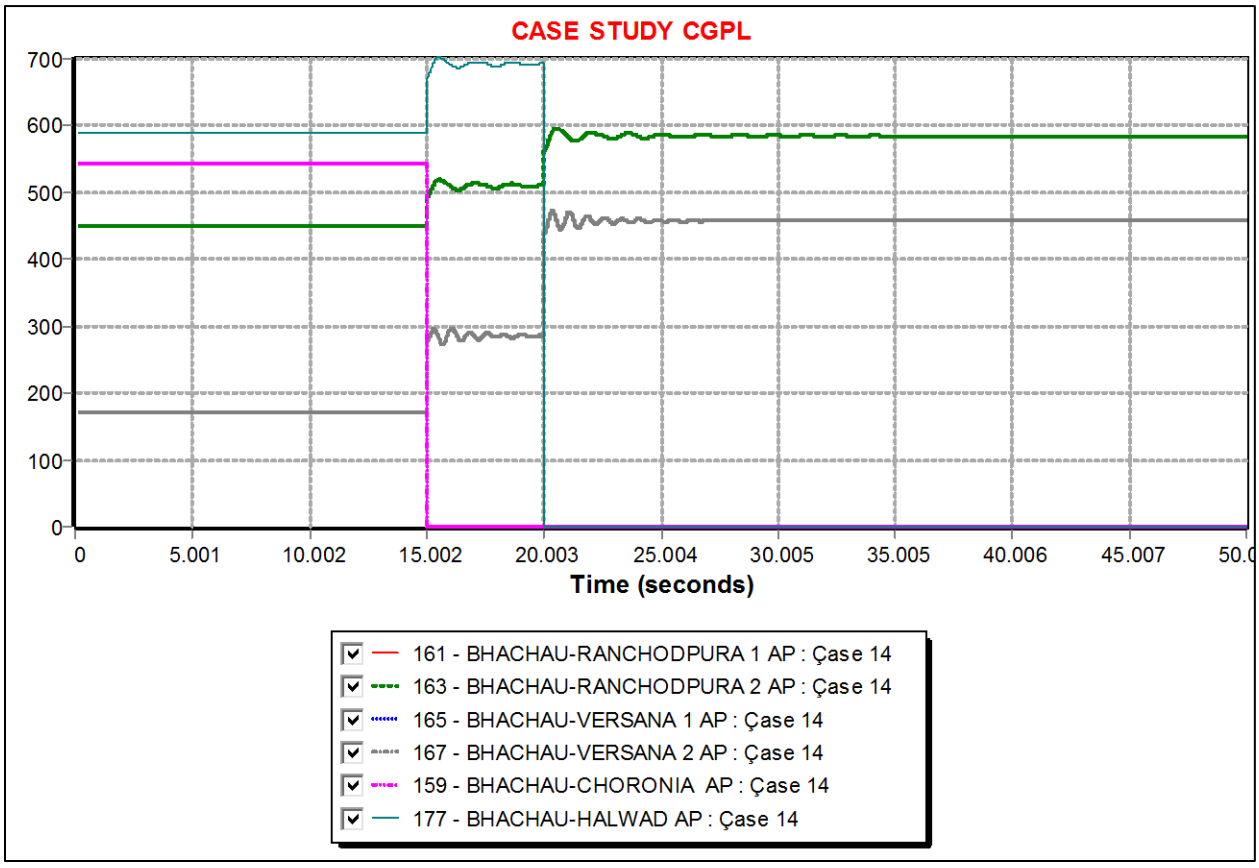

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 13
191 - CGPL-BHACHAU 1 AP : Case 13
195 - CGPL-BHACHAU 3 AP : Case 13
189 - CGPL-JETPUR 2 AP : Case 13
193 - CGPL-BHACHAU 2 AP : Case 13
197 - CGPL-BHACHAU 4 AP : Case 13


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 13
163 - BHACHAU-RANCHODPURA 2 AP : Çase 13
165 - BHACHAU-VERSANA 1 AP : Çase 13
167 - BHACHAU-VERSANA 2 AP : Çase 13
159 - BHACHAU-CHORONIA AP : Çase 13
177 - BHACHAU-HALWAD AP : Çase 13

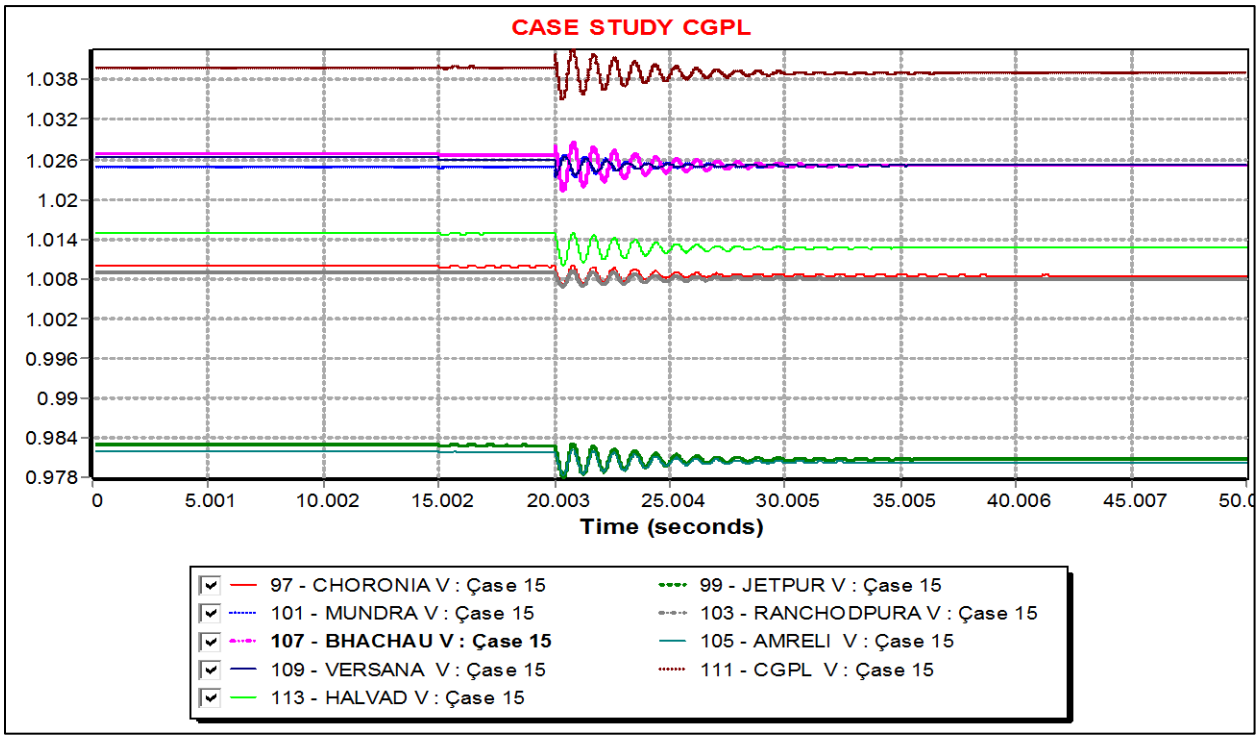
Case 14

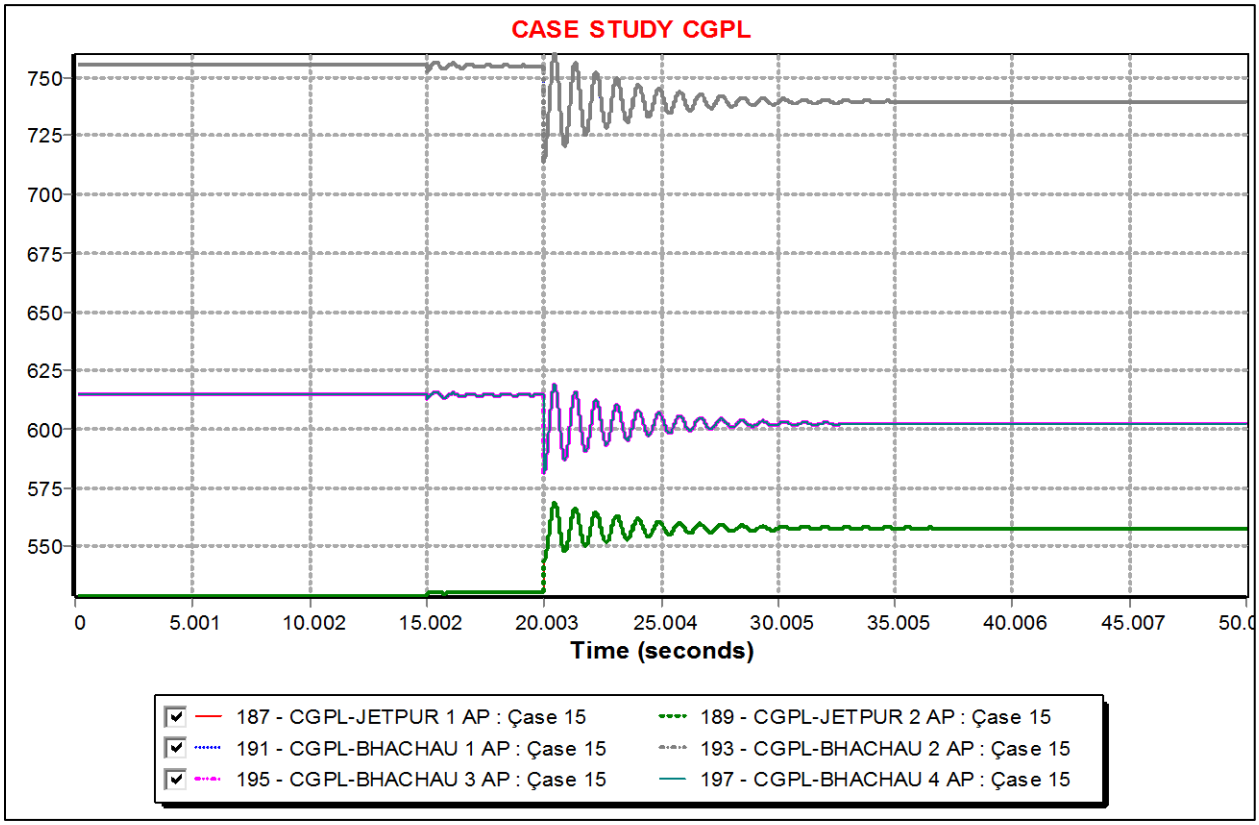

CASE STUDY CGPL
1.035
1.027
1.02
1.012
1.005
0.997
0.99
0.982
0.975
0.967
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 14
99 - JETPUR V : Çase 14
101 - MUNDRA V : Çase 14
103 - RANCHODPURA V : Çase 14
107 - BHACHAU V : Çase 14
105 - AMRELI V : Çase 14
109 - VERSANA V : Çase 14
111 - CGPL V : Çase 14
113 - HALVAD V : Çase 14

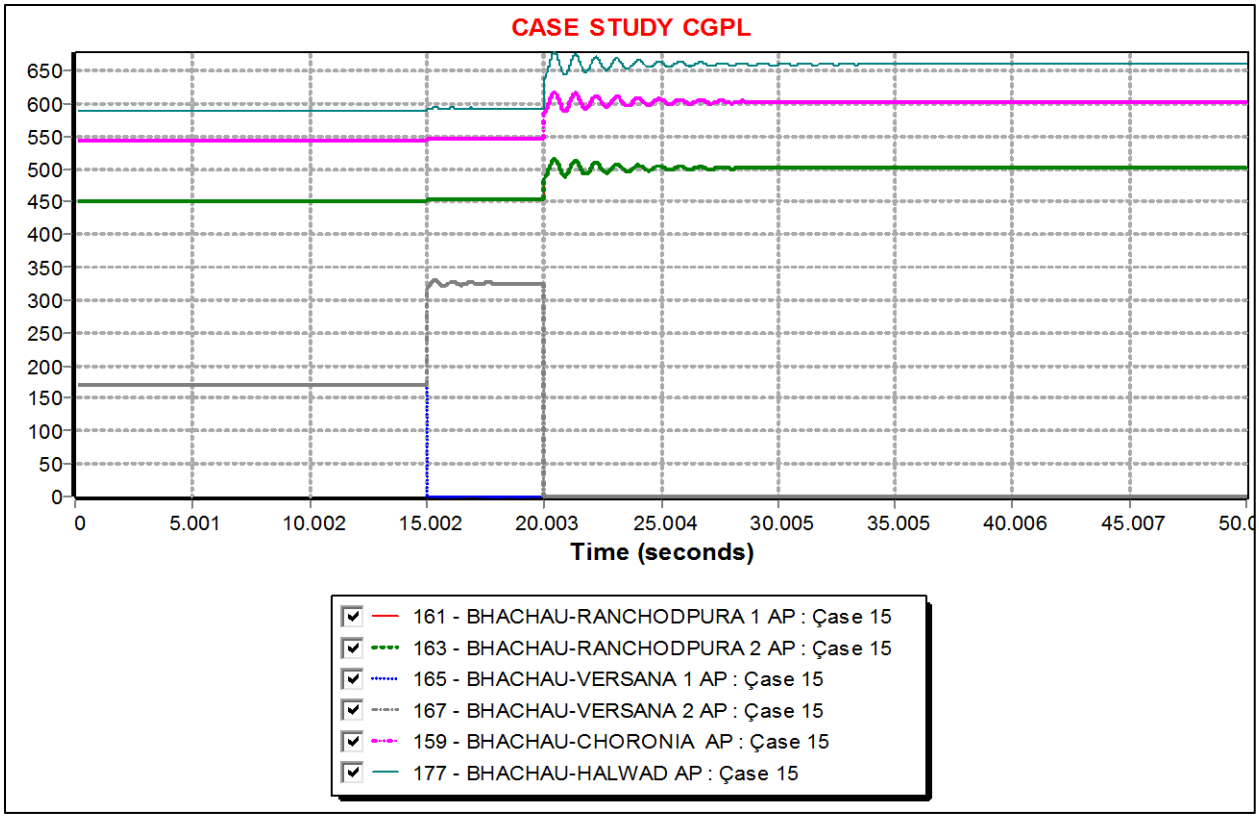

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 14
189 - CGPL-JETPUR 2 AP : Çase 14
191 - CGPL-BHACHAU 1 AP : Çase 14
193 - CGPL-BHACHAU 2 AP : Çase 14
195 - CGPL-BHACHAU 3 AP : Çase 14
197 - CGPL-BHACHAU 4 AP : Çase 14


CASE STUDY CGPL
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 14
163 - BHACHAU-RANCHODPURA 2 AP : Çase 14
165 - BHACHAU-VERSANA 1 AP : Çase 14
167 - BHACHAU-VERSANA 2 AP : Çase 14
159 - BHACHAU-CHORONIA AP : Çase 14
177 - BHACHAU-HALWAD AP : Çase 14

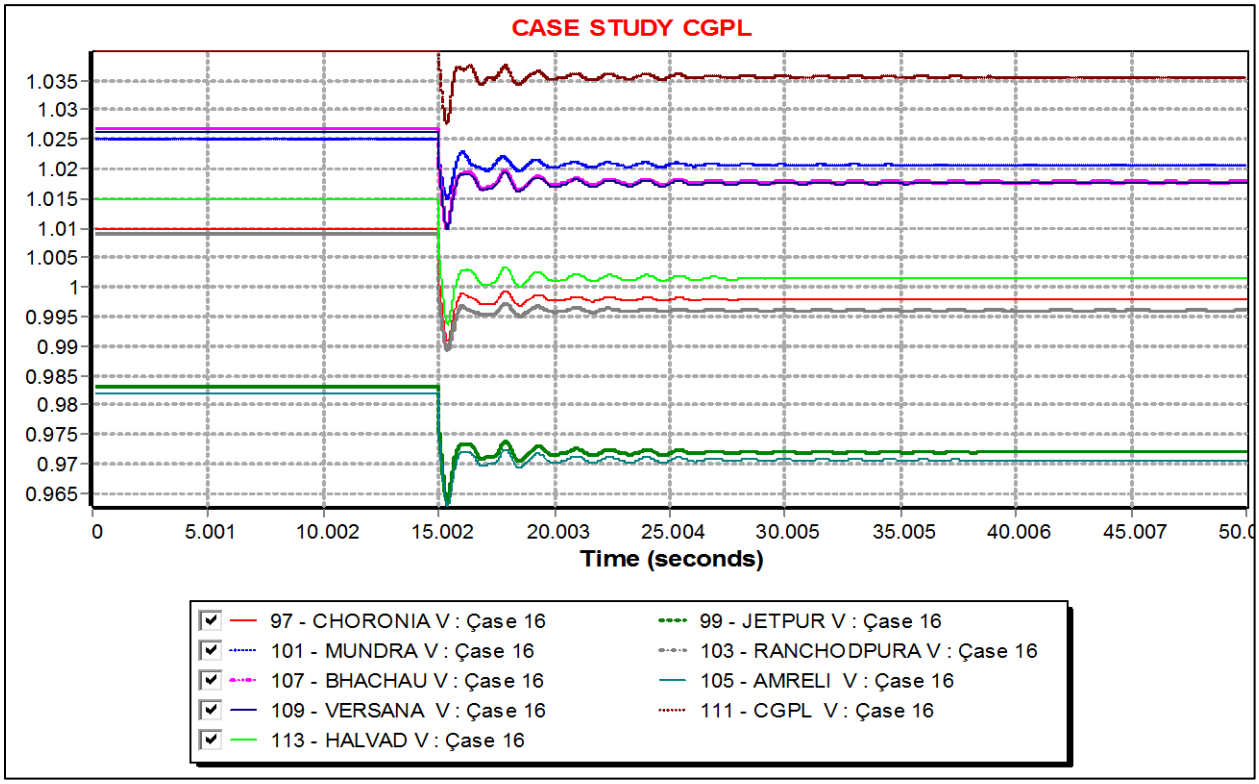
Case 15:

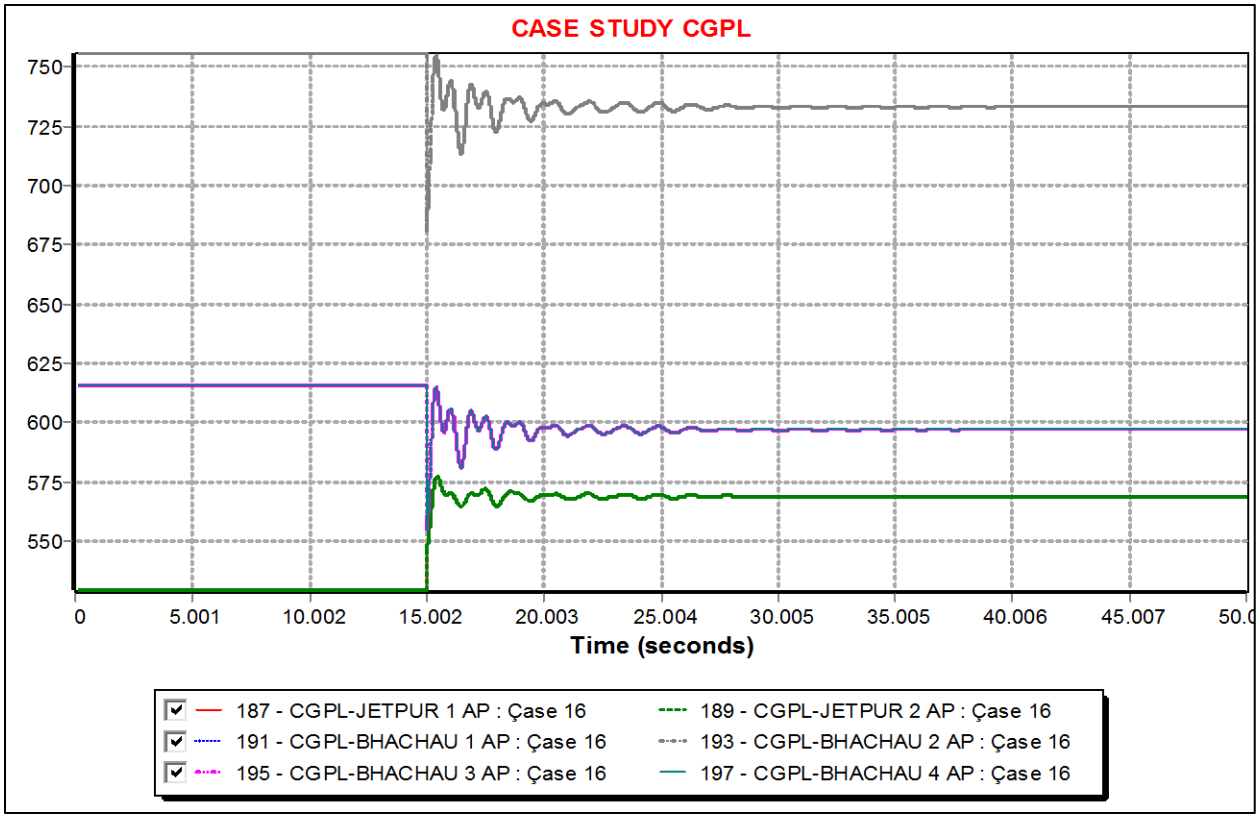

CASE STUDY CGPL
1.038
1.032
1.026
1.02
1.014
1.008
1.002
0.996
0.99
0.984
0.978
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 15
101 - MUNDRA V : Case 15
107 - BHACHAU V : Case 15
109 - VERSANA V : Case 15
113 - HALVAD V : Case 15
99 - JETPUR V : Case 15
103 - RANCHODPURA V : Case 15
105 - AMRELI V : Case 15
111 - CGPL V : Case 15

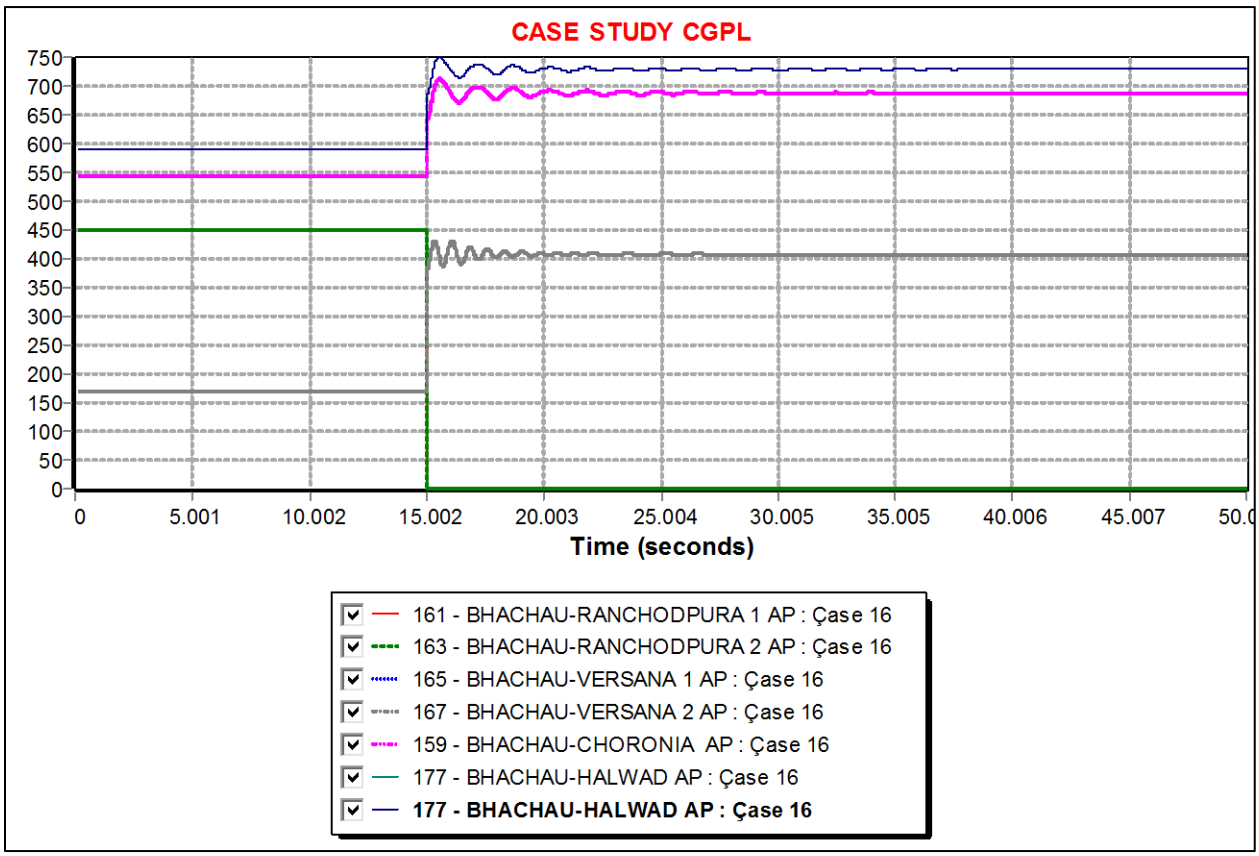

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 15
191 - CGPL-BHACHAU 1 AP : Case 15
195 - CGPL-BHACHAU 3 AP : Case 15
189 - CGPL-JETPUR 2 AP : Case 15
193 - CGPL-BHACHAU 2 AP : Case 15
197 - CGPL-BHACHAU 4 AP : Case 15


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 15
163 - BHACHAU-RANCHODPURA 2 AP : Çase 15
165 - BHACHAU-VERSANA 1 AP : Çase 15
167 - BHACHAU-VERSANA 2 AP : Çase 15
159 - BHACHAU-CHORONIA AP : Çase 15
177 - BHACHAU-HALWAD AP : Çase 15

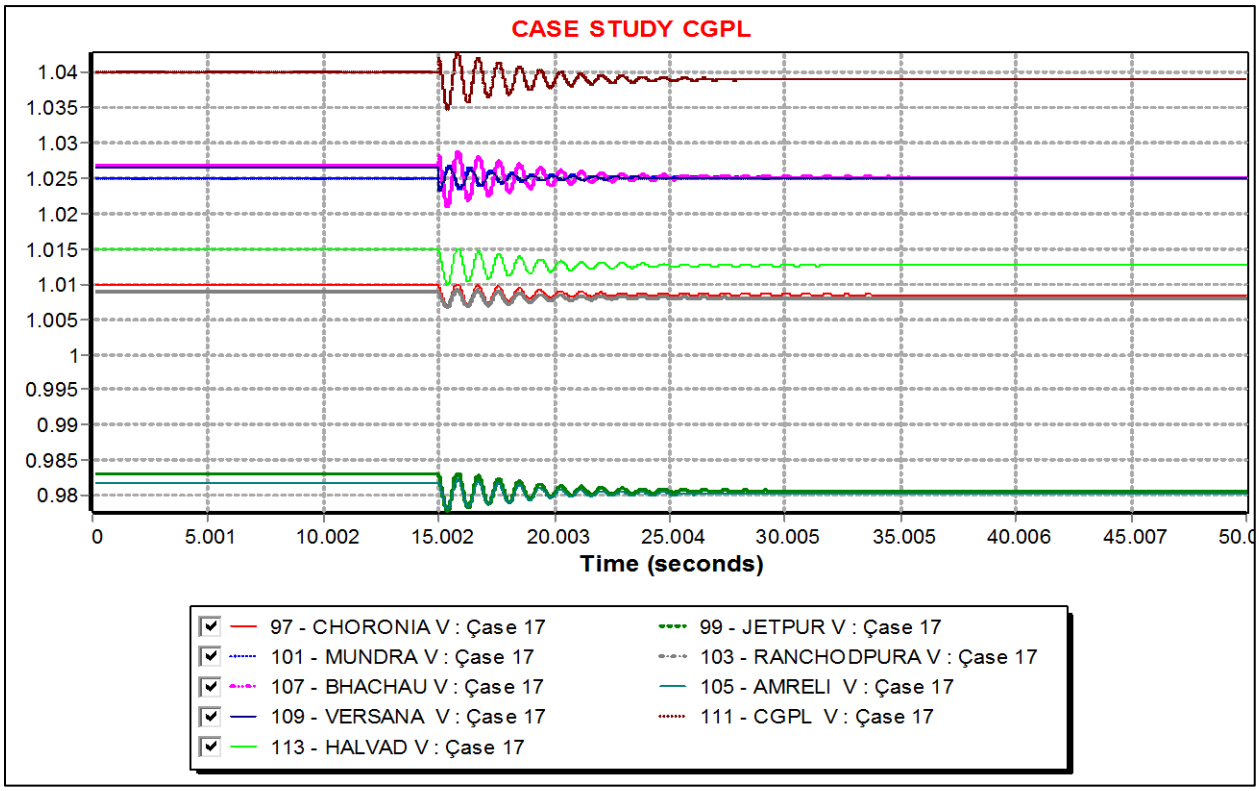
Case 16 :

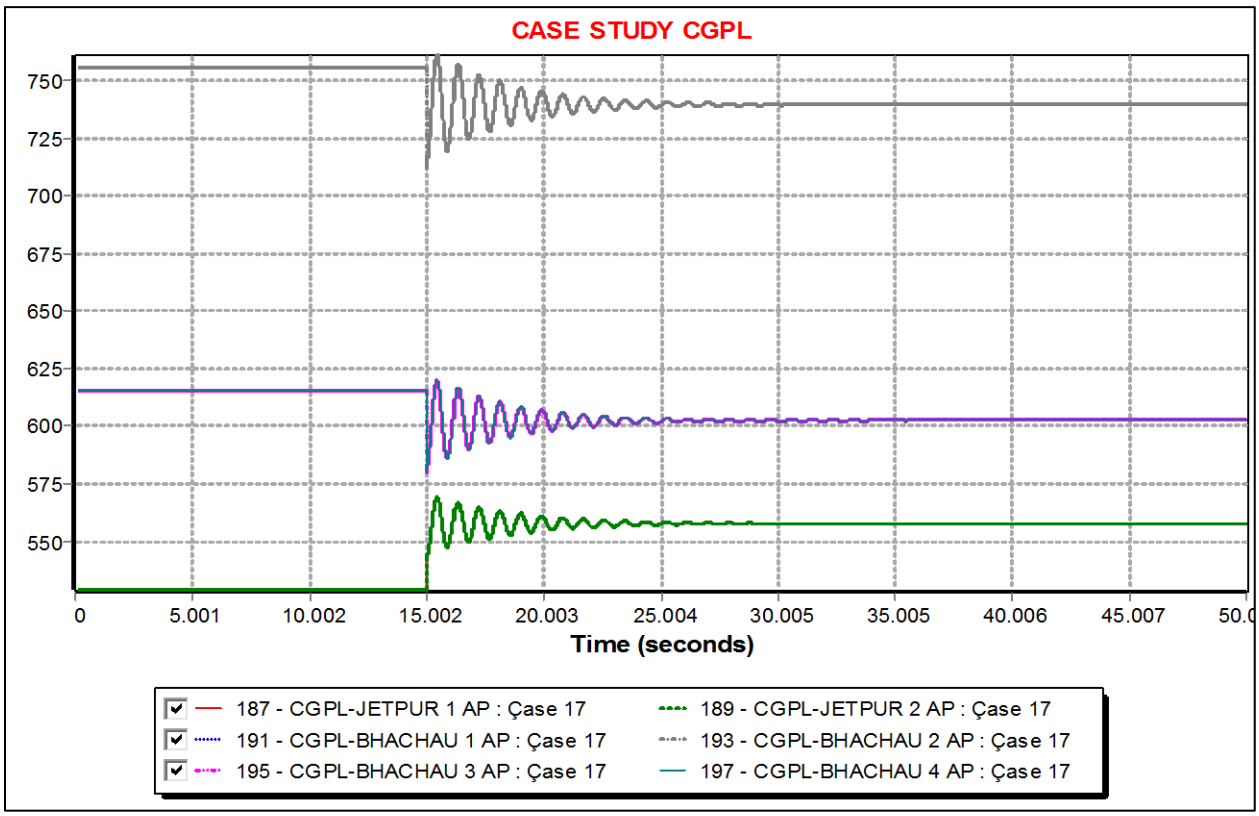

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 16
99 - JETPUR V : Çase 16
101 - MUNDRA V : Çase 16
103 - RANCHODPURA V : Çase 16
107 - BHACHAU V : Çase 16
105 - AMRELI V : Çase 16
109 - VERSANA V : Çase 16
111 - CGPL V : Çase 16
113 - HALVAD V : Çase 16

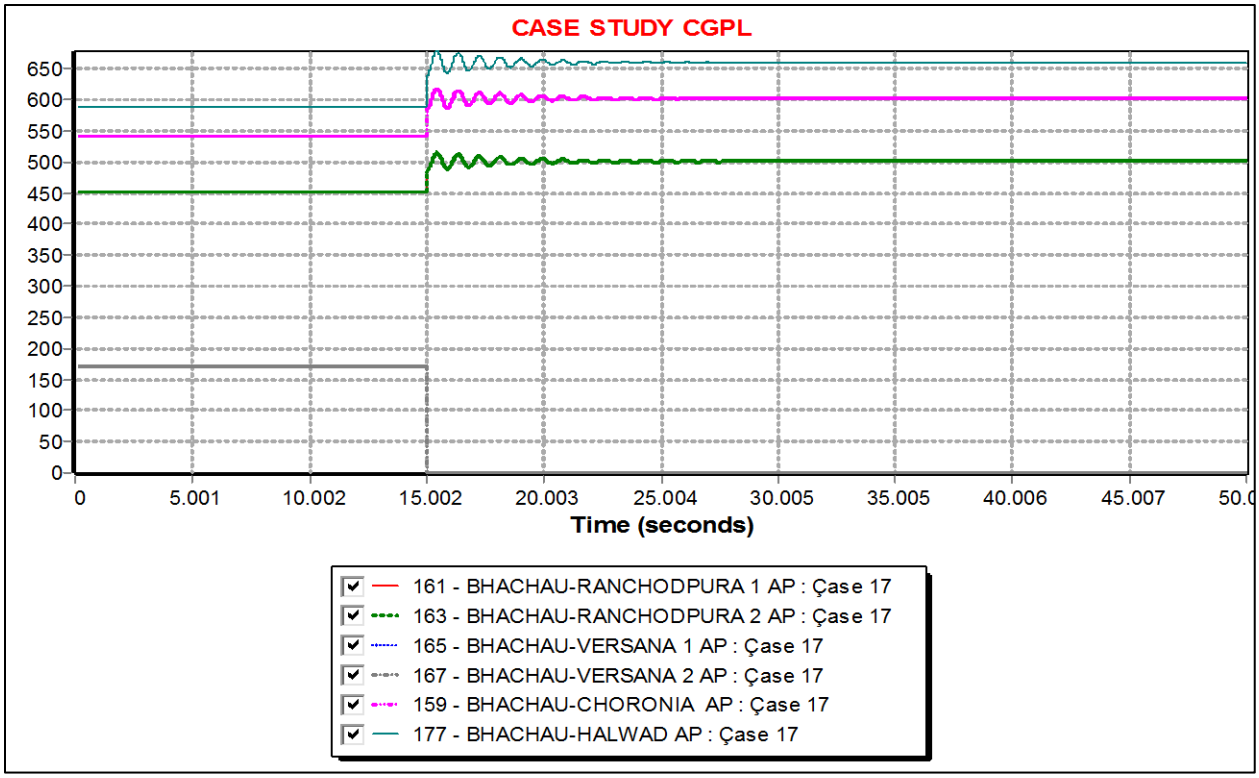

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 16
189 - CGPL-JETPUR 2 AP : Çase 16
191 - CGPL-BHACHAU 1 AP : Çase 16
193 - CGPL-BHACHAU 2 AP : Çase 16
195 - CGPL-BHACHAU 3 AP : Çase 16
197 - CGPL-BHACHAU 4 AP : Çase 16


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 16
163 - BHACHAU-RANCHODPURA 2 AP : Çase 16
165 - BHACHAU-VERSANA 1 AP : Çase 16
167 - BHACHAU-VERSANA 2 AP : Çase 16
159 - BHACHAU-CHORONIA AP : Çase 16
177 - BHACHAU-HALWAD AP : Çase 16
177 - BHACHAU-HALWAD AP : Çase 16

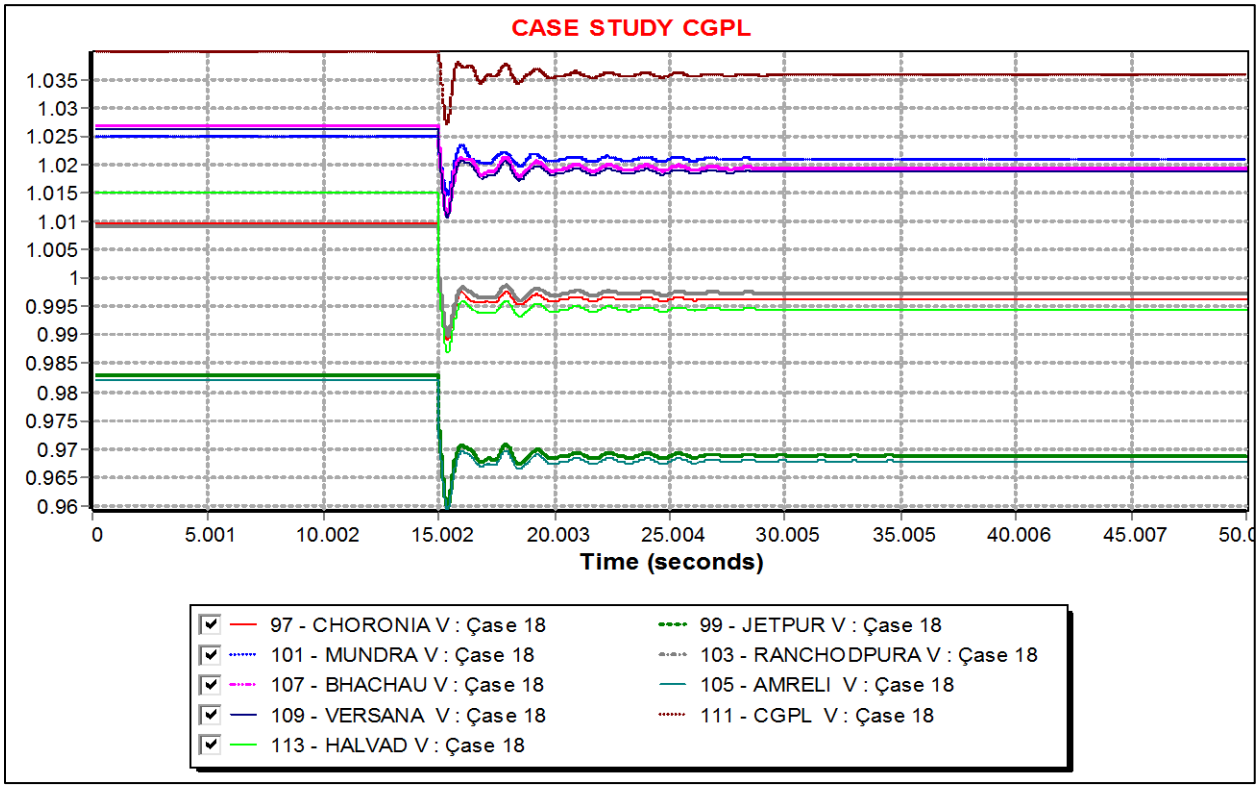
Case 17:

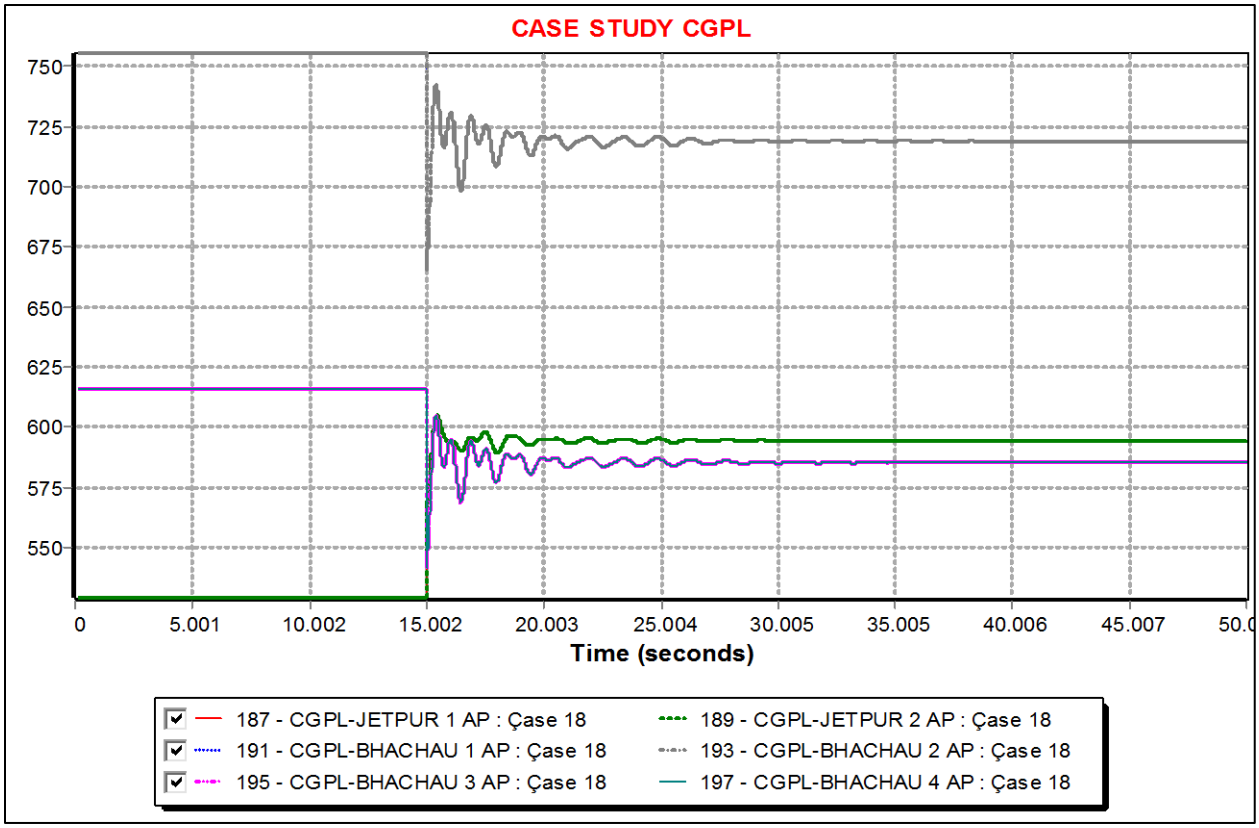

CASE STUDY CGPL
1.04
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 17
101 - MUNDRA V : Çase 17
107 - BHACHAU V : Çase 17
109 - VERSANA V : Çase 17
113 - HALVAD V : Çase 17
99 - JETPUR V : Çase 17
103 - RANCHODPURA V : Çase 17
105 - AMRELI V : Çase 17
111 - CGPL V : Çase 17

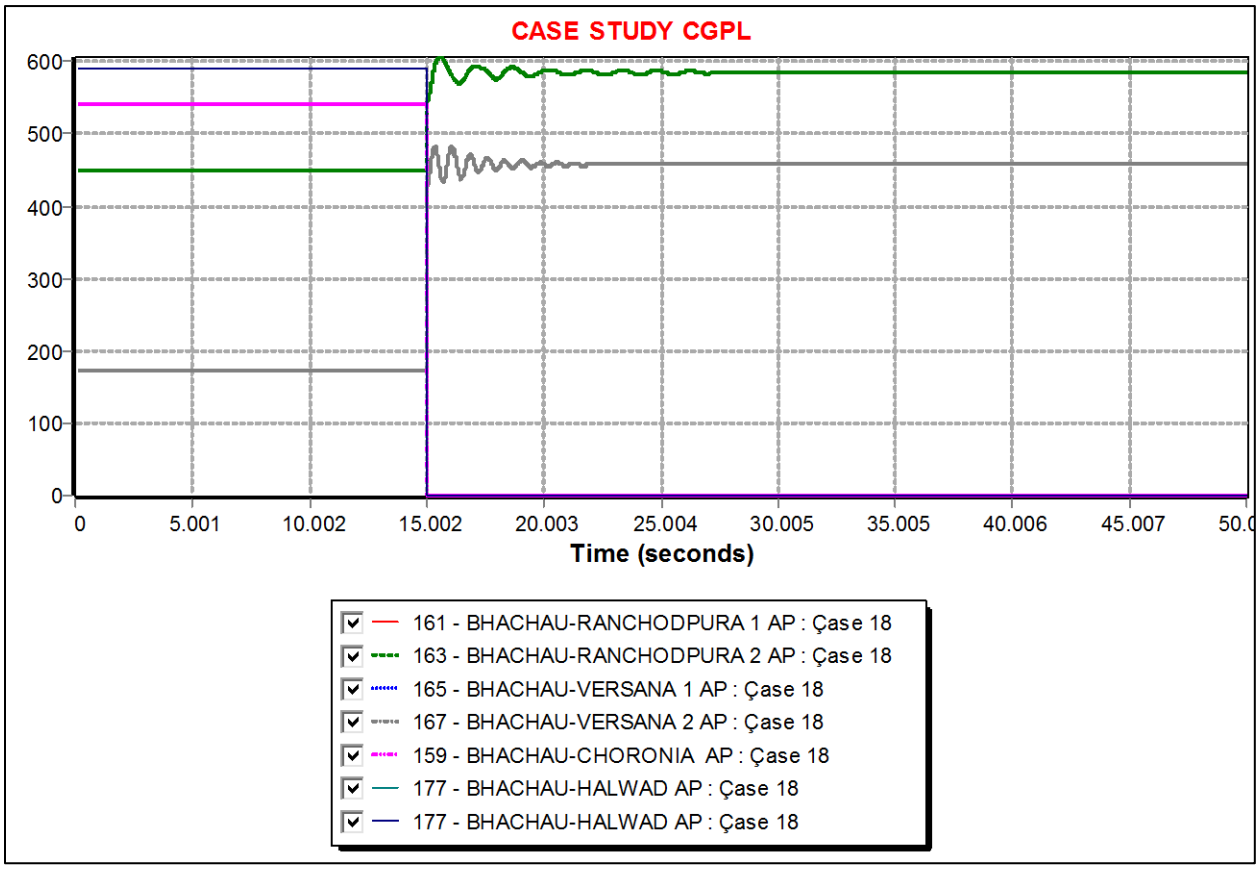

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 17
191 - CGPL-BHACHAU 1 AP : Çase 17
195 - CGPL-BHACHAU 3 AP : Çase 17
189 - CGPL-JETPUR 2 AP : Çase 17
193 - CGPL-BHACHAU 2 AP : Çase 17
197 - CGPL-BHACHAU 4 AP : Çase 17


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 17
163 - BHACHAU-RANCHODPURA 2 AP : Çase 17
165 - BHACHAU-VERSANA 1 AP : Çase 17
167 - BHACHAU-VERSANA 2 AP : Çase 17
159 - BHACHAU-CHORONIA AP : Çase 17
177 - BHACHAU-HALWAD AP : Çase 17

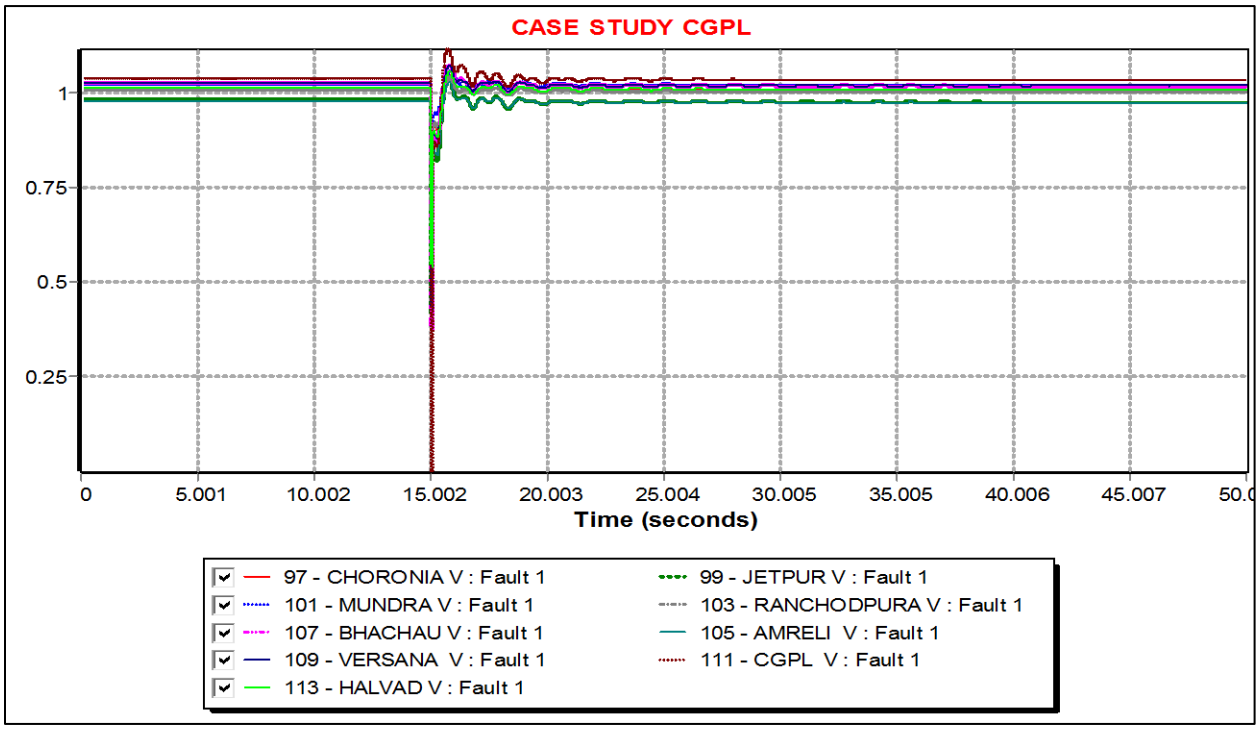
Case 18:

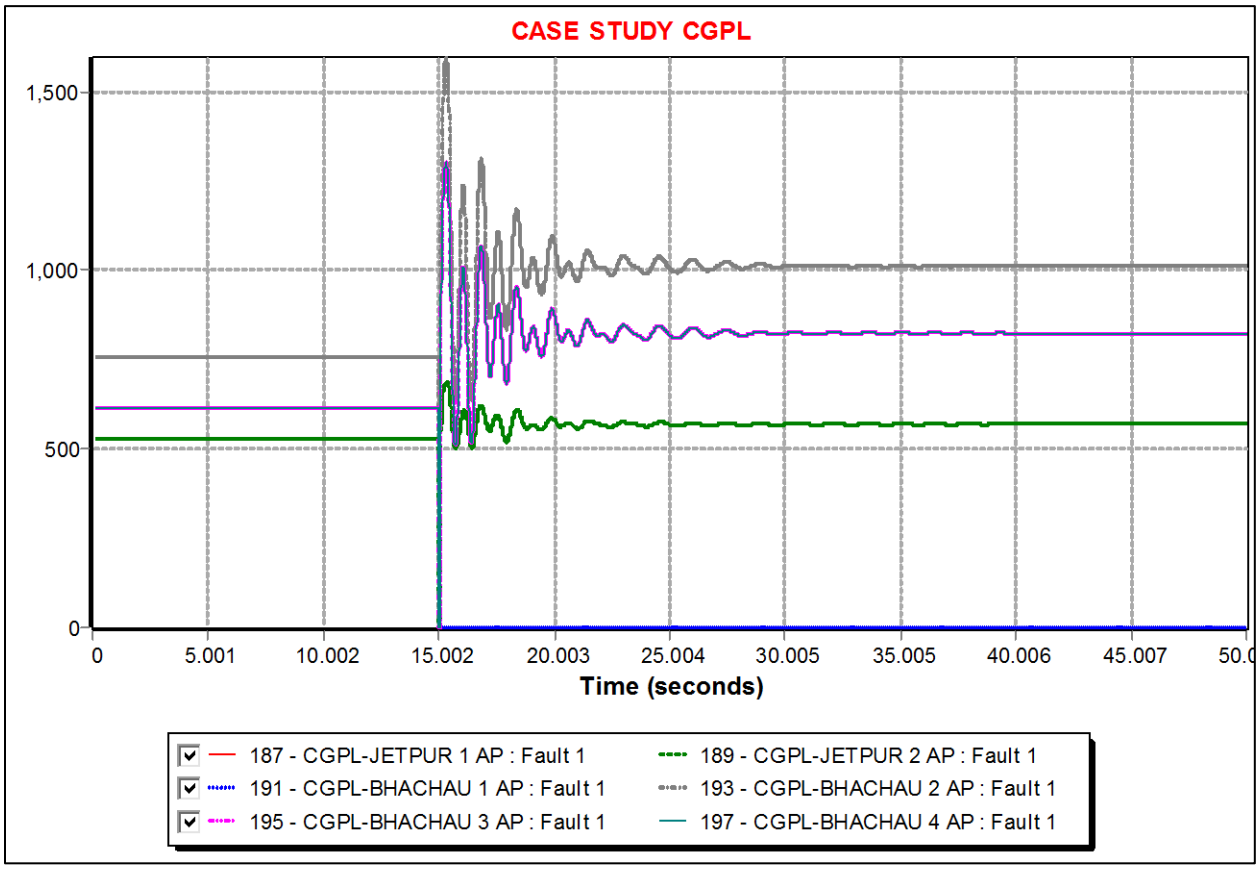

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 18
99 - JETPUR V : Çase 18
101 - MUNDRA V : Çase 18
103 - RANCHODPURA V : Çase 18
107 - BHACHAU V : Çase 18
105 - AMRELI V : Çase 18
109 - VERSANA V : Çase 18
111 - CGPL V : Çase 18
113 - HALVAD V : Çase 18

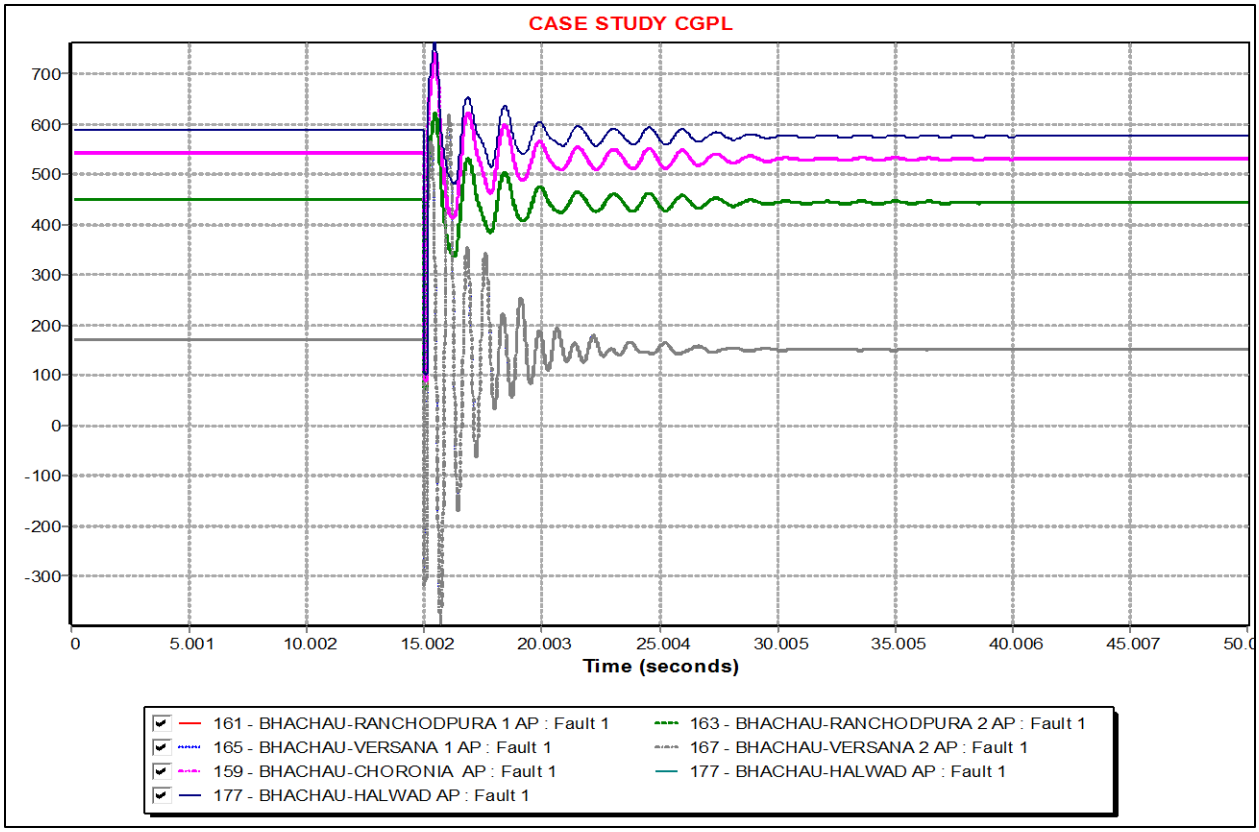

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 18
189 - CGPL-JETPUR 2 AP : Çase 18
191 - CGPL-BHACHAU 1 AP : Çase 18
193 - CGPL-BHACHAU 2 AP : Çase 18
195 - CGPL-BHACHAU 3 AP : Çase 18
197 - CGPL-BHACHAU 4 AP : Çase 18


CASE STUDY CGPL
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 18
163 - BHACHAU-RANCHODPURA 2 AP : Çase 18
165 - BHACHAU-VERSANA 1 AP : Çase 18
167 - BHACHAU-VERSANA 2 AP : Çase 18
159 - BHACHAU-CHORONIA AP : Çase 18
177 - BHACHAU-HALWAD AP : Çase 18
177 - BHACHAU-HALWAD AP : Çase 18

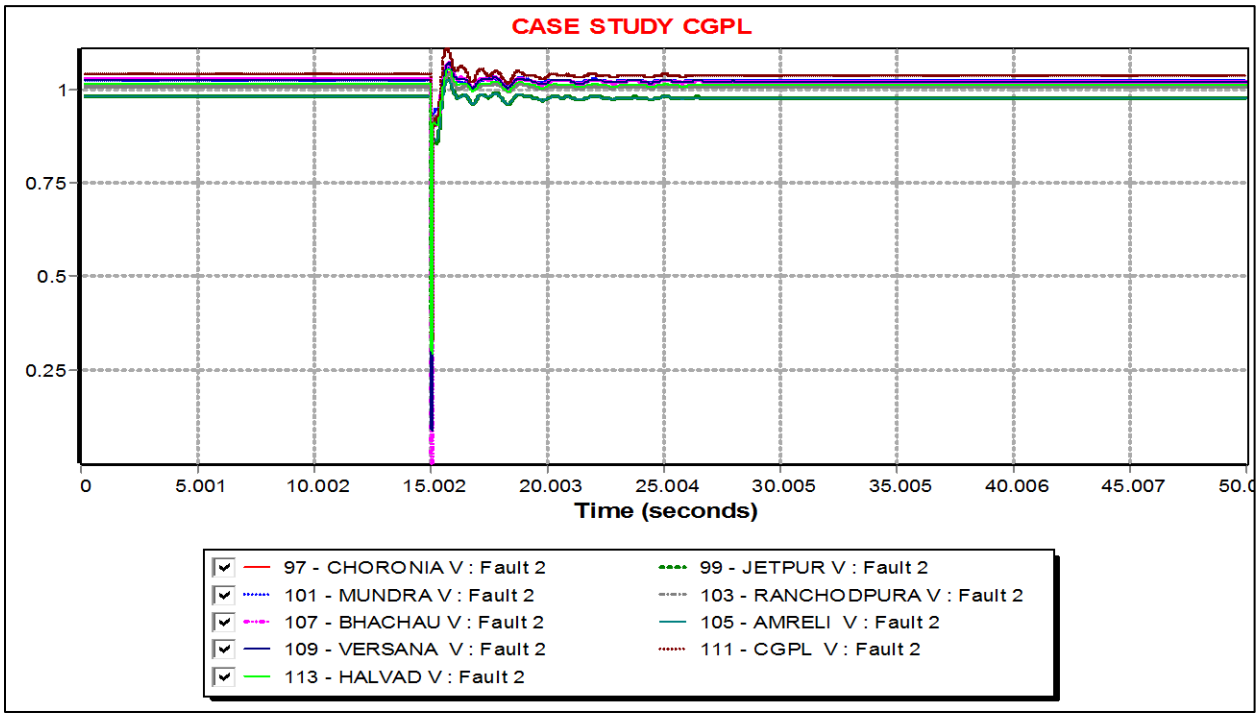
Fault 1:

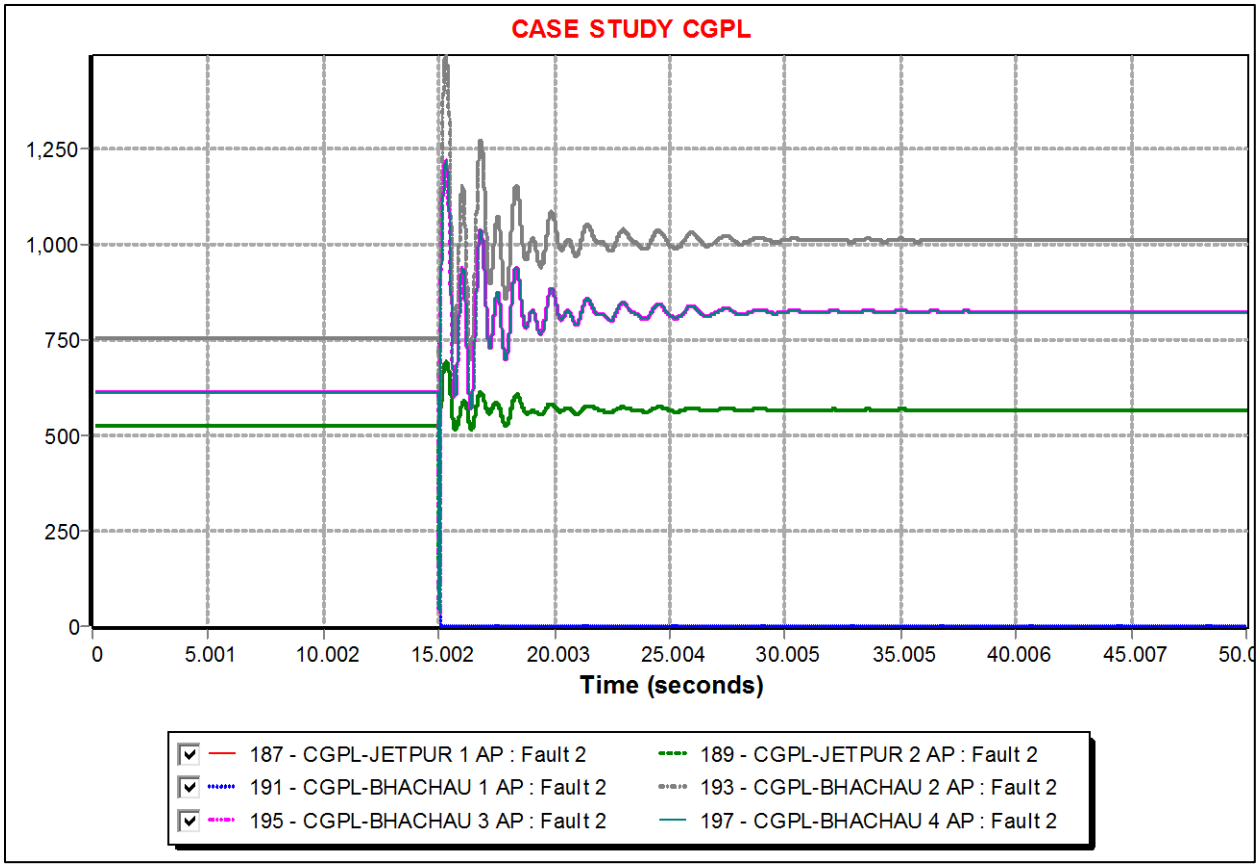

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 1
99 - JETPUR V : Fault 1
101 - MUNDRA V : Fault 1
103 - RANCHODPURA V : Fault 1
107 - BHACHAU V : Fault 1
105 - AMRELI V : Fault 1
109 - VERSANA V : Fault 1
111 - CGPL V : Fault 1
113 - HALVAD V : Fault 1

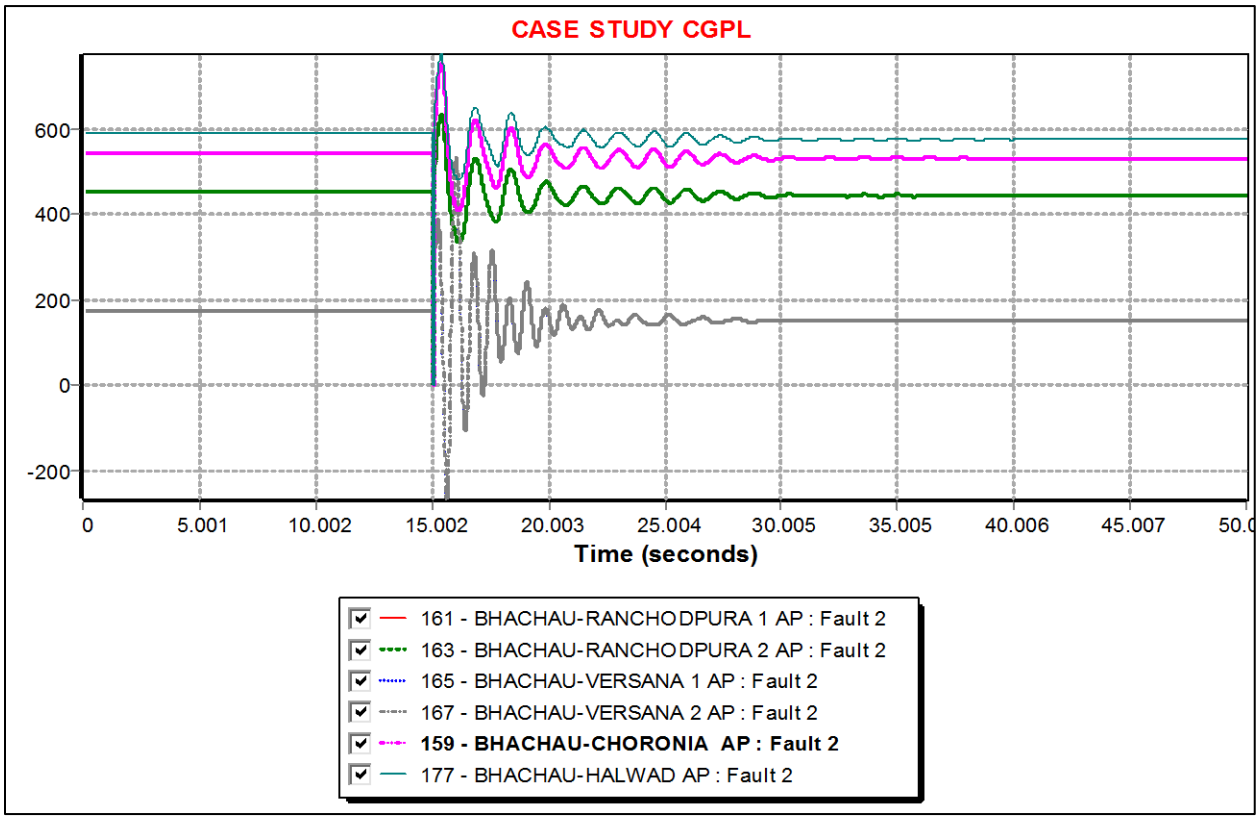

CASE STUDY CGPL
1,500
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 1
189 - CGPL-JETPUR 2 AP : Fault 1
191 - CGPL-BHACHAU 1 AP : Fault 1
193 - CGPL-BHACHAU 2 AP : Fault 1
195 - CGPL-BHACHAU 3 AP : Fault 1
197 - CGPL-BHACHAU 4 AP : Fault 1


CASE STUDY CGPL
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 1
165 - BHACHAU-VERSANA 1 AP : Fault 1
159 - BHACHAU-CHORONIA AP : Fault 1
177 - BHACHAU-HALWAD AP : Fault 1
163 - BHACHAU-RANCHODPURA 2 AP : Fault 1
167 - BHACHAU-VERSANA 2 AP : Fault 1
177 - BHACHAU-HALWAD AP : Fault 1

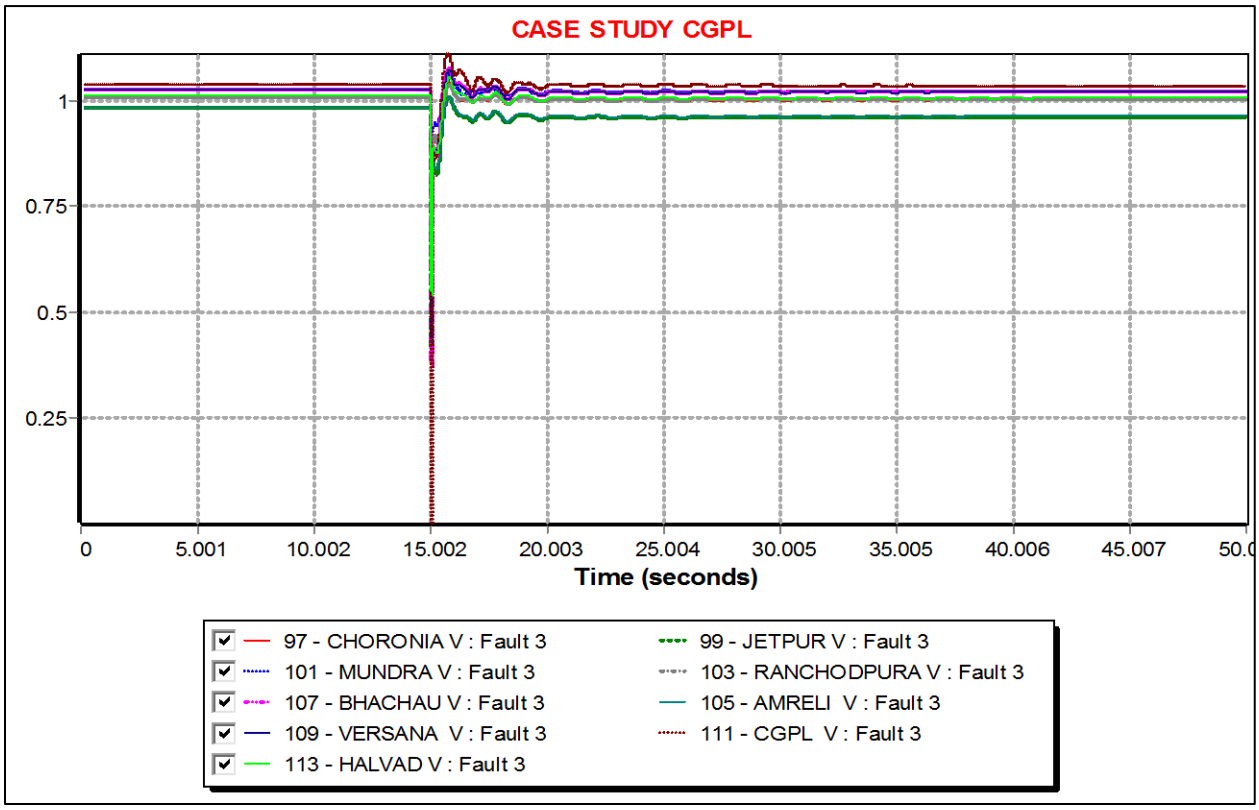
Fault 2:

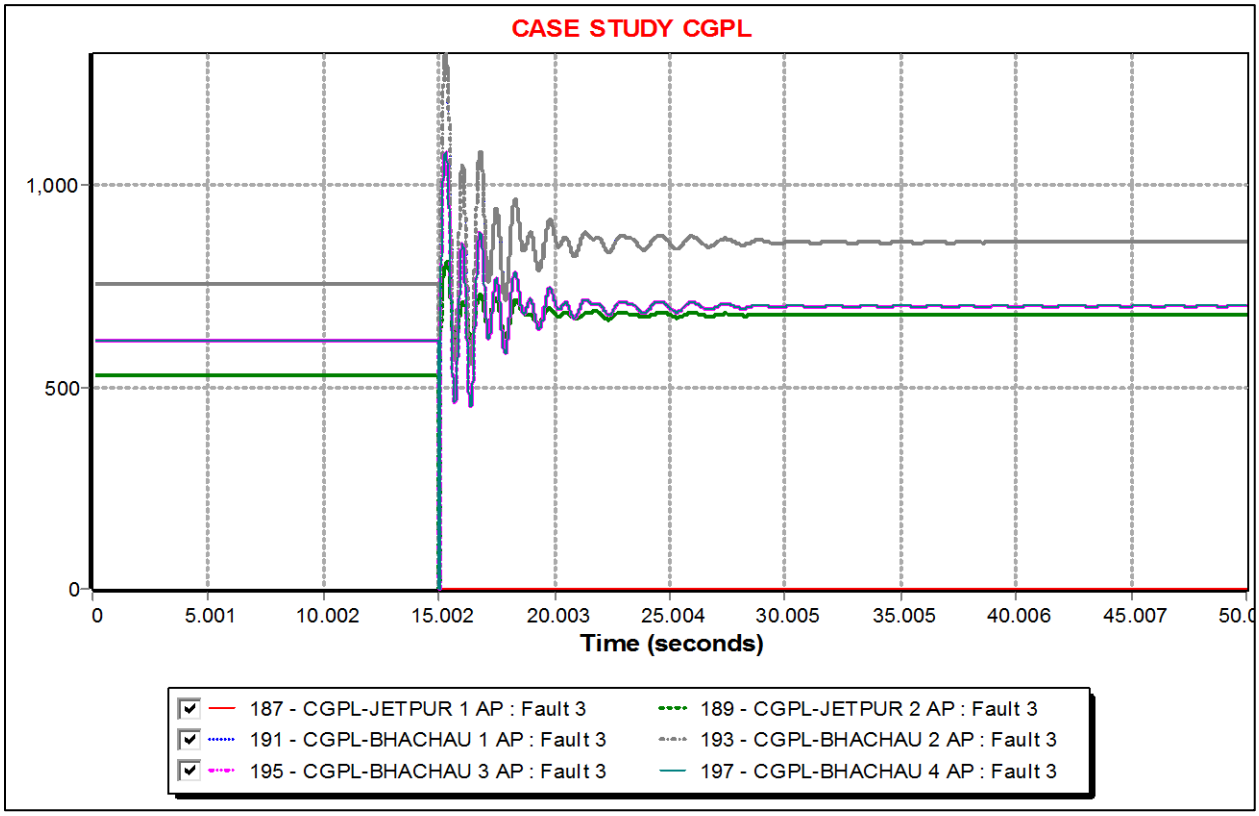

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 2
101 - MUNDRA V : Fault 2
107 - BHACHAU V : Fault 2
109 - VERSANA V : Fault 2
113 - HALVAD V : Fault 2
99 - JETPUR V : Fault 2
103 - RANCHODPURA V : Fault 2
105 - AMRELI V : Fault 2
111 - CGPL V : Fault 2

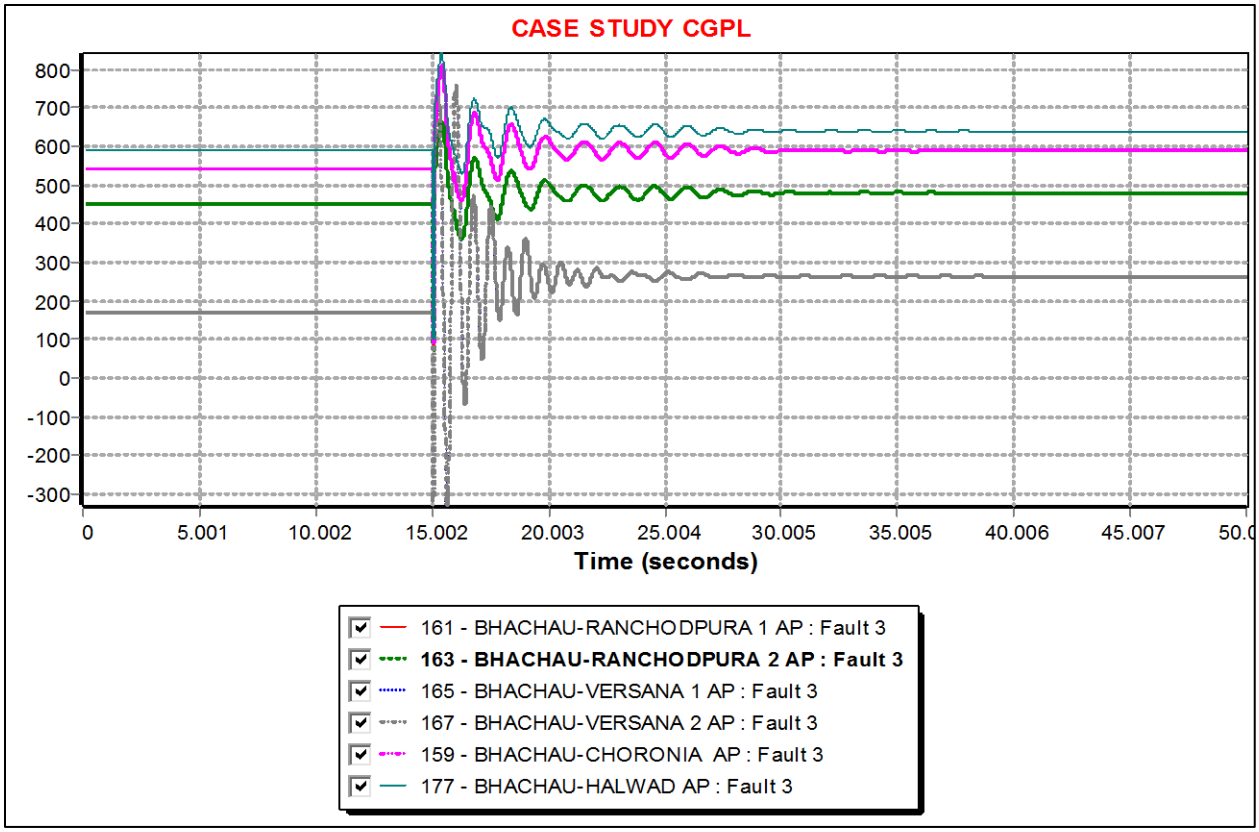

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 2
189 - CGPL-JETPUR 2 AP : Fault 2
191 - CGPL-BHACHAU 1 AP : Fault 2
193 - CGPL-BHACHAU 2 AP : Fault 2
195 - CGPL-BHACHAU 3 AP : Fault 2
197 - CGPL-BHACHAU 4 AP : Fault 2


CASE STUDY CGPL
600
400
200
0
-200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 2
163 - BHACHAU-RANCHODPURA 2 AP : Fault 2
165 - BHACHAU-VERSANA 1 AP : Fault 2
167 - BHACHAU-VERSANA 2 AP : Fault 2
159 - BHACHAU-CHORONIA AP : Fault 2
177 - BHACHAU-HALWAD AP : Fault 2

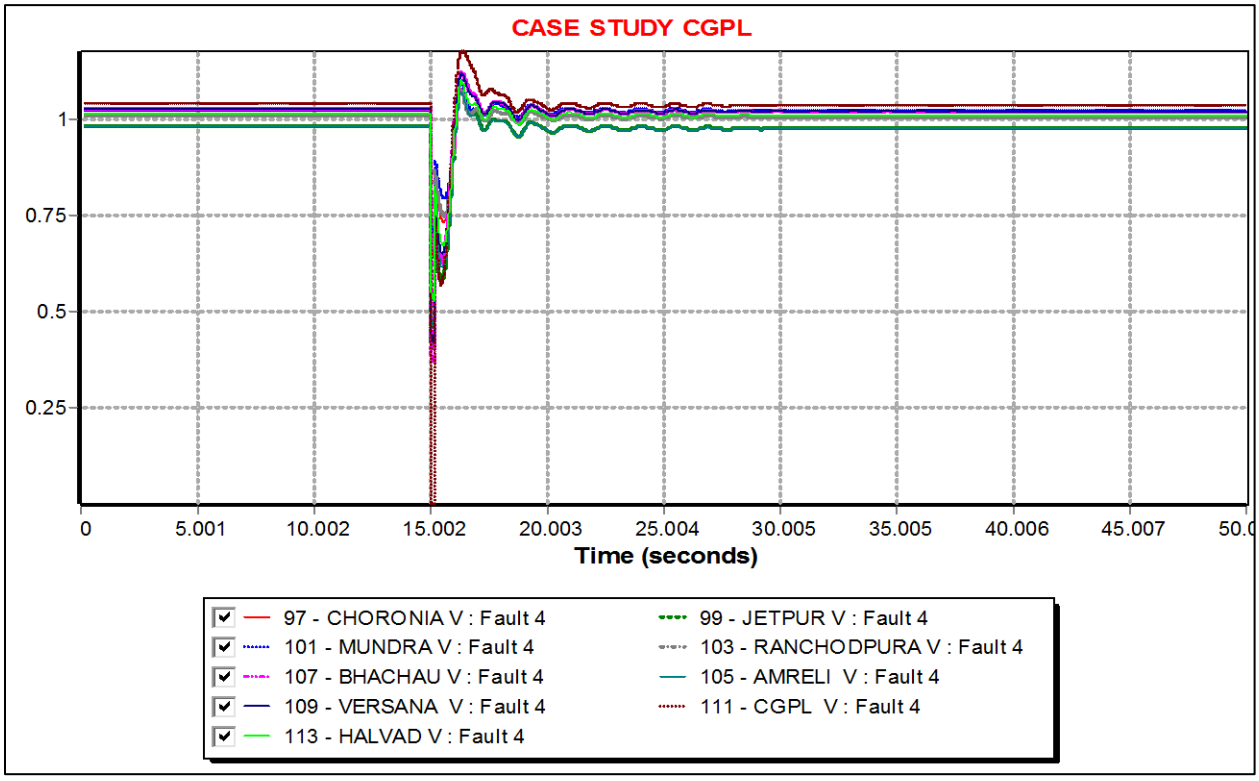
Fault 3:

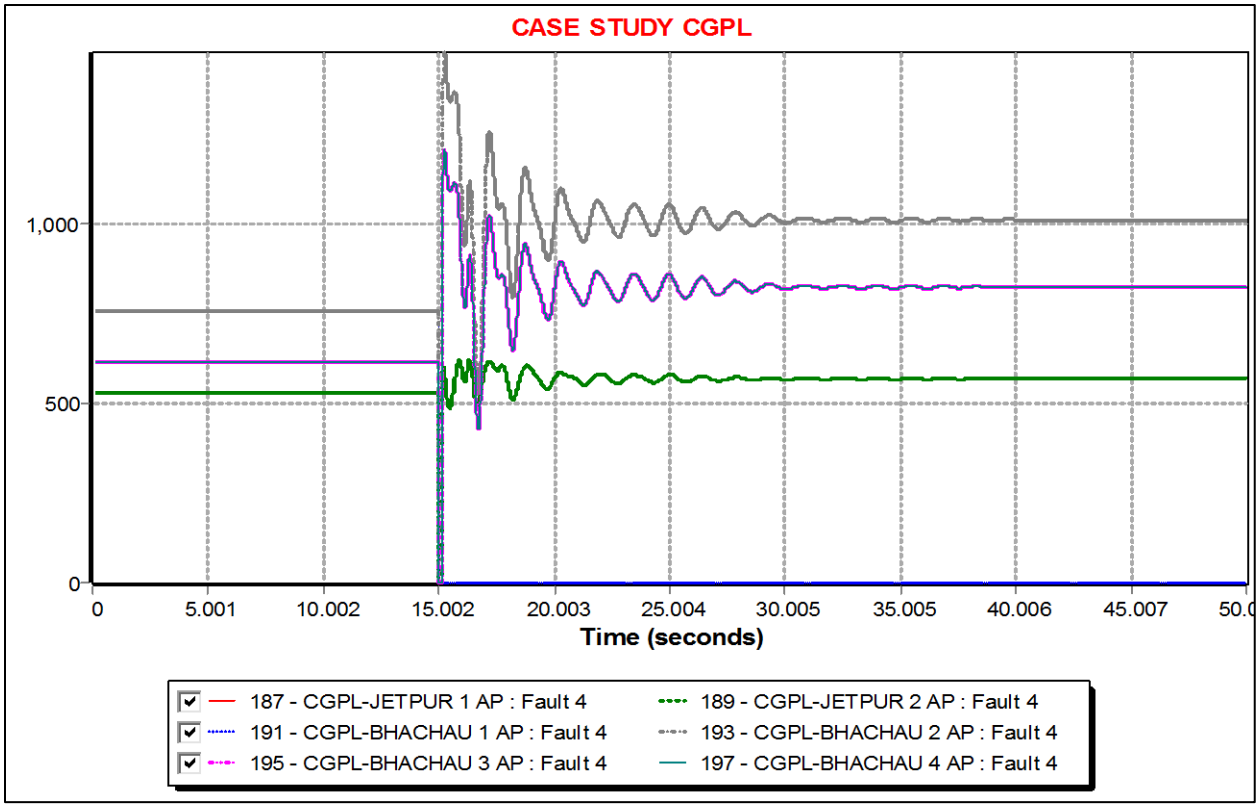

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 3
99 - JETPUR V : Fault 3
101 - MUNDRA V : Fault 3
103 - RANCHODPURA V : Fault 3
107 - BHACHAU V : Fault 3
105 - AMRELI V : Fault 3
109 - VERSANA V : Fault 3
111 - CGPL V : Fault 3
113 - HALVAD V : Fault 3

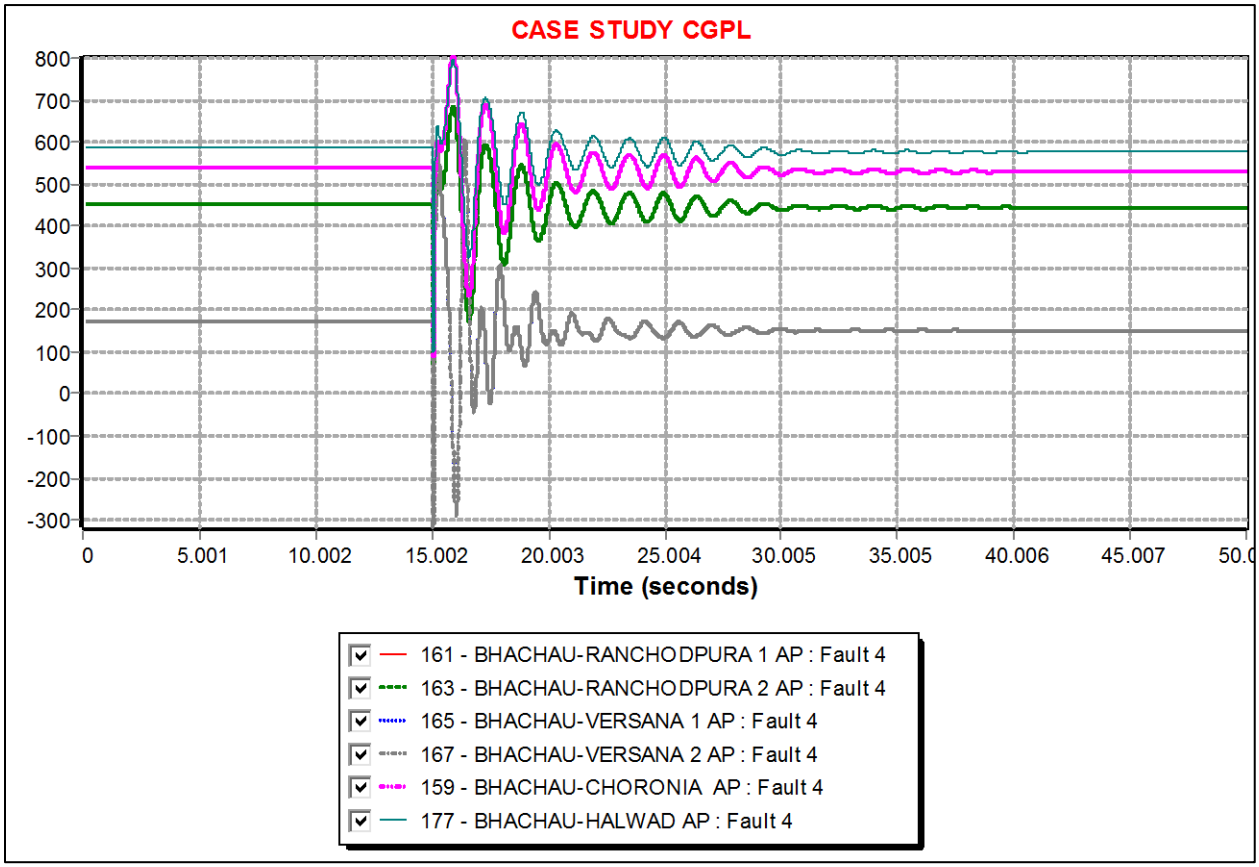

CASE STUDY CGPL
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 3
189 - CGPL-JETPUR 2 AP : Fault 3
191 - CGPL-BHACHAU 1 AP : Fault 3
193 - CGPL-BHACHAU 2 AP : Fault 3
195 - CGPL-BHACHAU 3 AP : Fault 3
197 - CGPL-BHACHAU 4 AP : Fault 3


CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 3
163 - BHACHAU-RANCHODPURA 2 AP : Fault 3
165 - BHACHAU-VERSANA 1 AP : Fault 3
167 - BHACHAU-VERSANA 2 AP : Fault 3
159 - BHACHAU-CHORONIA AP : Fault 3
177 - BHACHAU-HALWAD AP : Fault 3

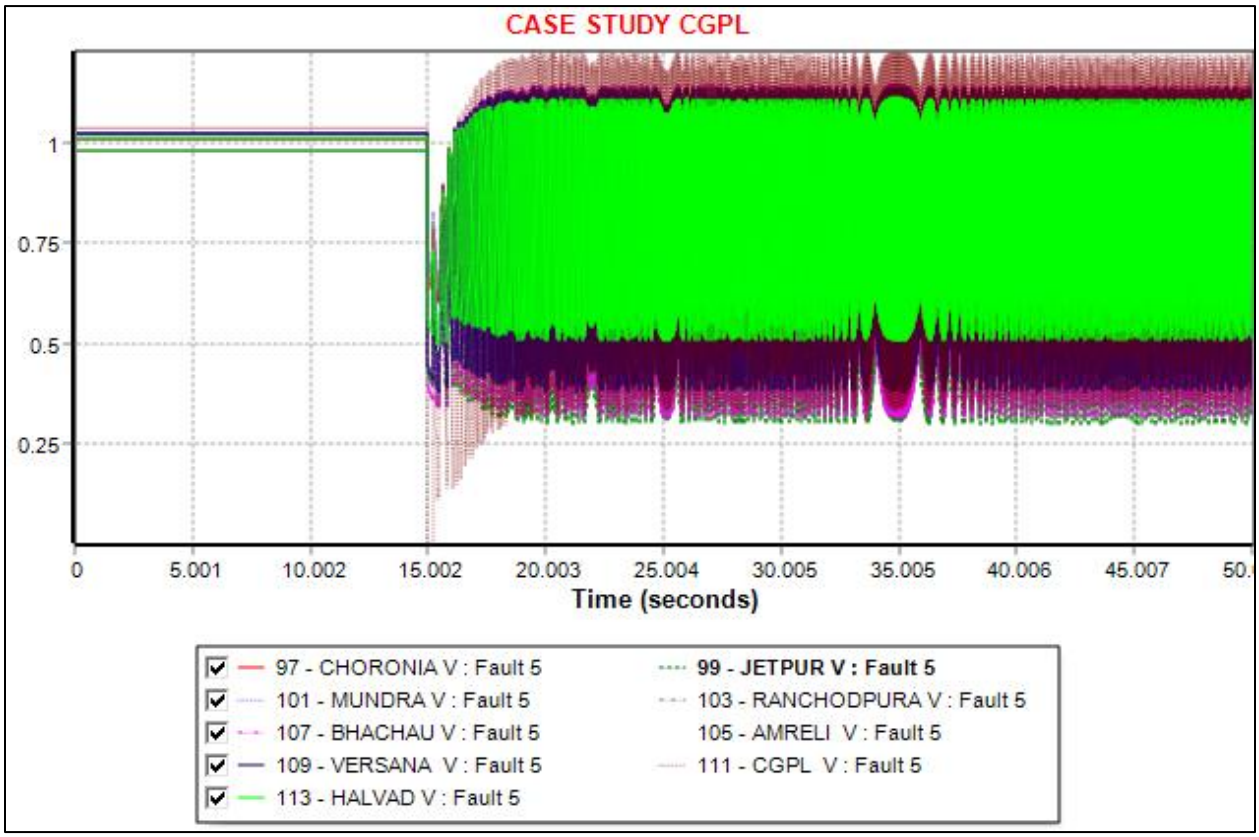
Fault 4:

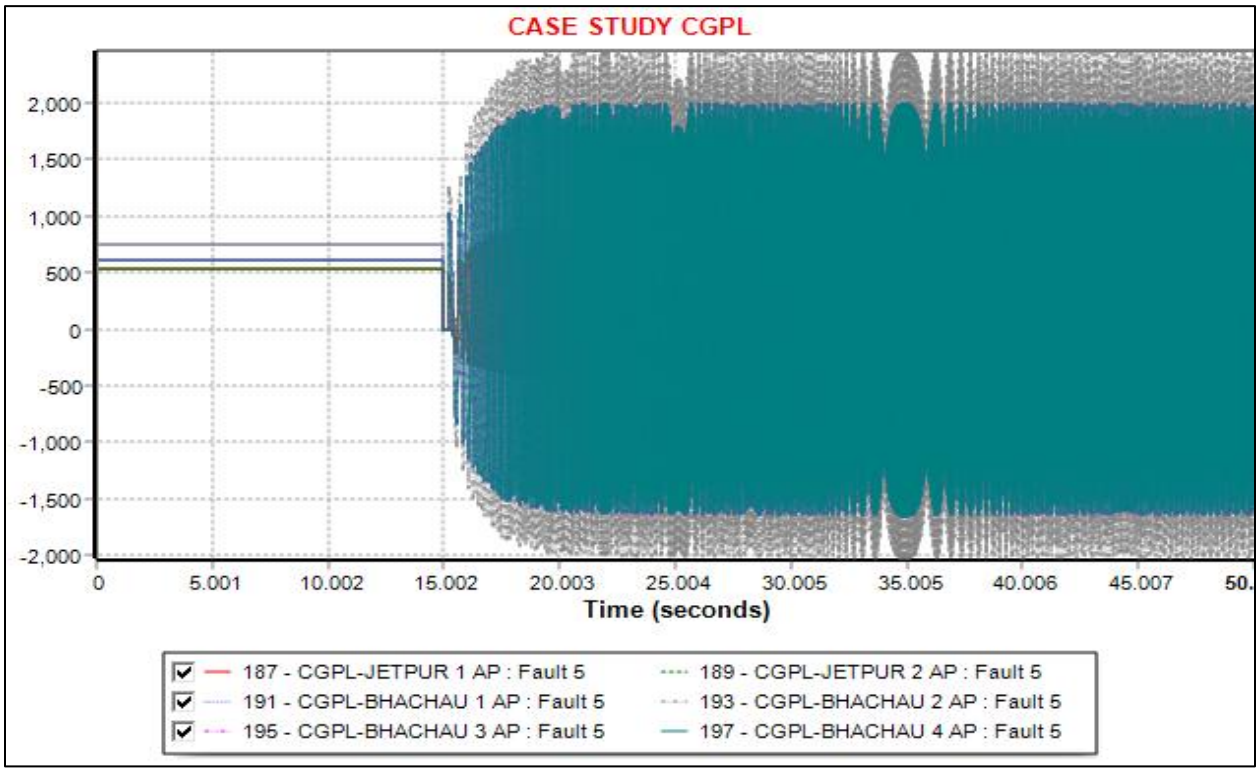

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 4
99 - JETPUR V : Fault 4
101 - MUNDRA V : Fault 4
103 - RANCHODPURA V : Fault 4
107 - BHACHAU V : Fault 4
105 - AMRELI V : Fault 4
109 - VERSANA V : Fault 4
111 - CGPL V : Fault 4
113 - HALVAD V : Fault 4


CASE STUDY CGPL
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 4
189 - CGPL-JETPUR 2 AP : Fault 4
191 - CGPL-BHACHAU 1 AP : Fault 4
193 - CGPL-BHACHAU 2 AP : Fault 4
195 - CGPL-BHACHAU 3 AP : Fault 4
197 - CGPL-BHACHAU 4 AP : Fault 4

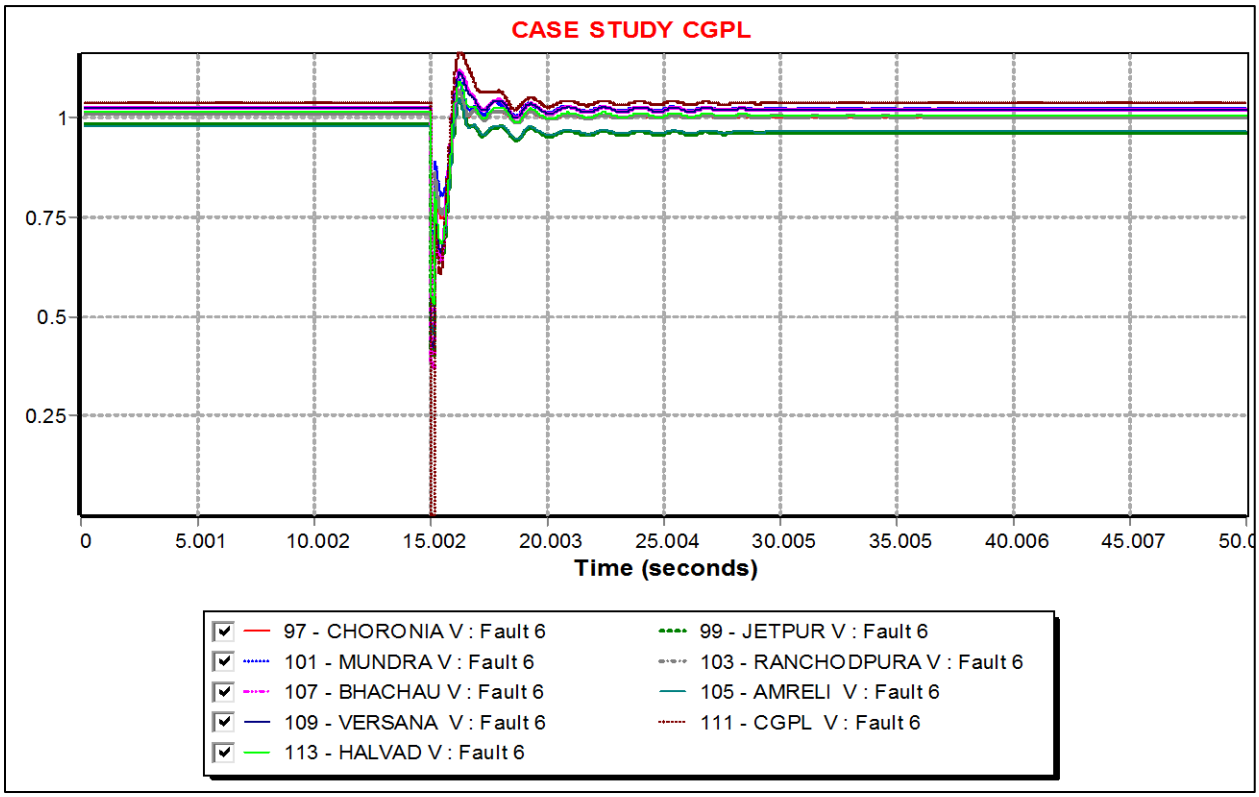

CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 4
163 - BHACHAU-RANCHODPURA 2 AP : Fault 4
165 - BHACHAU-VERSANA 1 AP : Fault 4
167 - BHACHAU-VERSANA 2 AP : Fault 4
159 - BHACHAU-CHORONIA AP : Fault 4
177 - BHACHAU-HALWAD AP : Fault 4

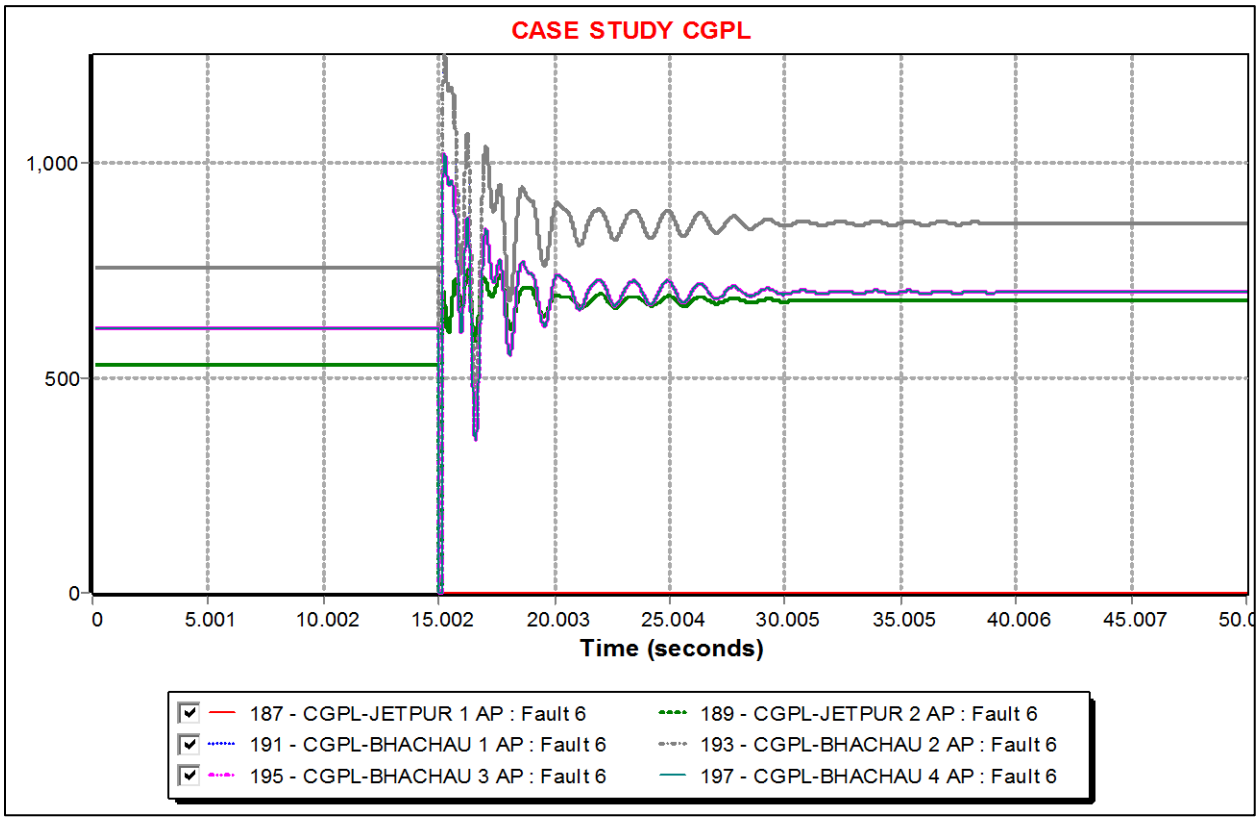
Fault 5:

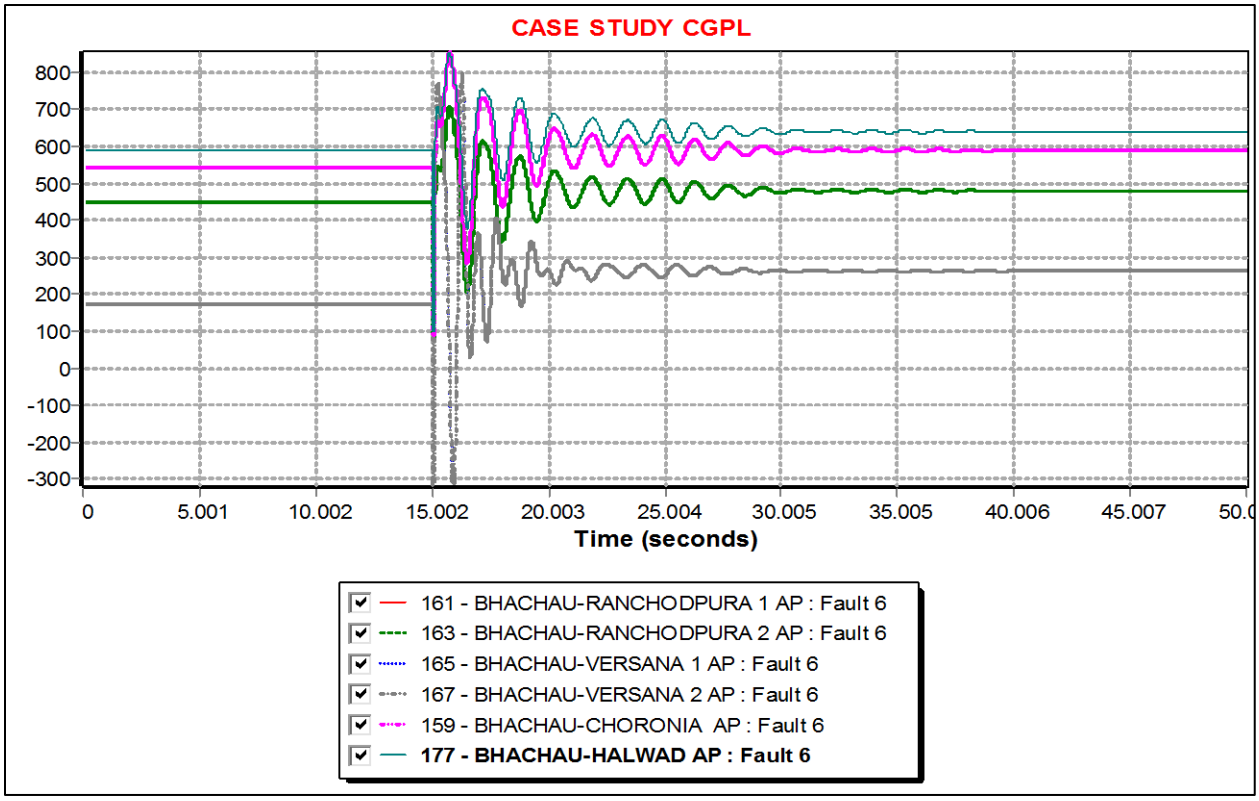

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 5
99 - JETPUR V : Fault 5
101 - MUNDRA V : Fault 5
103 - RANCHODPURA V : Fault 5
107 - BHACHAU V : Fault 5
105 - AMRELI V : Fault 5
109 - VERSANA V : Fault 5
111 - CGPL V : Fault 5
113 - HALVAD V : Fault 5


CASE STUDY CGPL
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 5
189 - CGPL-JETPUR 2 AP : Fault 5
191 - CGPL-BHACHAU 1 AP : Fault 5
193 - CGPL-BHACHAU 2 AP : Fault 5
195 - CGPL-BHACHAU 3 AP : Fault 5
197 - CGPL-BHACHAU 4 AP : Fault 5

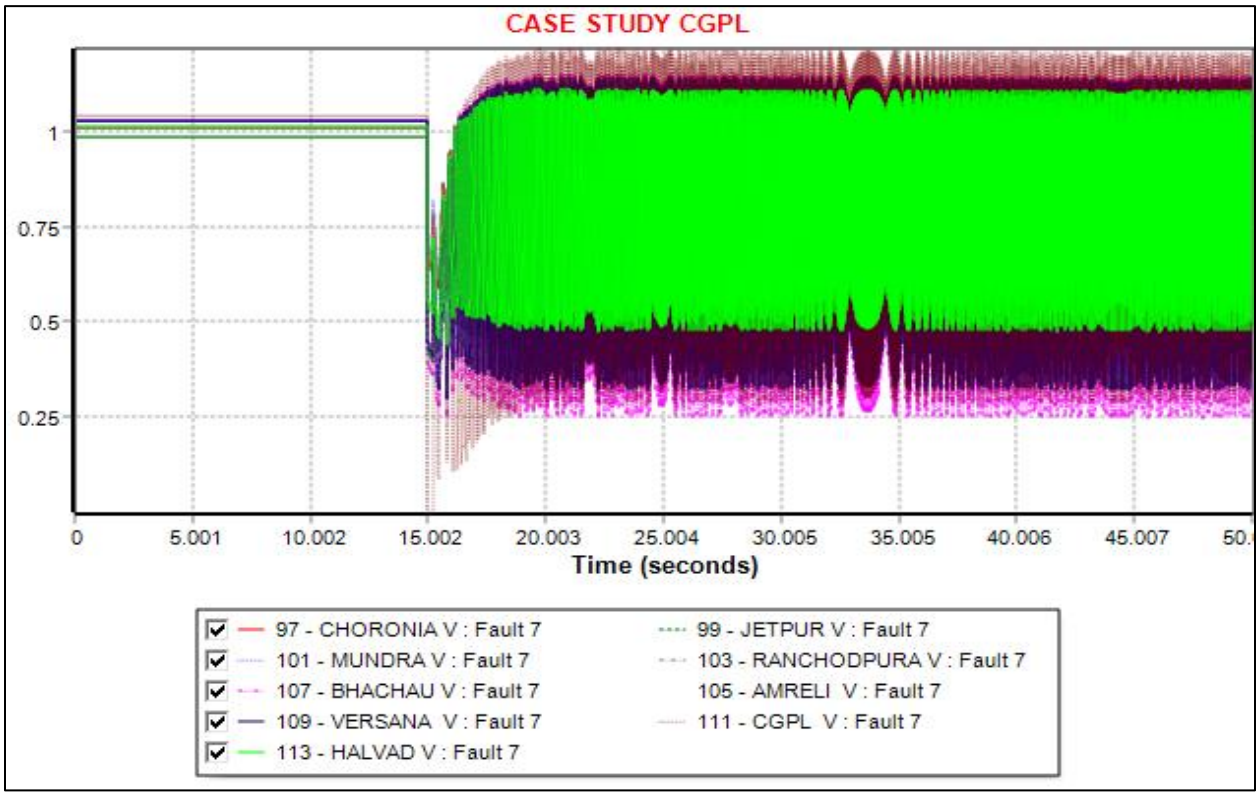
Fault 6:

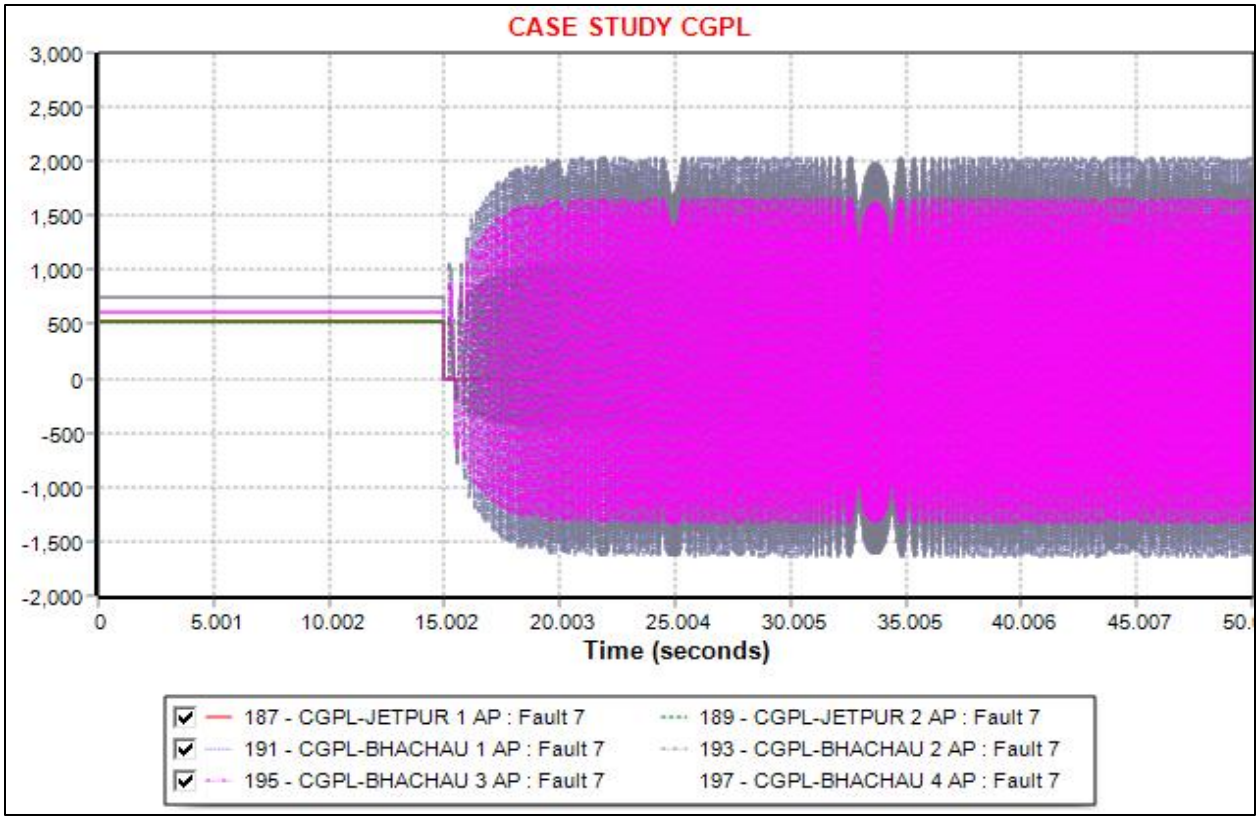

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 6
99 - JETPUR V : Fault 6
101 - MUNDRA V : Fault 6
103 - RANCHODPURA V : Fault 6
107 - BHACHAU V : Fault 6
105 - AMRELI V : Fault 6
109 - VERSANA V : Fault 6
111 - CGPL V : Fault 6
113 - HALVAD V : Fault 6


CASE STUDY CGPL
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 6
189 - CGPL-JETPUR 2 AP : Fault 6
191 - CGPL-BHACHAU 1 AP : Fault 6
193 - CGPL-BHACHAU 2 AP : Fault 6
195 - CGPL-BHACHAU 3 AP : Fault 6
197 - CGPL-BHACHAU 4 AP : Fault 6

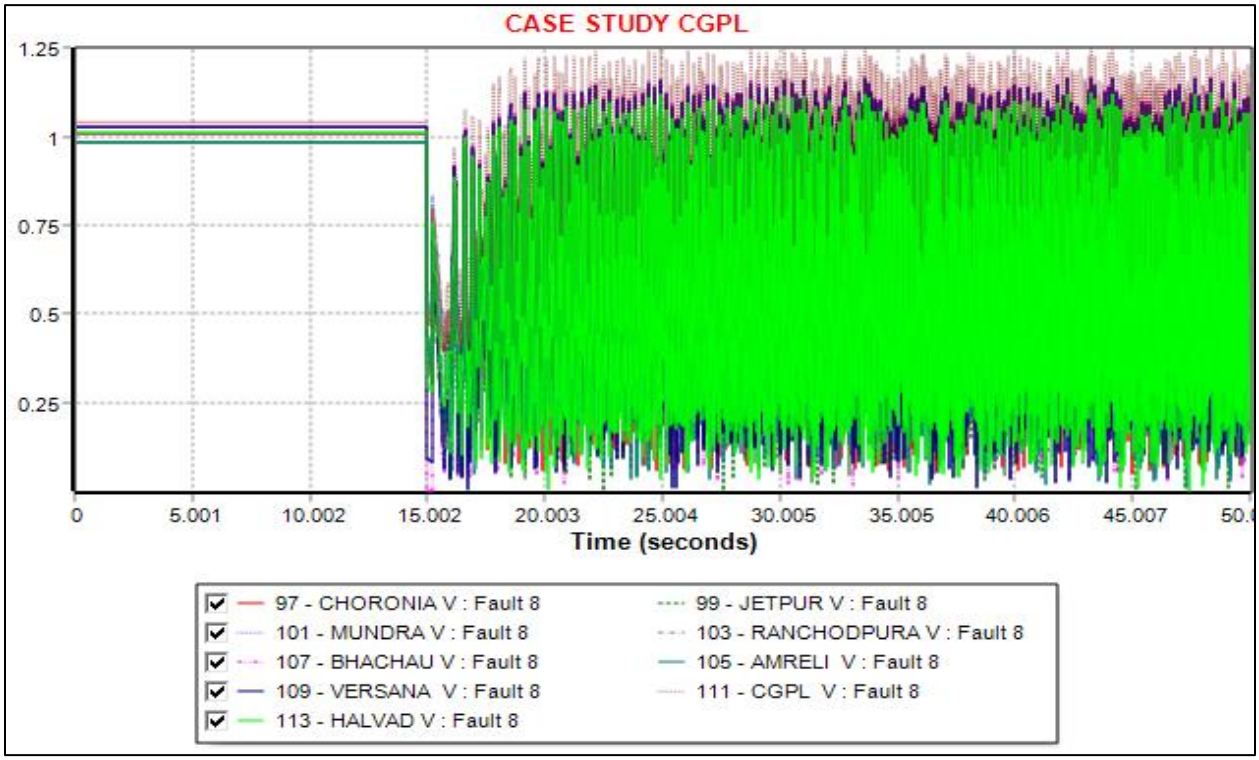

CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 6
163 - BHACHAU-RANCHODPURA 2 AP : Fault 6
165 - BHACHAU-VERSANA 1 AP : Fault 6
167 - BHACHAU-VERSANA 2 AP : Fault 6
159 - BHACHAU-CHORONIA AP : Fault 6
177 - BHACHAU-HALWAD AP : Fault 6

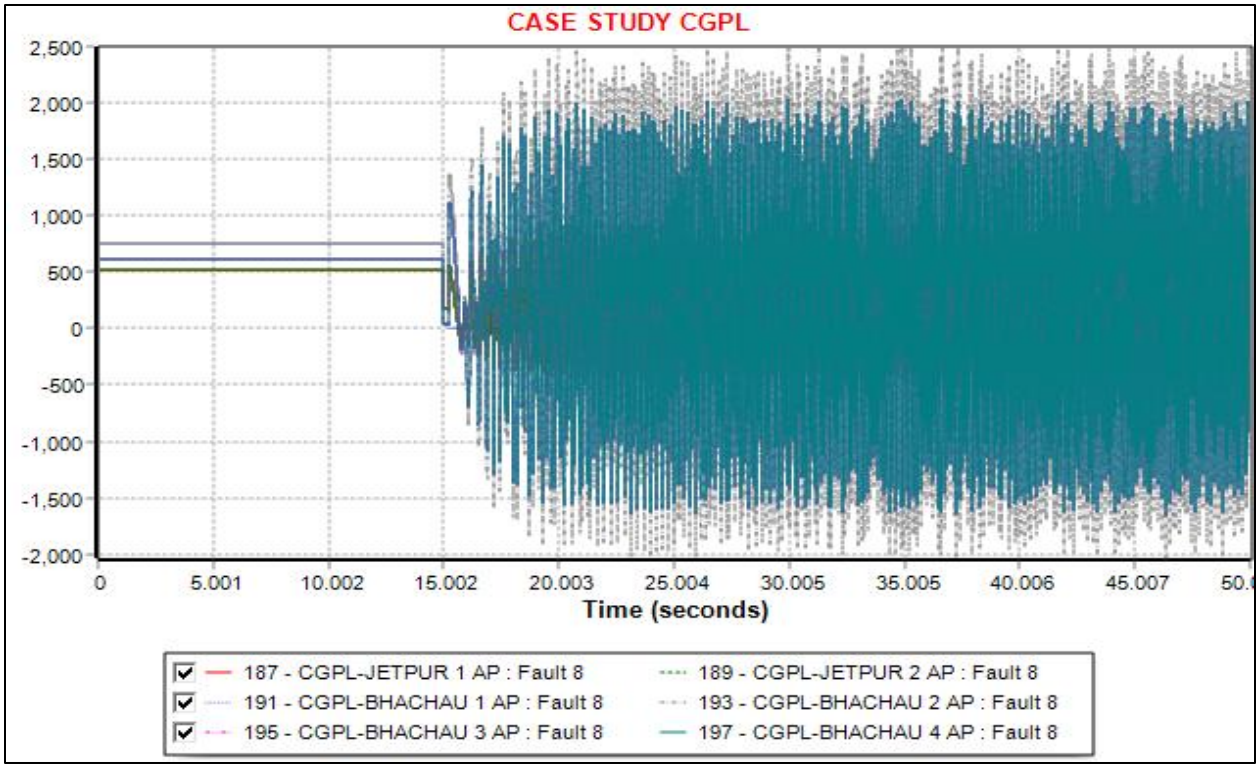
Fault 7 :


CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 7
99 - JETPUR V : Fault 7
101 - MUNDRA V : Fault 7
103 - RANCHODPURA V : Fault 7
107 - BHACHAU V : Fault 7
105 - AMRELI V : Fault 7
109 - VERSANA V : Fault 7
111 - CGPL V : Fault 7
113 - HALVAD V : Fault 7

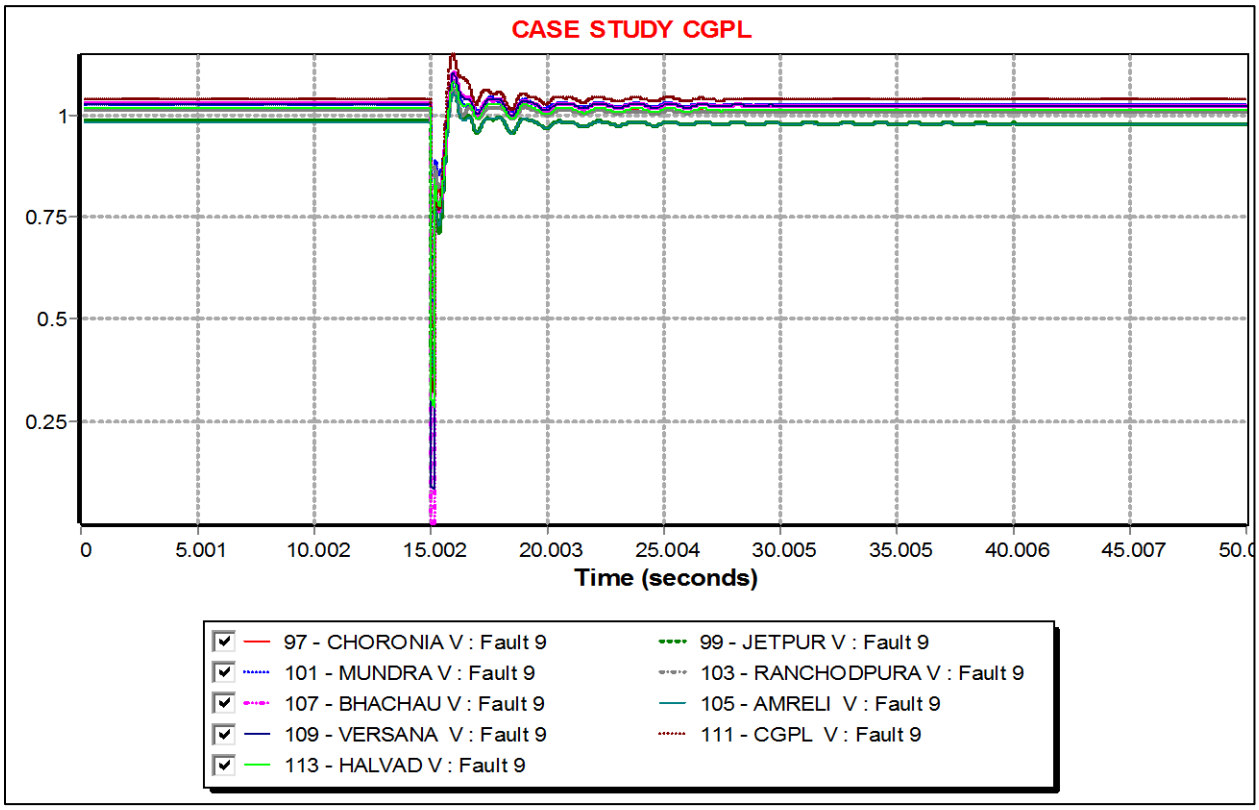

CASE STUDY CGPL
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 7
189 - CGPL-JETPUR 2 AP : Fault 7
191 - CGPL-BHACHAU 1 AP : Fault 7
193 - CGPL-BHACHAU 2 AP : Fault 7
195 - CGPL-BHACHAU 3 AP : Fault 7
197 - CGPL-BHACHAU 4 AP : Fault 7

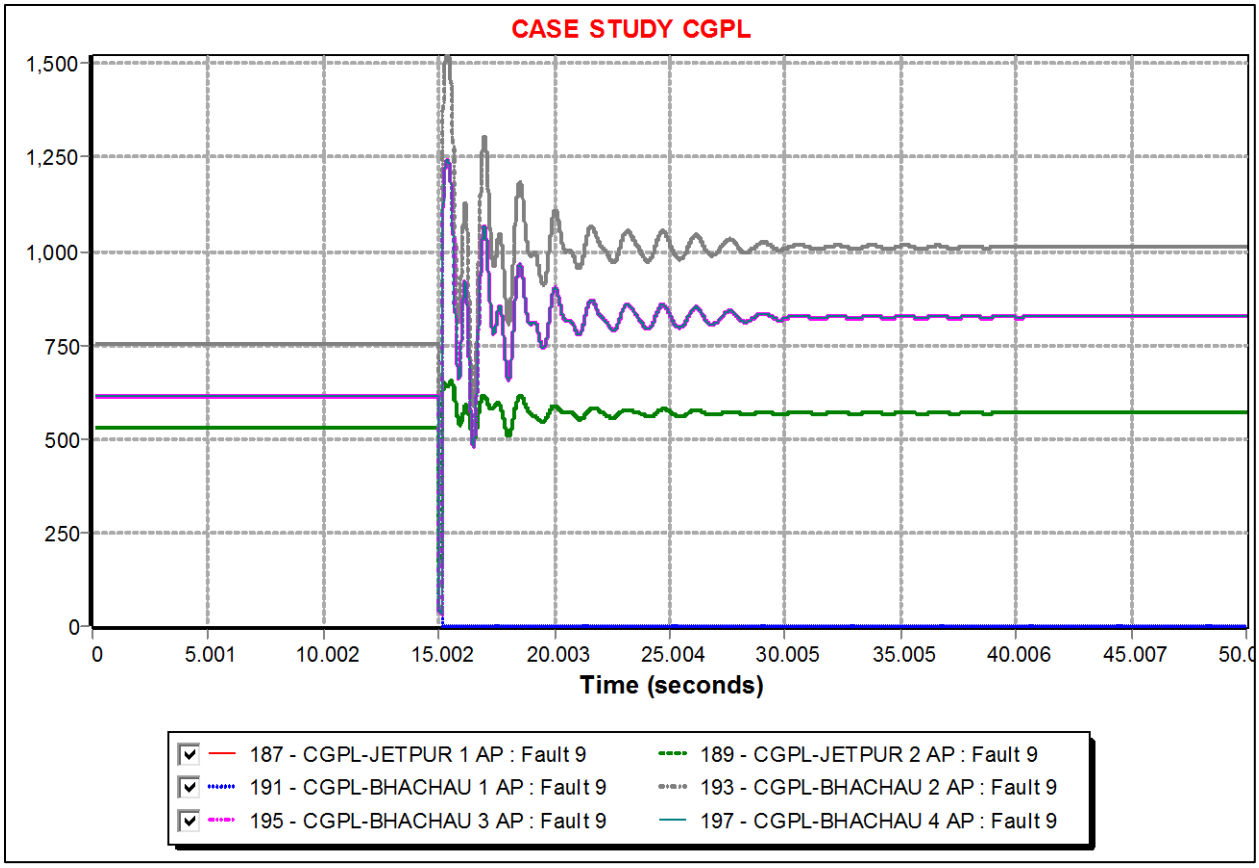
Fault 8 :

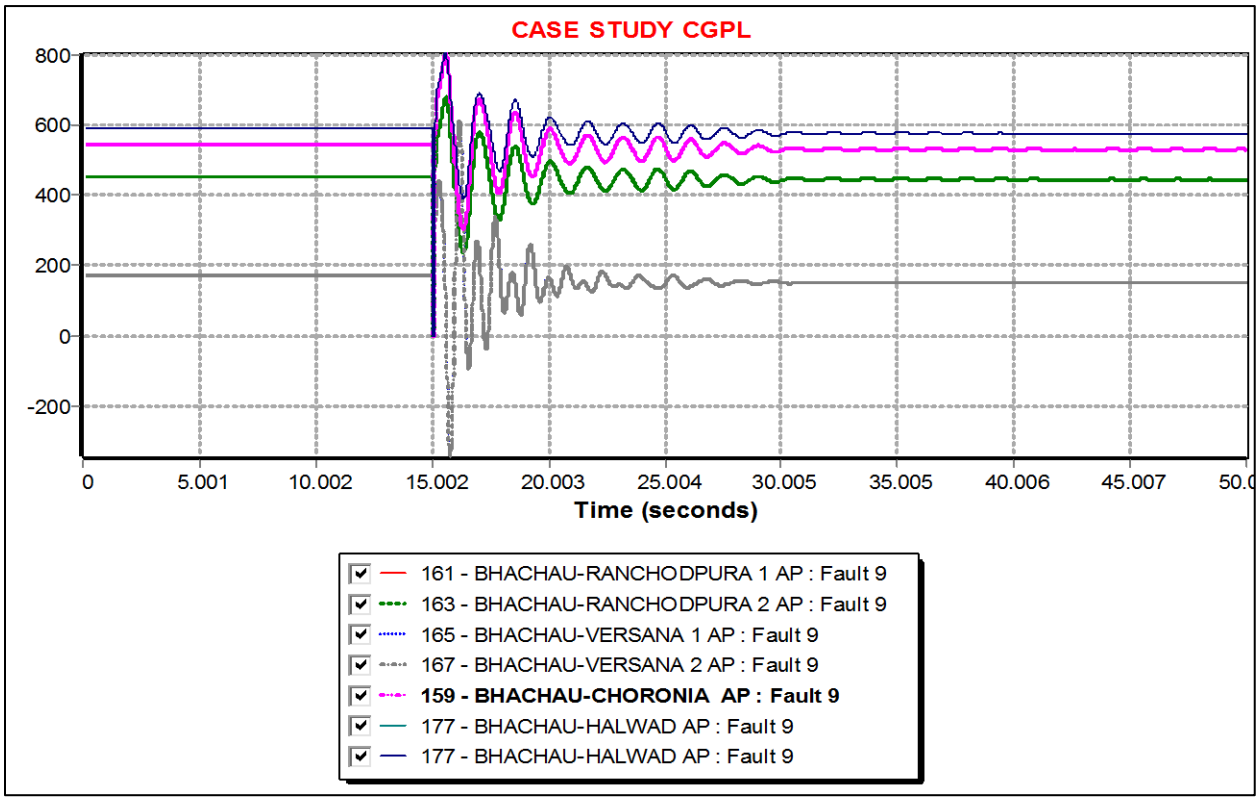

CASE STUDY CGPL
1.25
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 8
99 - JETPUR V : Fault 8
101 - MUNDRA V : Fault 8
103 - RANCHODPURA V : Fault 8
107 - BHACHAU V : Fault 8
105 - AMRELI V : Fault 8
109 - VERSANA V : Fault 8
111 - CGPL V : Fault 8
113 - HALVAD V : Fault 8


CASE STUDY CGPL
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 8
189 - CGPL-JETPUR 2 AP : Fault 8
191 - CGPL-BHACHAU 1 AP : Fault 8
193 - CGPL-BHACHAU 2 AP : Fault 8
195 - CGPL-BHACHAU 3 AP : Fault 8
197 - CGPL-BHACHAU 4 AP : Fault 8

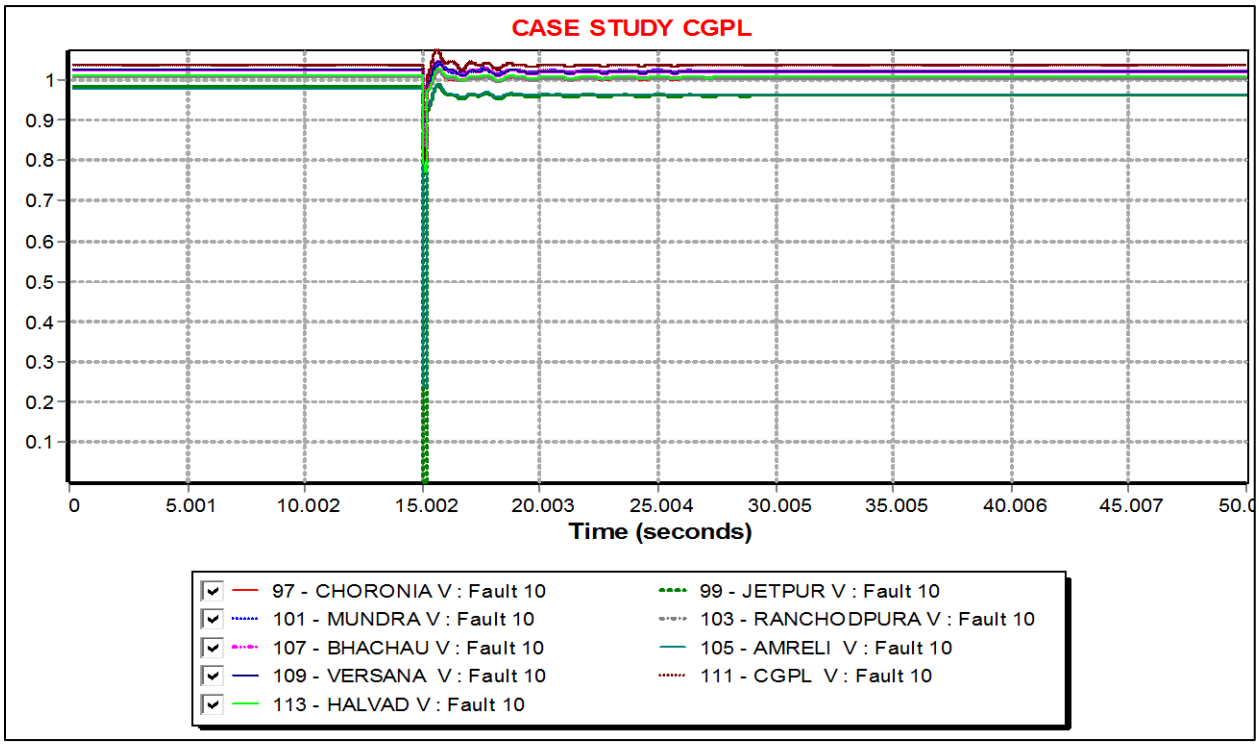
Fault 9:

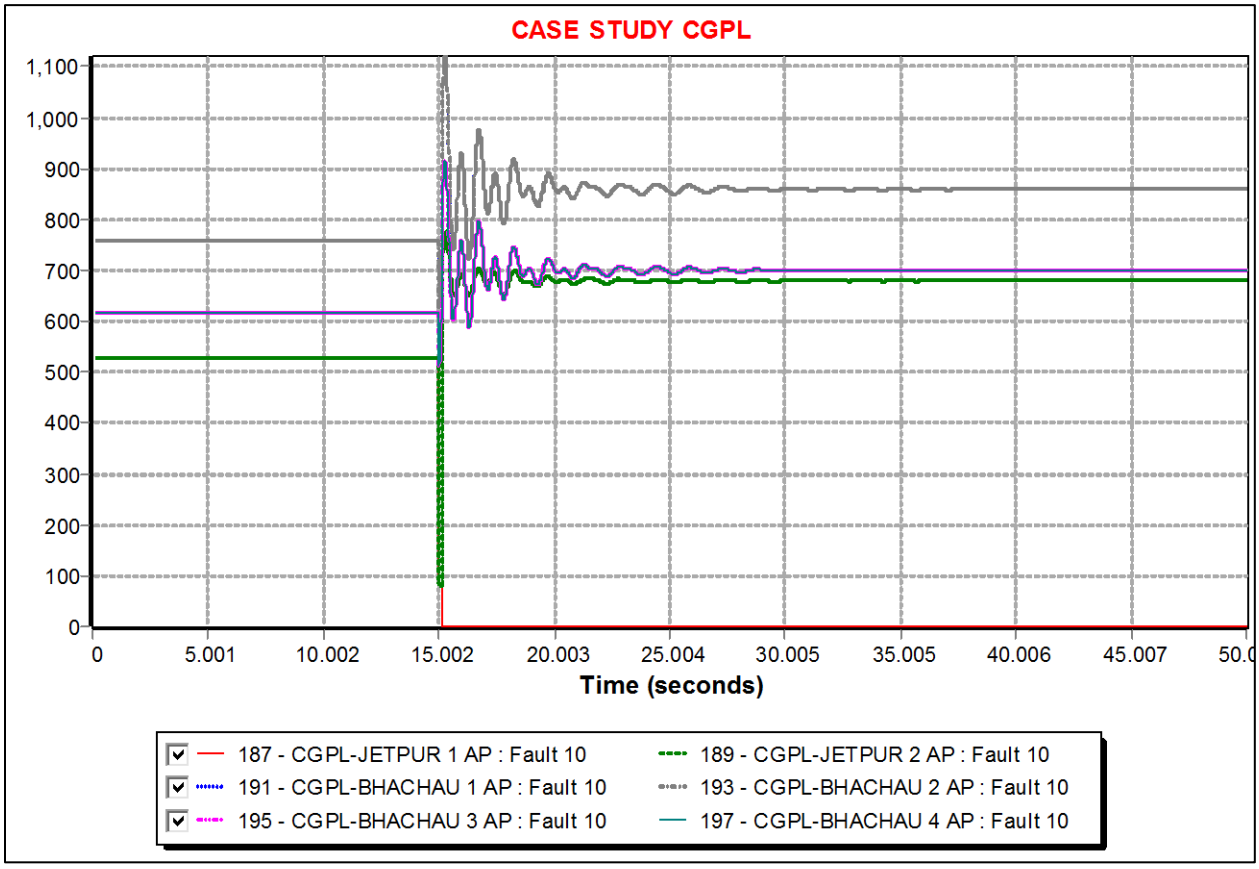

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 9
99 - JETPUR V : Fault 9
101 - MUNDRA V : Fault 9
103 - RANCHODPURA V : Fault 9
107 - BHACHAU V : Fault 9
105 - AMRELI V : Fault 9
109 - VERSANA V : Fault 9
111 - CGPL V : Fault 9
113 - HALVAD V : Fault 9

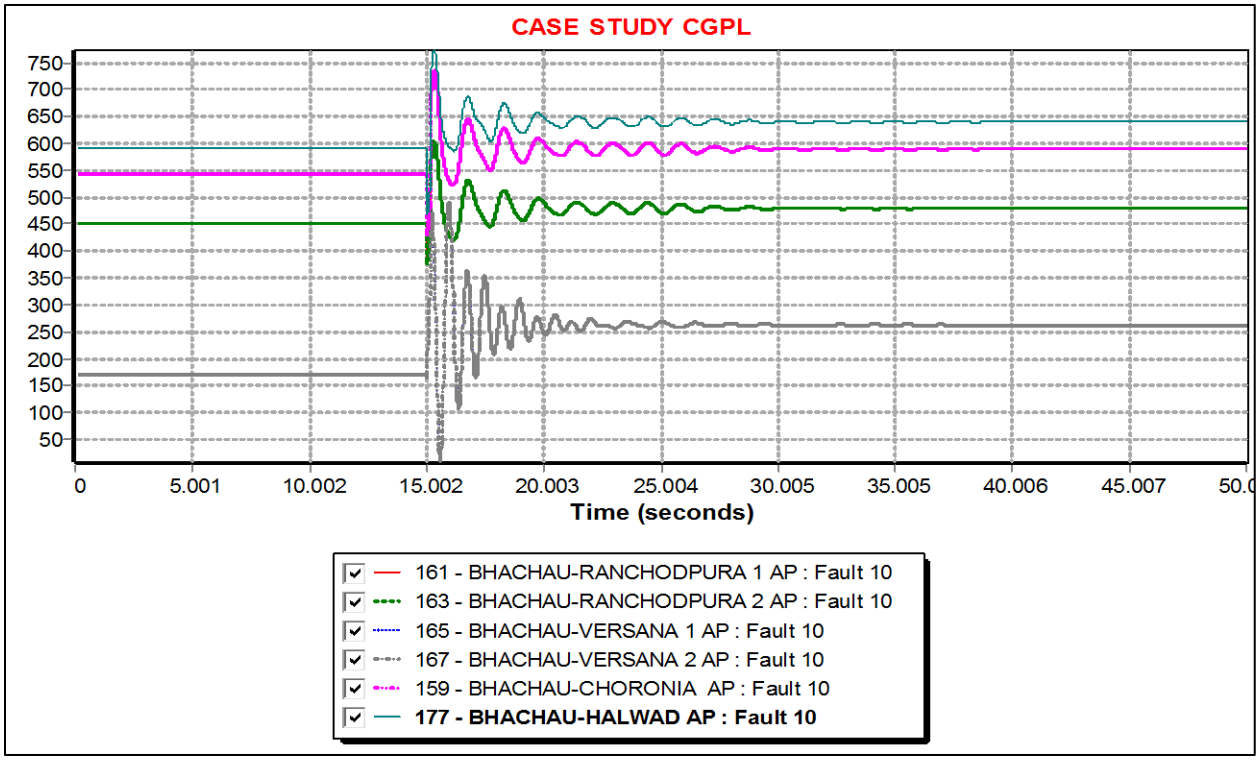

CASE STUDY CGPL
1,500
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 9
189 - CGPL-JETPUR 2 AP : Fault 9
191 - CGPL-BHACHAU 1 AP : Fault 9
193 - CGPL-BHACHAU 2 AP : Fault 9
195 - CGPL-BHACHAU 3 AP : Fault 9
197 - CGPL-BHACHAU 4 AP : Fault 9


CASE STUDY CGPL
800
600
400
200
0
-200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 9
163 - BHACHAU-RANCHODPURA 2 AP : Fault 9
165 - BHACHAU-VERSANA 1 AP : Fault 9
167 - BHACHAU-VERSANA 2 AP : Fault 9
159 - BHACHAU-CHORONIA AP : Fault 9
177 - BHACHAU-HALWAD AP : Fault 9
177 - BHACHAU-HALWAD AP : Fault 9

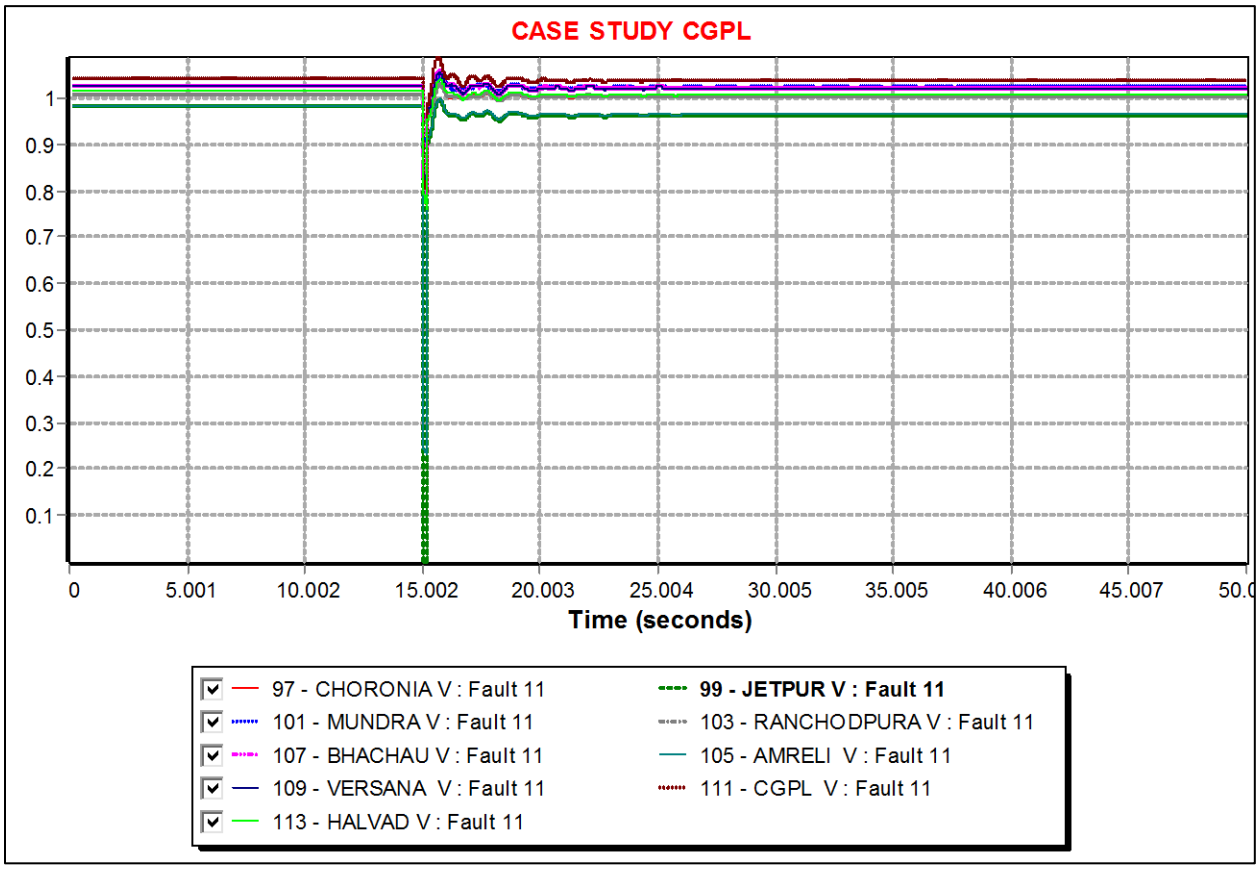
Fault 10:

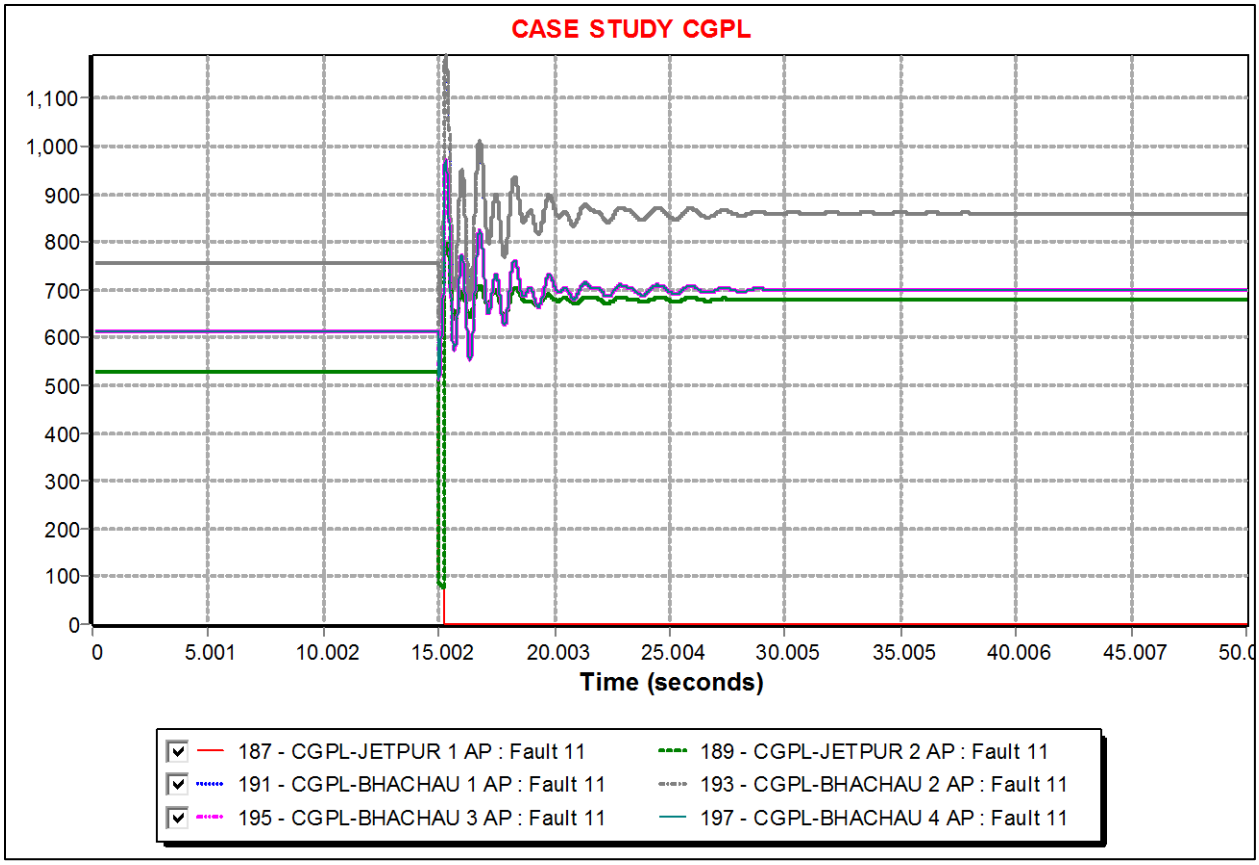

CASE STUDY CGPL
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 10
99 - JETPUR V : Fault 10
101 - MUNDRA V : Fault 10
103 - RANCHODPURA V : Fault 10
107 - BHACHAU V : Fault 10
105 - AMRELI V : Fault 10
109 - VERSANA V : Fault 10
111 - CGPL V : Fault 10
113 - HALVAD V : Fault 10

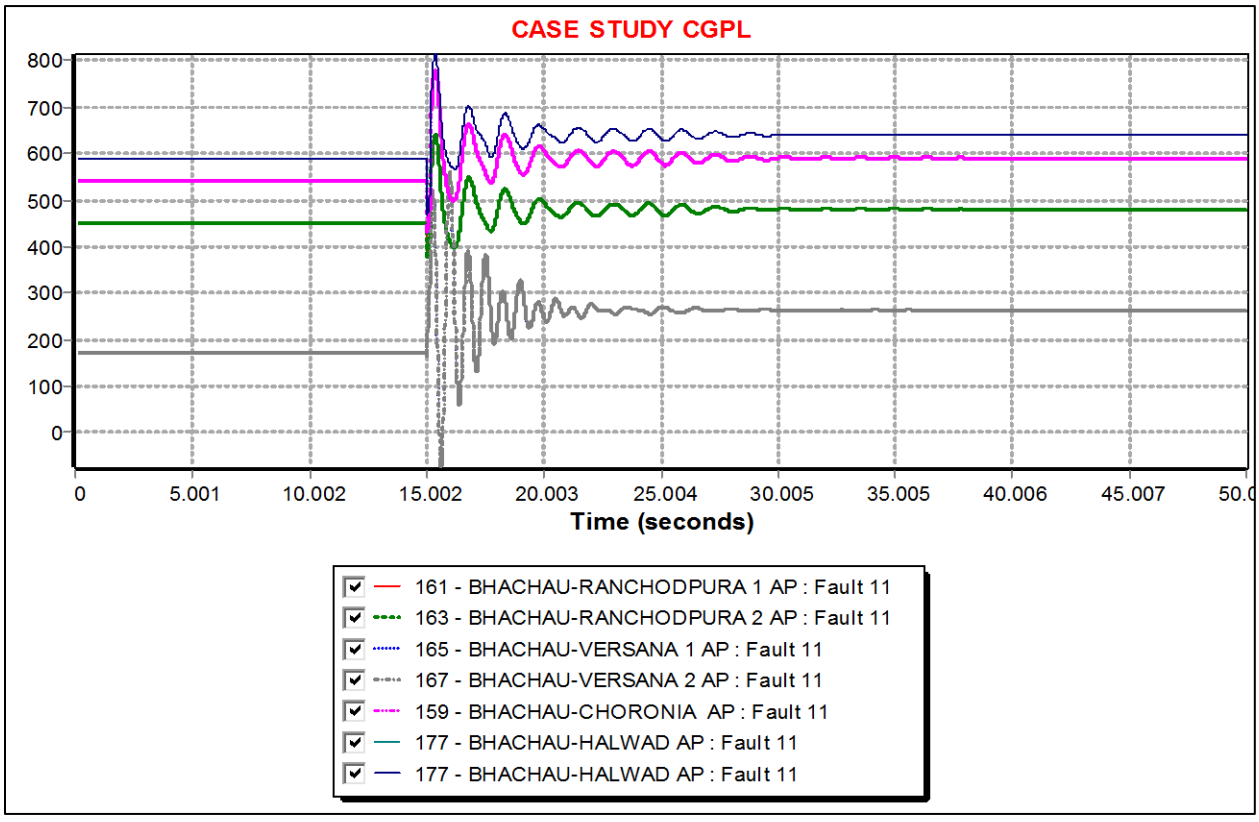

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 10
189 - CGPL-JETPUR 2 AP : Fault 10
191 - CGPL-BHACHAU 1 AP : Fault 10
193 - CGPL-BHACHAU 2 AP : Fault 10
195 - CGPL-BHACHAU 3 AP : Fault 10
197 - CGPL-BHACHAU 4 AP : Fault 10


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 10
163 - BHACHAU-RANCHODPURA 2 AP : Fault 10
165 - BHACHAU-VERSANA 1 AP : Fault 10
167 - BHACHAU-VERSANA 2 AP : Fault 10
159 - BHACHAU-CHORONIA AP : Fault 10
177 - BHACHAU-HALWAD AP : Fault 10

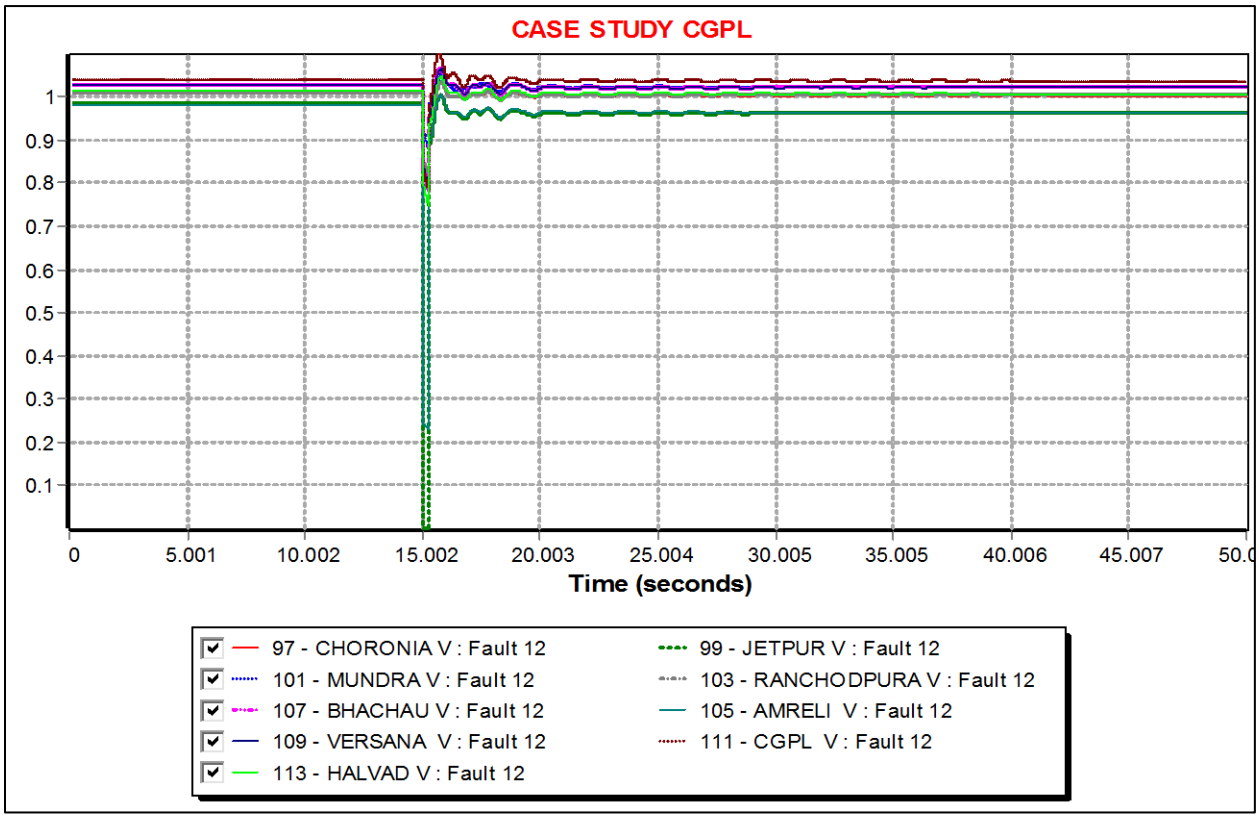
Fault 11:

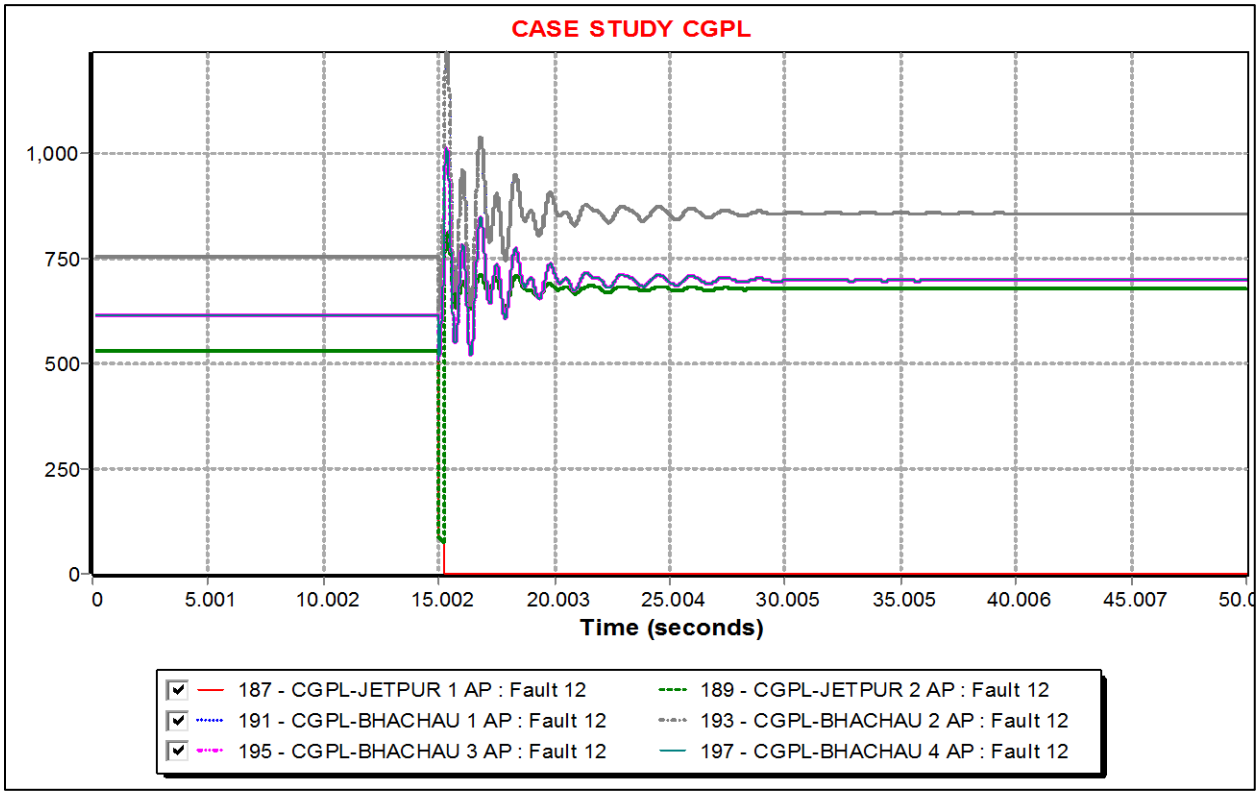

CASE STUDY CGPL
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 11
99 - JETPUR V : Fault 11
101 - MUNDRA V : Fault 11
103 - RANCHODPURA V : Fault 11
107 - BHACHAU V : Fault 11
105 - AMRELI V : Fault 11
109 - VERSANA V : Fault 11
111 - CGPL V : Fault 11
113 - HALVAD V : Fault 11

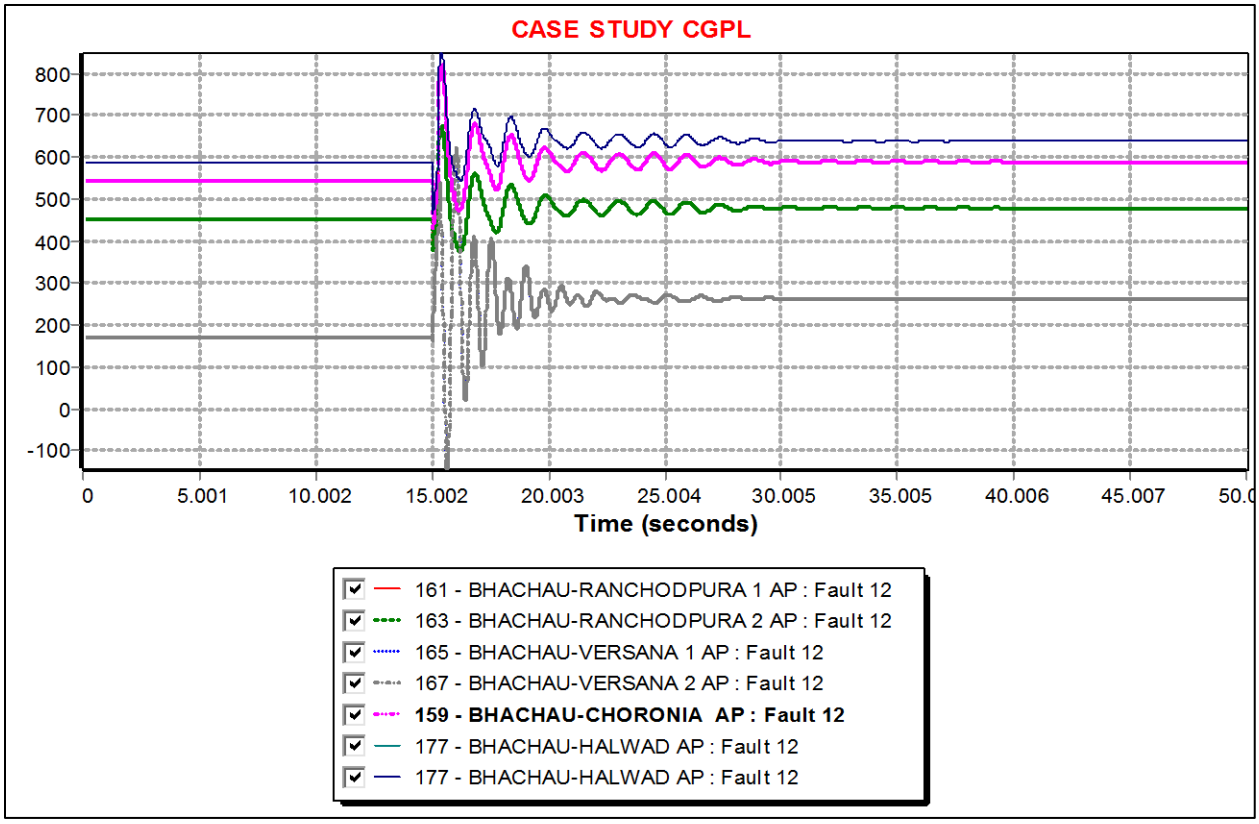

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 11
189 - CGPL-JETPUR 2 AP : Fault 11
191 - CGPL-BHACHAU 1 AP : Fault 11
193 - CGPL-BHACHAU 2 AP : Fault 11
195 - CGPL-BHACHAU 3 AP : Fault 11
197 - CGPL-BHACHAU 4 AP : Fault 11


CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 11
163 - BHACHAU-RANCHODPURA 2 AP : Fault 11
165 - BHACHAU-VERSANA 1 AP : Fault 11
167 - BHACHAU-VERSANA 2 AP : Fault 11
159 - BHACHAU-CHORONIA AP : Fault 11
177 - BHACHAU-HALWAD AP : Fault 11
177 - BHACHAU-HALWAD AP : Fault 11

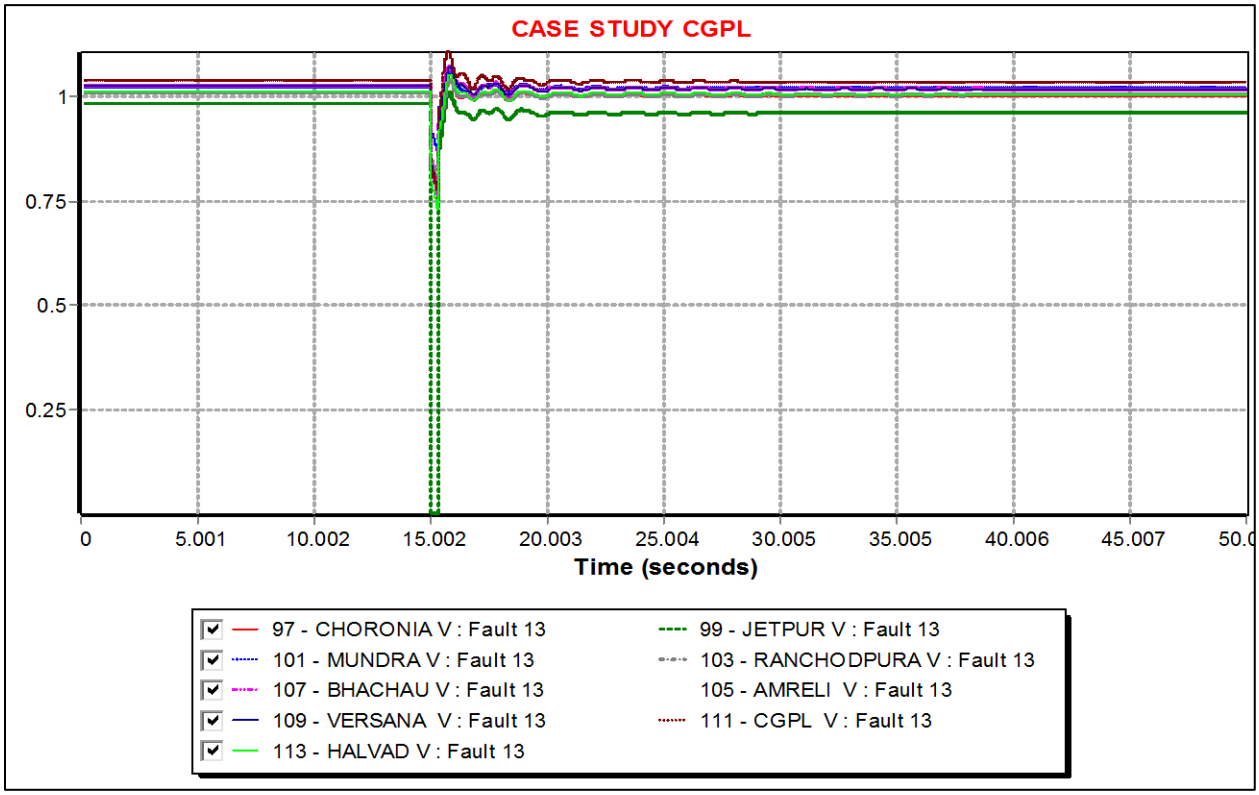
Fault 12:

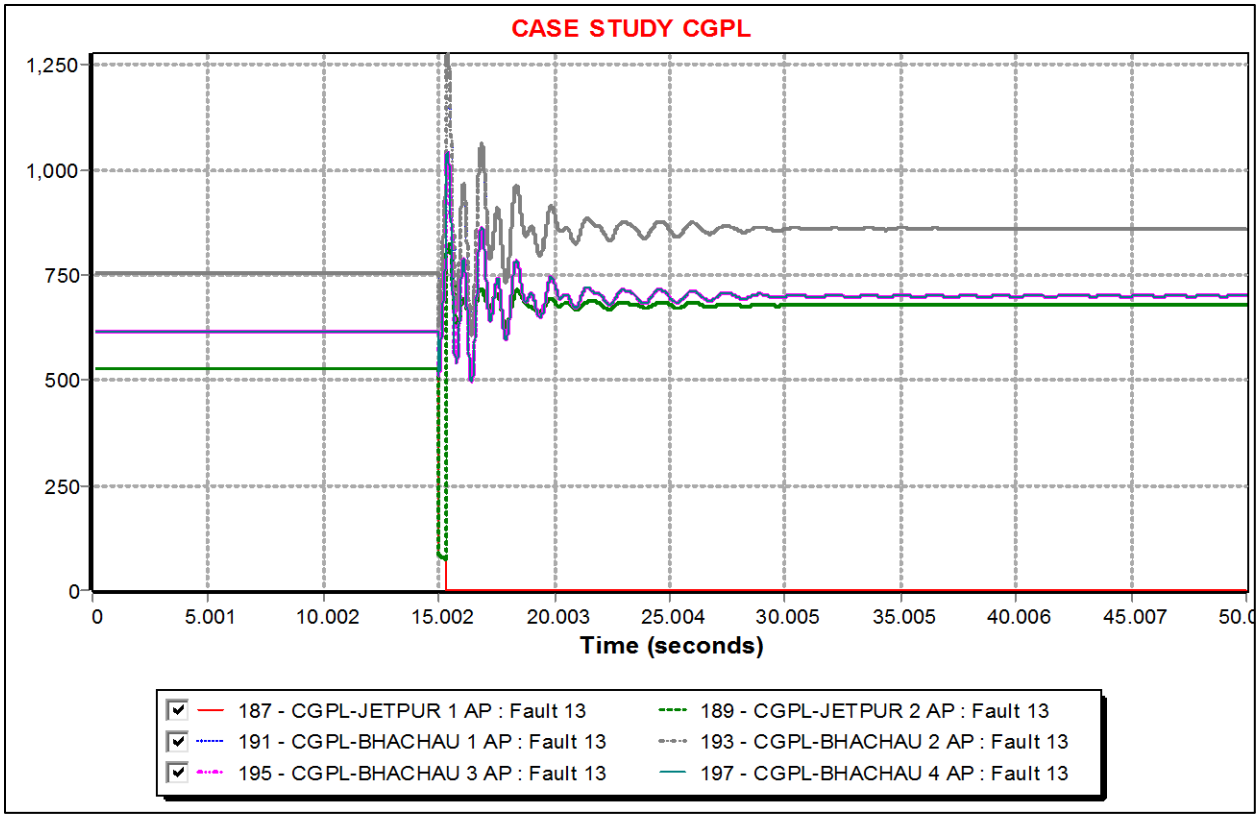

CASE STUDY CGPL
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 12
99 - JETPUR V : Fault 12
101 - MUNDRA V : Fault 12
103 - RANCHODPURA V : Fault 12
107 - BHACHAU V : Fault 12
105 - AMRELI V : Fault 12
109 - VERSANA V : Fault 12
111 - CGPL V : Fault 12
113 - HALVAD V : Fault 12

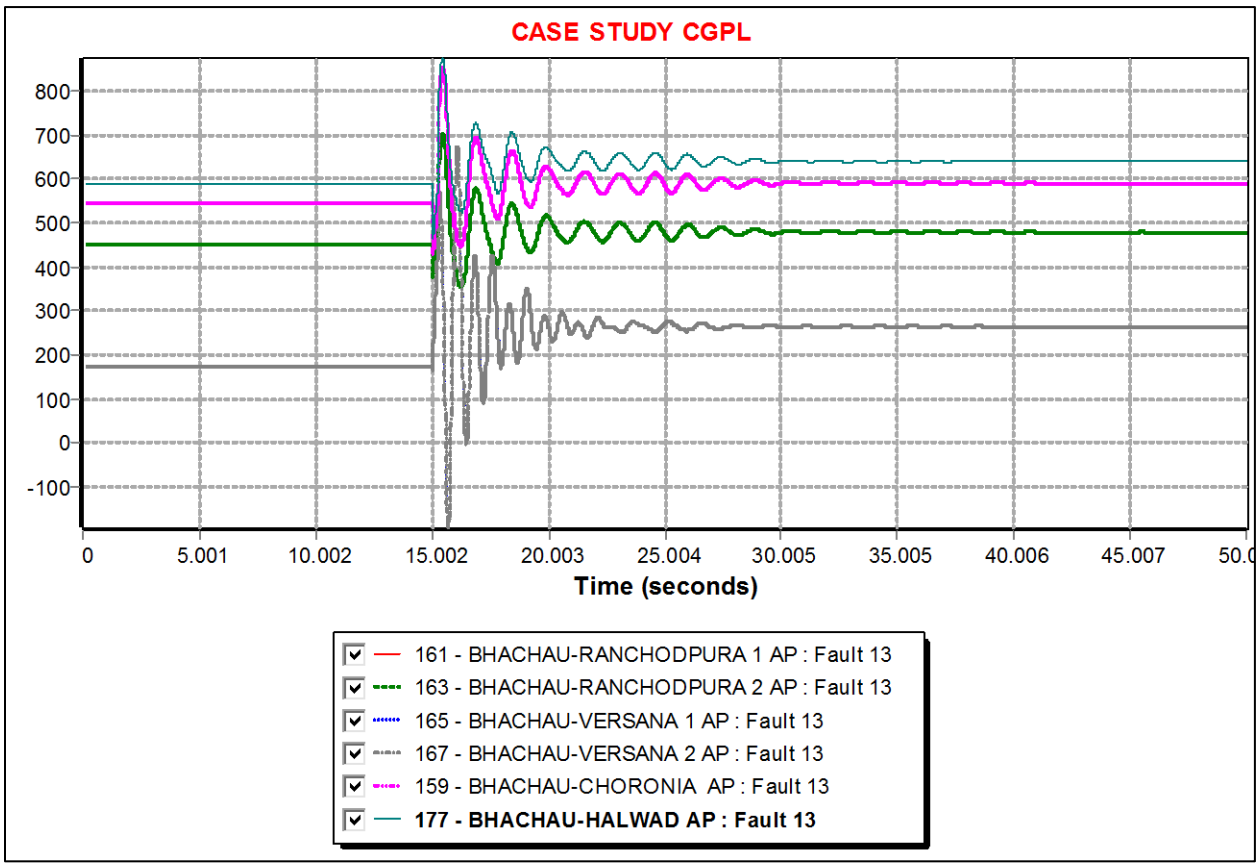

CASE STUDY CGPL
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 12
189 - CGPL-JETPUR 2 AP : Fault 12
191 - CGPL-BHACHAU 1 AP : Fault 12
193 - CGPL-BHACHAU 2 AP : Fault 12
195 - CGPL-BHACHAU 3 AP : Fault 12
197 - CGPL-BHACHAU 4 AP : Fault 12


CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 12
163 - BHACHAU-RANCHODPURA 2 AP : Fault 12
165 - BHACHAU-VERSANA 1 AP : Fault 12
167 - BHACHAU-VERSANA 2 AP : Fault 12
159 - BHACHAU-CHORONIA AP : Fault 12
177 - BHACHAU-HALWAD AP : Fault 12
177 - BHACHAU-HALWAD AP : Fault 12

Fault 13:

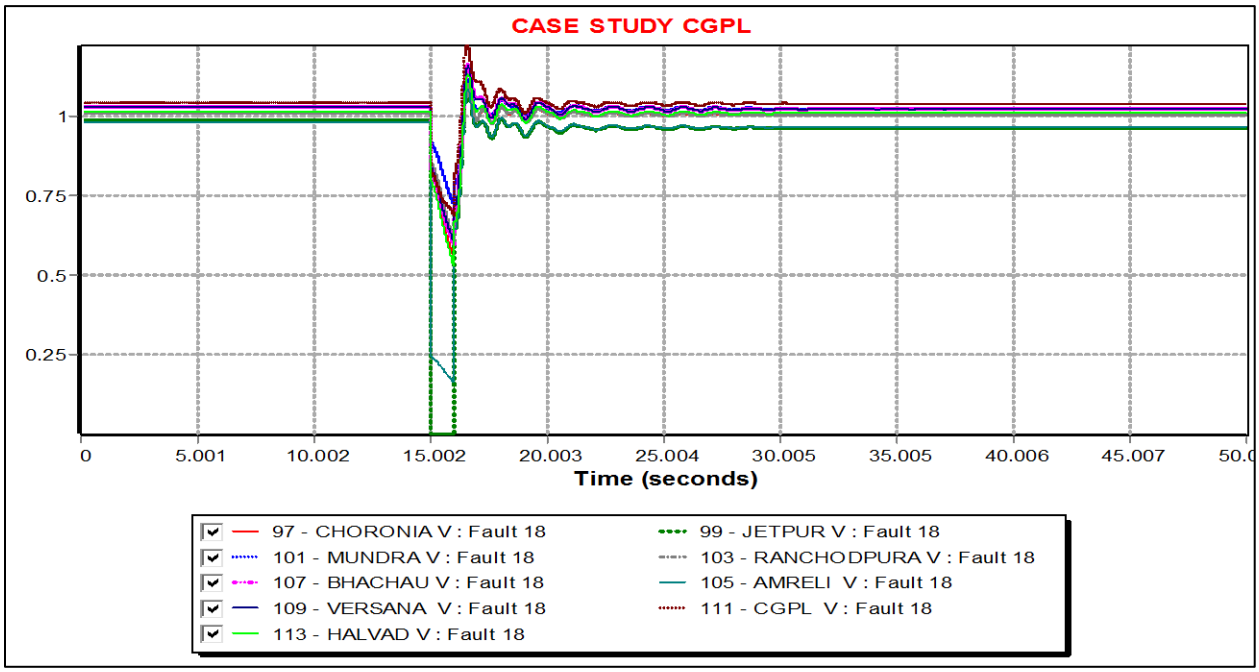

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 13
99 - JETPUR V : Fault 13
101 - MUNDRA V : Fault 13
103 - RANCHODPURA V : Fault 13
107 - BHACHAU V : Fault 13
105 - AMRELI V : Fault 13
109 - VERSANA V : Fault 13
111 - CGPL V : Fault 13
113 - HALVAD V : Fault 13

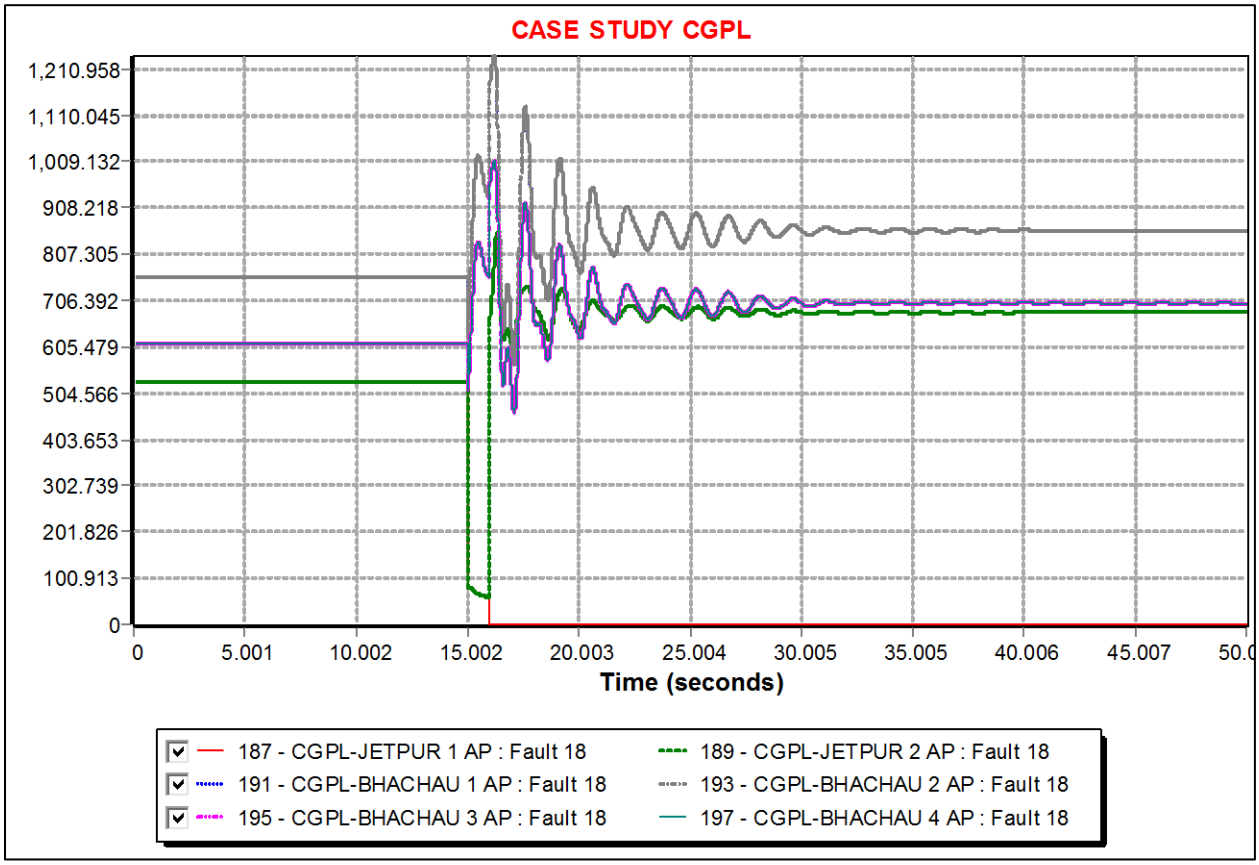

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 13
189 - CGPL-JETPUR 2 AP : Fault 13
191 - CGPL-BHACHAU 1 AP : Fault 13
193 - CGPL-BHACHAU 2 AP : Fault 13
195 - CGPL-BHACHAU 3 AP : Fault 13
197 - CGPL-BHACHAU 4 AP : Fault 13

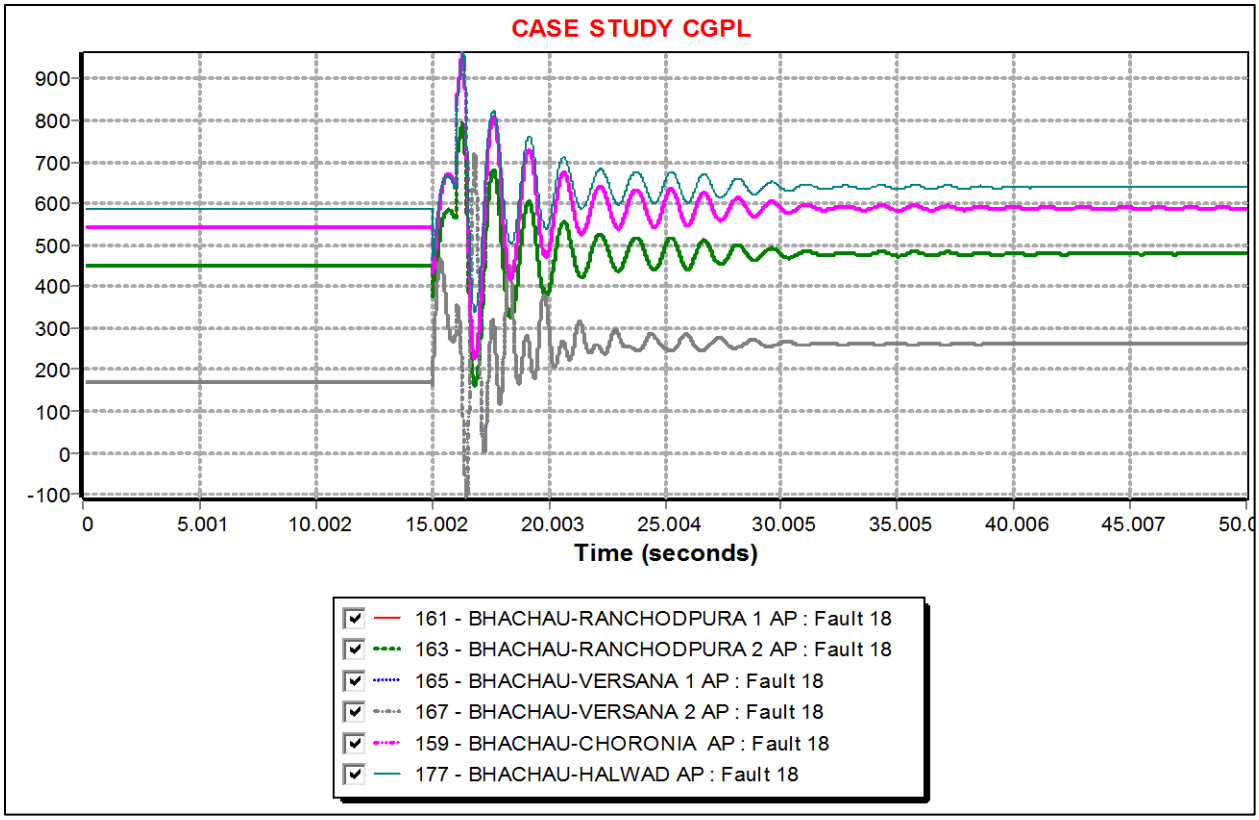

CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 13
163 - BHACHAU-RANCHODPURA 2 AP : Fault 13
165 - BHACHAU-VERSANA 1 AP : Fault 13
167 - BHACHAU-VERSANA 2 AP : Fault 13
159 - BHACHAU-CHORONIA AP : Fault 13
177 - BHACHAU-HALWAD AP : Fault 13

Fault 14, 15,16,17, stable.

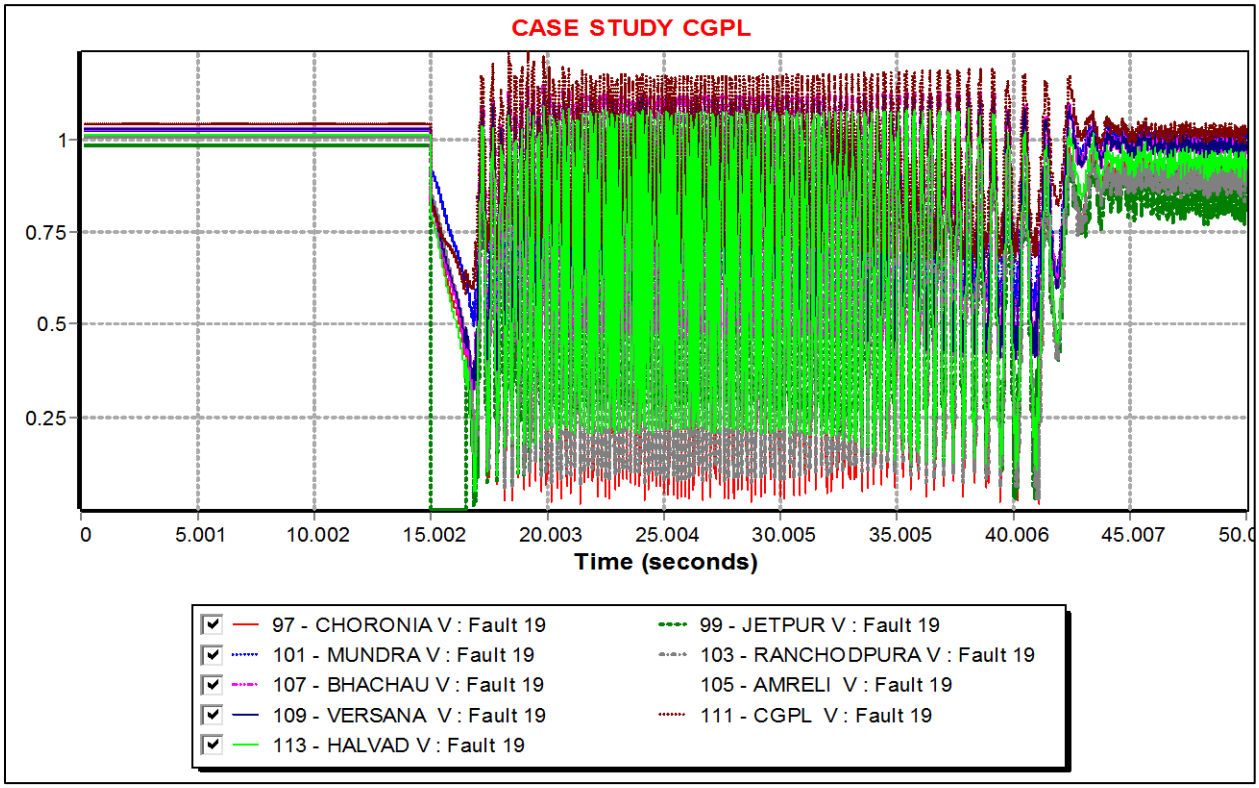
Fault 18:

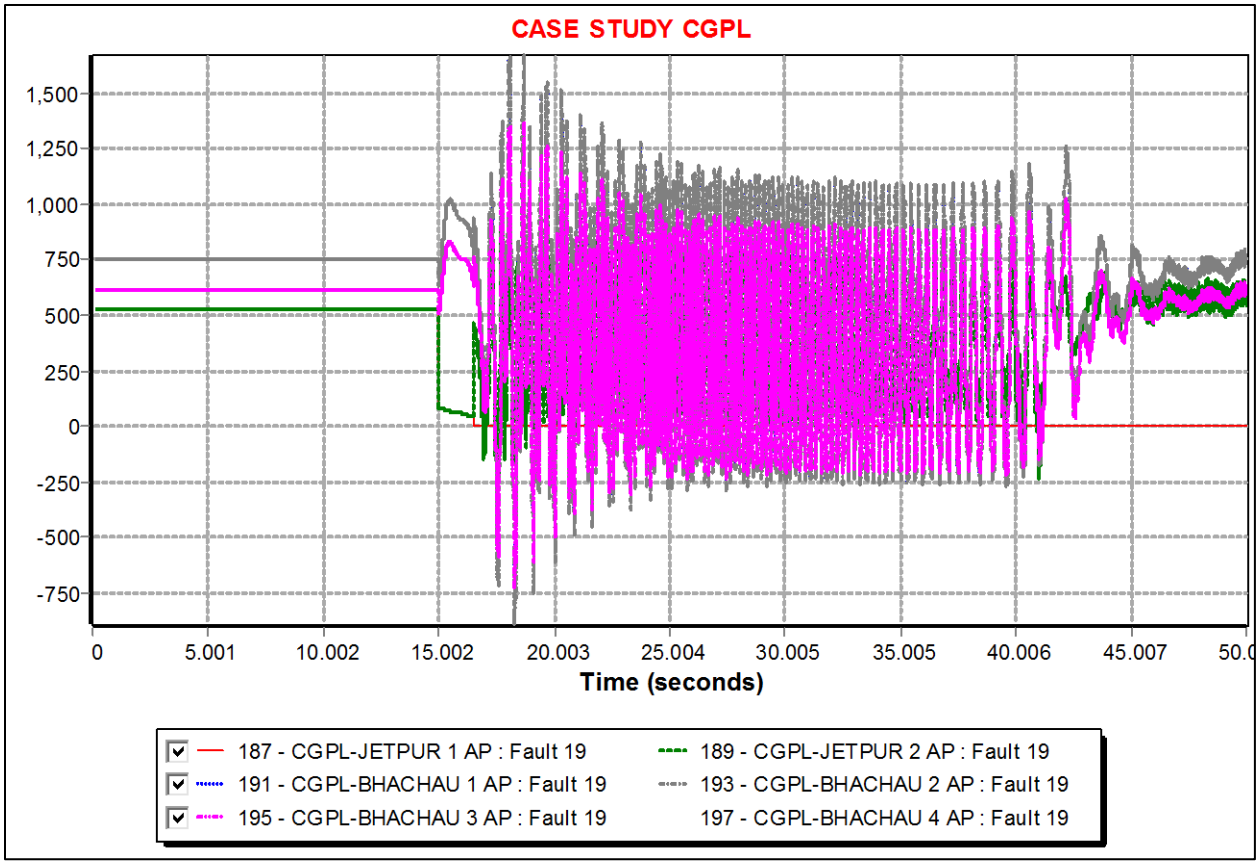




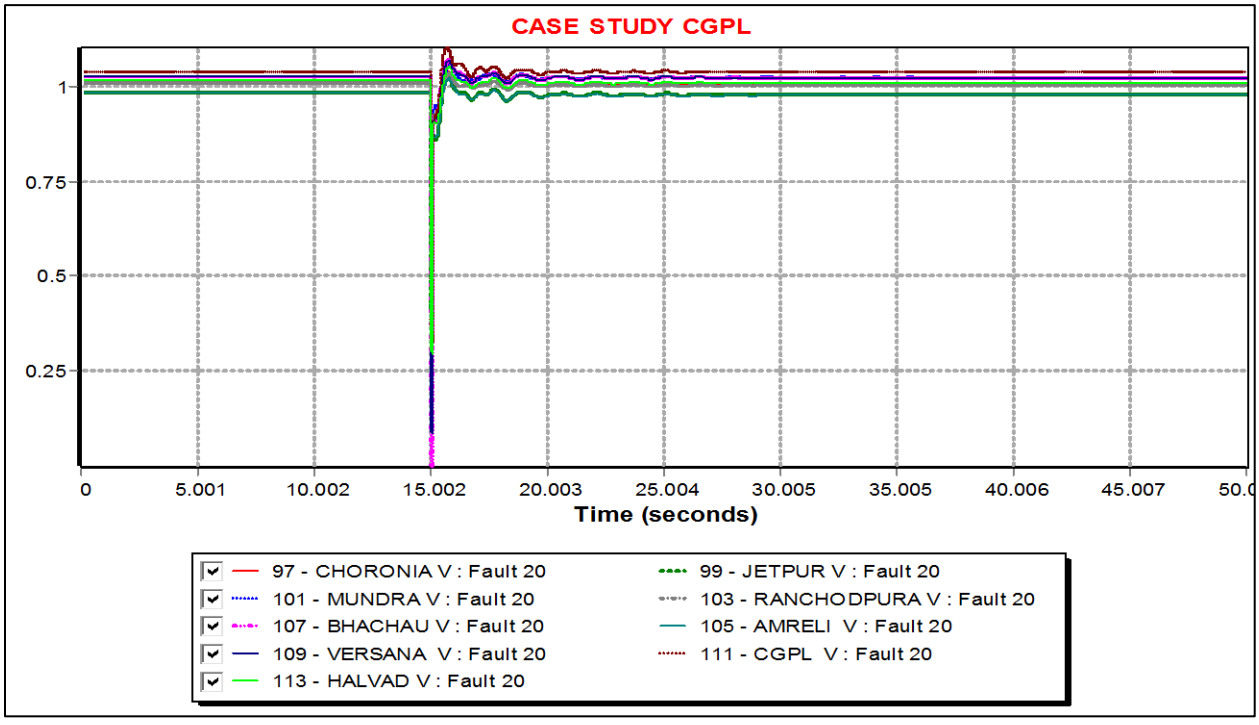

CASE STUDY CGPL
900
800
700
600
500
400
300
200
100
0
-100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 18
163 - BHACHAU-RANCHODPURA 2 AP : Fault 18
165 - BHACHAU-VERSANA 1 AP : Fault 18
167 - BHACHAU-VERSANA 2 AP : Fault 18
159 - BHACHAU-CHORONIA AP : Fault 18
177 - BHACHAU-HALWAD AP : Fault 18

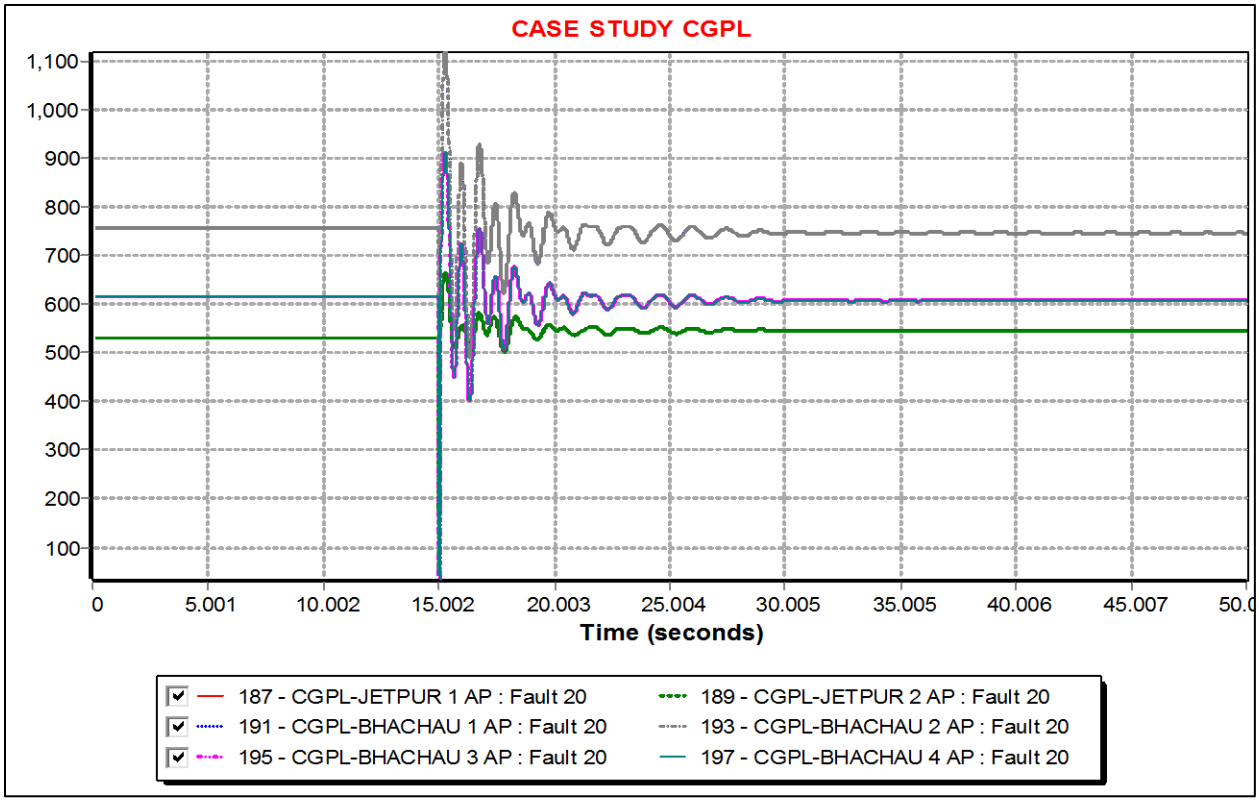
Fault 19:

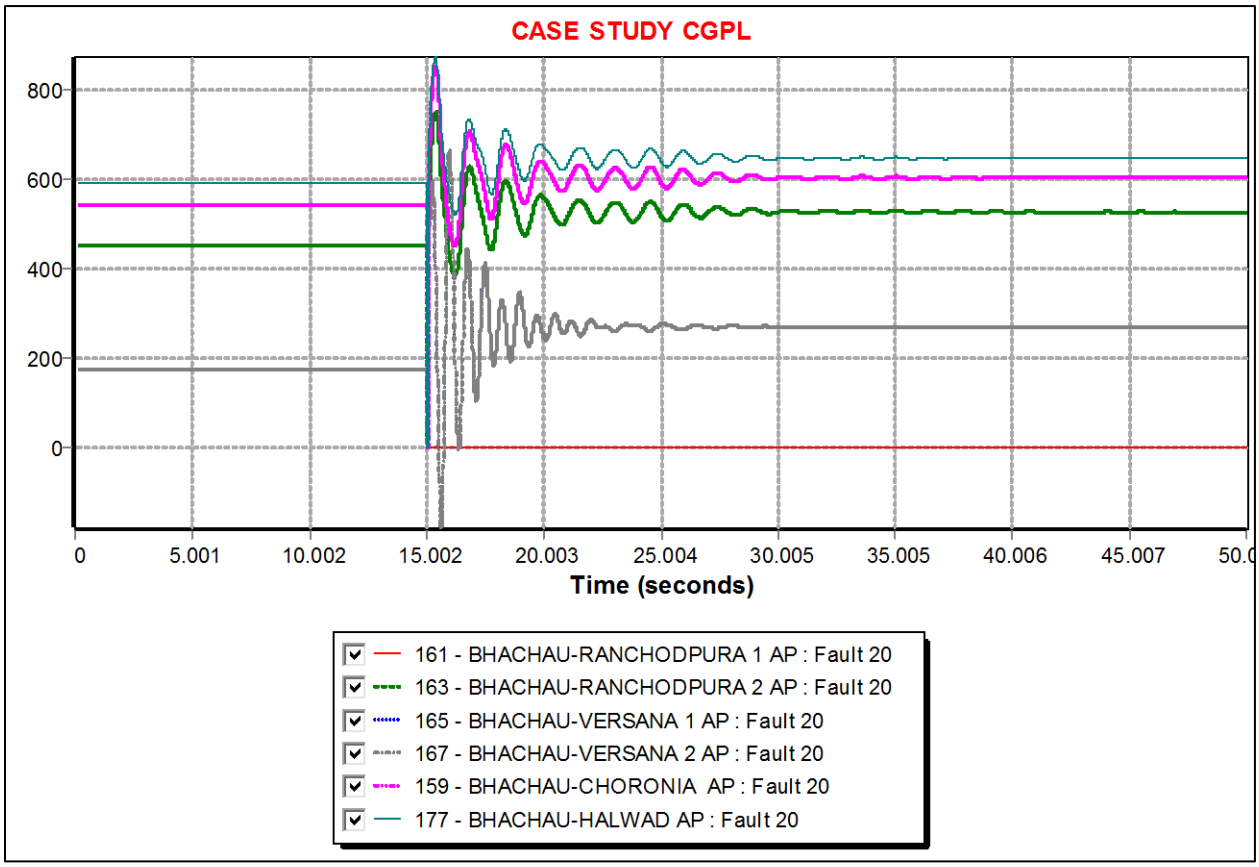

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 19
101 - MUNDRA V : Fault 19
107 - BHACHAU V : Fault 19
109 - VERSANA V : Fault 19
113 - HALVAD V : Fault 19
99 - JETPUR V : Fault 19
103 - RANCHODPURA V : Fault 19
105 - AMRELI V : Fault 19
111 - CGPL V : Fault 19


CASE STUDY CGPL
1,500
1,250
1,000
750
500
250
0
-250
-500
-750
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 19
189 - CGPL-JETPUR 2 AP : Fault 19
191 - CGPL-BHACHAU 1 AP : Fault 19
193 - CGPL-BHACHAU 2 AP : Fault 19
195 - CGPL-BHACHAU 3 AP : Fault 19
197 - CGPL-BHACHAU 4 AP : Fault 19

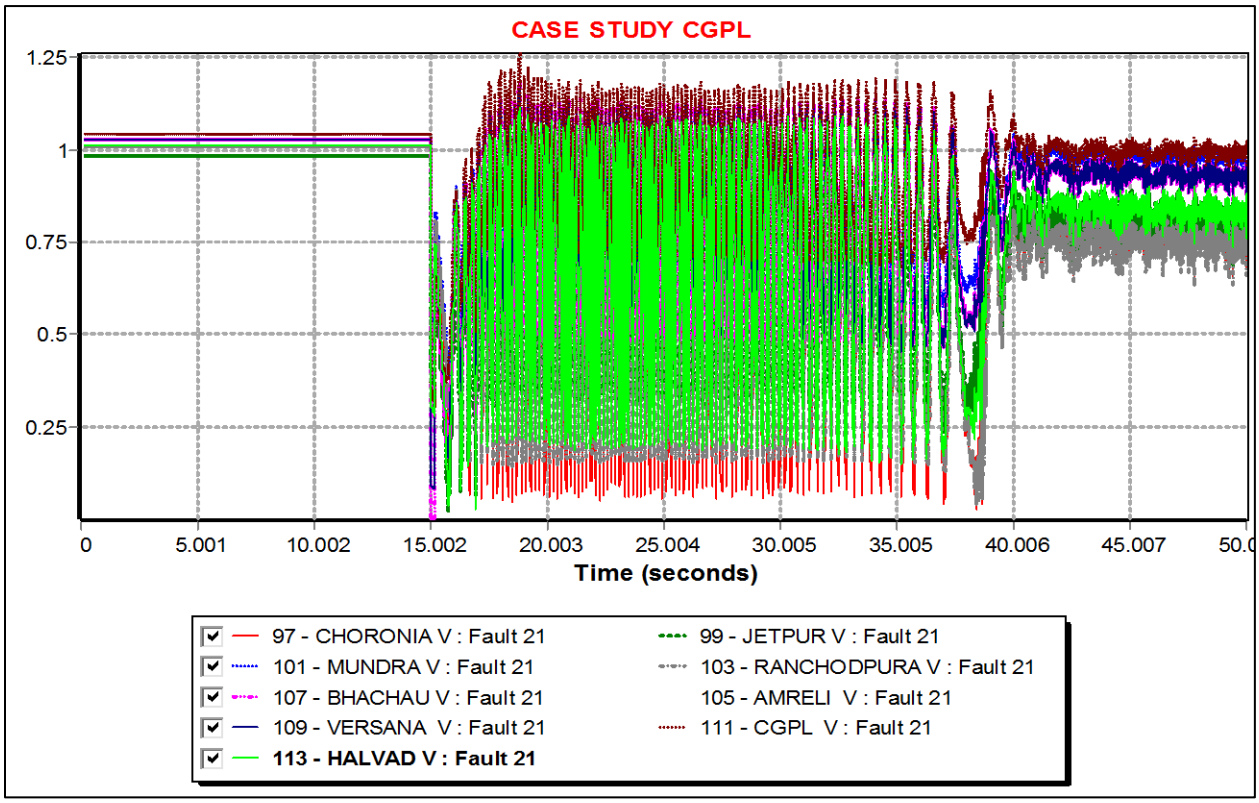
Fault 20:

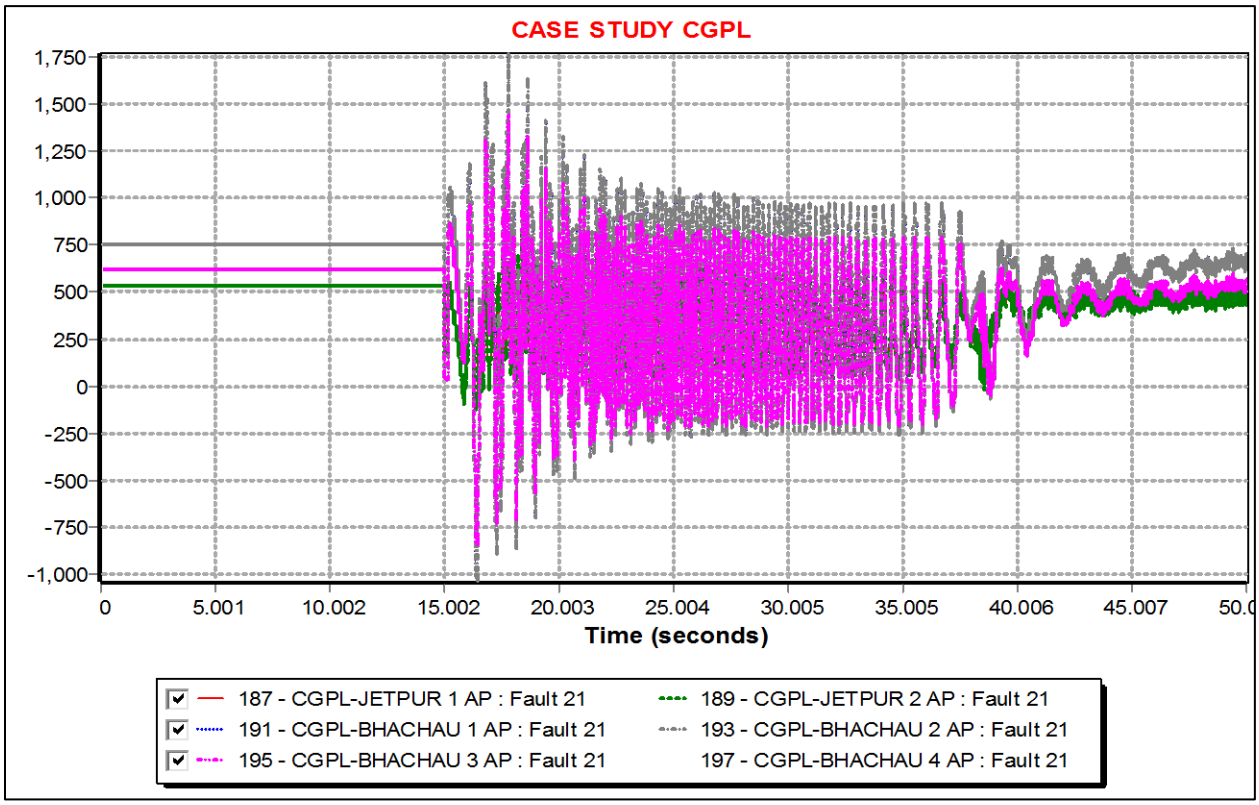

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 20
99 - JETPUR V : Fault 20
101 - MUNDRA V : Fault 20
103 - RANCHODPURA V : Fault 20
107 - BHACHAU V : Fault 20
105 - AMRELI V : Fault 20
109 - VERSANA V : Fault 20
111 - CGPL V : Fault 20
113 - HALVAD V : Fault 20

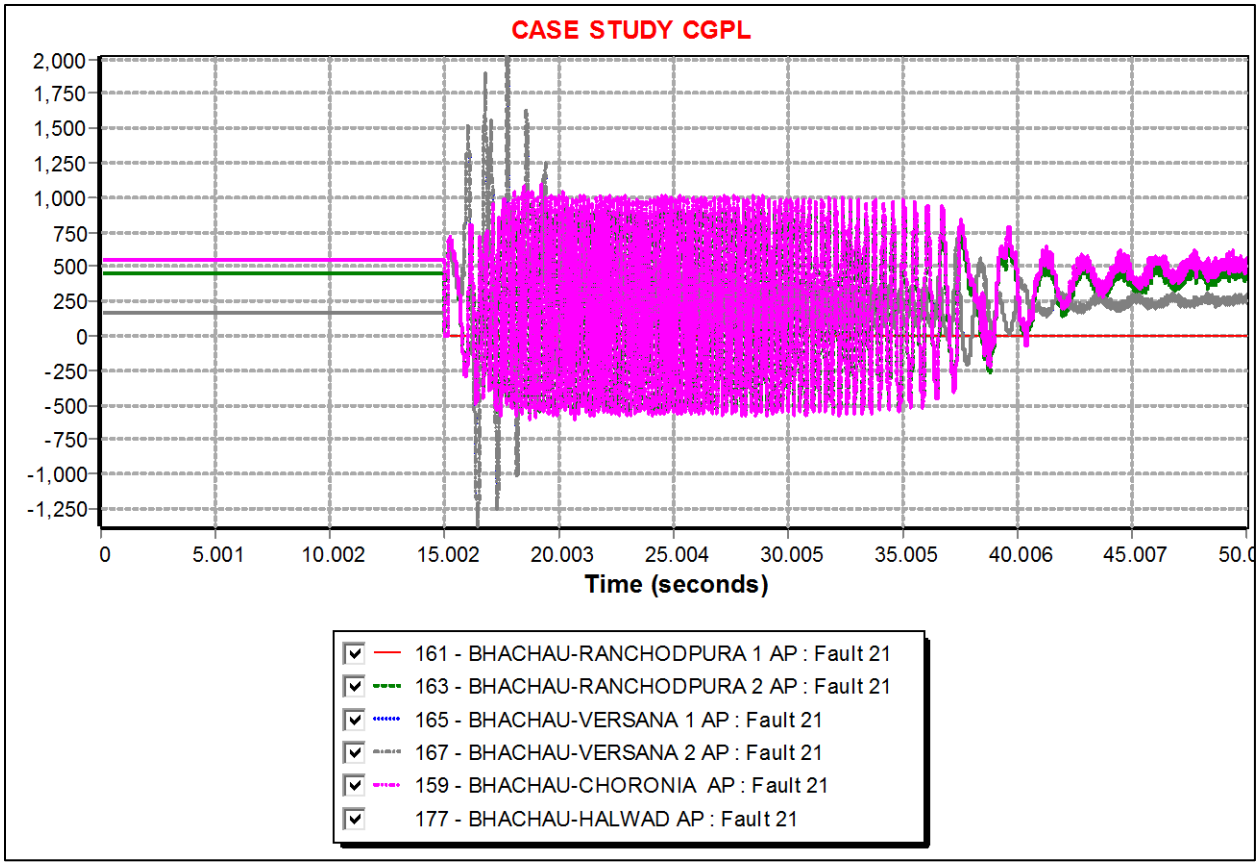

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 20
189 - CGPL-JETPUR 2 AP : Fault 20
191 - CGPL-BHACHAU 1 AP : Fault 20
193 - CGPL-BHACHAU 2 AP : Fault 20
195 - CGPL-BHACHAU 3 AP : Fault 20
197 - CGPL-BHACHAU 4 AP : Fault 20


CASE STUDY CGPL
800
600
400
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 20
163 - BHACHAU-RANCHODPURA 2 AP : Fault 20
165 - BHACHAU-VERSANA 1 AP : Fault 20
167 - BHACHAU-VERSANA 2 AP : Fault 20
159 - BHACHAU-CHORONIA AP : Fault 20
177 - BHACHAU-HALWAD AP : Fault 20

Fault 21:


CASE STUDY CGPL
1.25
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 21
99 - JETPUR V : Fault 21
101 - MUNDRA V : Fault 21
103 - RANCHODPURA V : Fault 21
107 - BHACHAU V : Fault 21
105 - AMRELI V : Fault 21
109 - VERSANA V : Fault 21
111 - CGPL V : Fault 21
113 - HALVAD V : Fault 21


CASE STUDY CGPL
1,750
1,500
1,250
1,000
750
500
250
0
-250
-500
-750
-1,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 21
189 - CGPL-JETPUR 2 AP : Fault 21
191 - CGPL-BHACHAU 1 AP : Fault 21
193 - CGPL-BHACHAU 2 AP : Fault 21
195 - CGPL-BHACHAU 3 AP : Fault 21
197 - CGPL-BHACHAU 4 AP : Fault 21



Fault 22,24,26 are stable and similar to Fault 20.

Fault 23,25,27 are unstable and similar to Fault 21

Study report for Submission to the Expert Group on Power Swing for the event at CGPL on 13th July'16.

Base-case has been set-up based on Load-Generation balance data available in NLDC SCADA on 13.7.16. While preparing the base-case it has been ensured that the lines which are opened on O/V prior to the CGPL blackout are kept open. Further, all the lines and ICT's connected to 400kV Versana sub-station except 400kV Bhachau-Versana 1 are kept in open condition.

Load-Generation prior to blackout of CGPL is as follows:

S. No.	Region	Generation	Demand
1	NR	39900	46100
2	ER	22470	16200
3	WR	38400	32000
4	SR	27000	29450
5	NER	2100	1900

Inter-Regional flows on each corridor are given below.

S. No.	Region	IR flow
1	WR →NR	4300
2	ER →NR	2900
3	WR →SR	1260
4	ER →SR	2100
5	ER →NER	380
6	NER→NR	500

Base case is prepared with the scenario of system prior to blackout of CGPL. The following events are simulated:

1. T=0-15 Sec : Initiation of the case
2. T=15 sec, Three phase Bus Fault at Versana
3. T=15.3 sec, Tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodpura D/C
4. T=15.37 Sec, Clearance of Bus fault at Versana

Studies are carried out to analyse the following aspects in view of the above disturbance:

1. Critical clearing time for CGPL for 3 phase bus fault at Bhachau and Versana and 3 phase fault on 400 kV CGPL-Bhachau circuit.
2. Whether non-tripping of 400 kV CGPL-Bhachau in Zone 2 (300 ms) could have stabilised the system.
3. Whether non-tripping of 400 kV Bhachau-Ranchodpura D/C in Zone 2 (300 ms) could have stabilised the system.

Based on the above, total 9 case studies have been carried out and results are given in table 1. The plots for these simulation are also attached in annexure.

Table 1: CGPL Event study for root case and critical clearing time

Study No.	Criteria	Results
Base Case 0	Exact scenario of event based on SOE.	**System is not stable**
Case 1	3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV CGPL-Bhachau 1 at 300 ms	System is stable

Case 2	3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV Bhachau-Ranchodpura D/C at 300 ms	**System is not stable**.
Case 3	3 Phase Bus Fault at 400 kV Versana cleared in 300 ms without tripping of any line	System is stable
Case 4	3 Phase Bus Fault at 400 kV Versana cleared in 370 ms without tripping of any line	System is stable.
Case 5	3 Phase Bus Fault at 400 kV Bhachau cleared in 250 ms without tripping of any line	System is Stable.
Case 6	3 Phase Bus Fault at 400 kV Bhachau cleared in 300 ms without tripping of any line	**System is not stable**.
Case 7	3 Phase fault on 400 kV CGPL- Bhachau ckt-2 cleared in 250 ms by tripping of line	System is Stable.
Case 8	3 Phase fault on 400 kV CGPL- Bhachau ckt-2 cleared in 300 ms by tripping of line	**System is not stable.**

As per the discussion held in the meeting of Committee on Power Swing at CGPL on 23rd August 2017, it was decided to include other case studies as given below:-

1. Impact of tripping of units after the tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodpura D/C and prior to clearance of the Versana fault.
2. Impact of tripping of units after the tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodpura D/C and clearance of the Versana fault.
3. Impact of Connectivity of all lines outside CGPL complex in Gujarat System keeping the event as it is.

The results of the additional 5 case studies carried out are given in table 2. The plots for these simulation are also attached in annexure.

Table 2: CGPL Event study with Unit Tripping

Study No.	Criteria	Results
Case 9	Base Case + One CGPL Unit tripping at 300 ms after fault at Versana	System is stable
Case 10	Base Case + One CGPL Unit tripping at 350 ms after fault at Versana	System is stable
Case 11	Base Case + One CGPL Unit Tripping at 400 ms after fault at Versana	System is stable
Case 12	Base Case + One CGPL Unit Tripping at 500 ms after fault at Versana	**System is not stable**.
Case 13	Base Case + All Line from Choronia, Jetpur and Ranchodpura in service	**System is not stable however, the power swing is slow during initial period after fault clearance at Versana.**

The Following additional studies have been suggested by Sh. Uday Trivedi, ATIL through email:

1. **Case 14:** Creating a 3 phase fault of 250 ms on each evacuating line from CGPL and to check the power swing observed on other lines and unit.
2. **Case 15:** Creating a 3 phase fault of 250 ms on each evacuating line from CGPL and thereafter its tripping to check the power swing observed on other lines and unit.

Accordingly 250 ms 3 Phase fault at remote end was simulated for 400 kV CGPL-Bhachau 1, 400 kV CGPL-Choronia and CGPL-Jetpur 1 circuit and the relevant plots of power flow on the lines and CGPL Machine angle is attached.

Inferences from Simulation Results:

1. **The major reason for the unstable system condition for CGPL is the tripping of 400 kV Bhachau-Ranchodpura circuits at 300 ms in Zone 2. This can be inferred from Base Case 1 and 2. It is also observed that if these lines would not have tripped in Zone 2 and if the fault at Versana got have cleared within 370 ms, then the system was stable.**
2. Critical Clearing time (Tc) for a 3 phase bus fault on 400 kV Versana or for the line fault on 400 kV Bhachau-Versana line near to Versana end is 370 ms.
3. Critical Clearing time (Tc) for a three phase fault on 400 kV CGPL-Bhachau circuit is ~250 ms.
4. From the sequence of events, fault in the system is cleared after 400 kV Bhachau-Versana line tripping after ~400ms (Start time - 02:37:10.453, End time-02:37:10.862, Time delay for Zone 2: 350 ms, Breaker operation time :45 ms) which is more than the critical clearing time of 370 ms.
5. For a fault cleared after 370 ms, system is going to oscillate which would ultimately trip the lines on PSB.
6. **Further, it is observed that the system is stable if One Unit of CGPL is tripped**
    a. After 300 ms of fault (Simultaneous with 400 kV Bhachau-Ranchodpura D/C and CGPL-Bhachau 1 ckt)
    b. After 350 ms of fault (after 50 ms of tripping of 400 kV Bhachau-Ranchodpura D/C and CGPL-Bhachau 1 ckt)
    c. After 400 ms of fault (After 30 ms of clearance of the fault)
7. Apart from this, it is observed that system is not stable if unit is tripped after 100 ms of fault clearance at Versana.
8. Along with this, it is observed that even if all the 400 kV Lines from CGPL, Bhachau and Jetpur would have been in service then also, system is unstable. **However, it is to be noted that the availability of these lines reduce the impact of swing.**

9. It is observed that large swing is observed in case of Fault on 400 kV CGPL-Bhachau circuit and 400 kV CGPL-Choronia circuit compared to fault on 400 kV CGPL Jetpur circuit.
10. Power Flow in initial swing is highest for 400 kV CGPL-Bhachau circuit followed by 400 kV CGPL –Choronia and lowest for 400 kV CGPL-Jetpur circuit during the faults.
11. In terms of CGPL unit angular stability, large swings are observed from 400 kV CGPL-Bhachau and CGPL-Choronia circuit compared with 400 kV CGPL-Jetpur circuits.

Study Plots

Base Case 0: 3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodrpura D/C at 300 ms

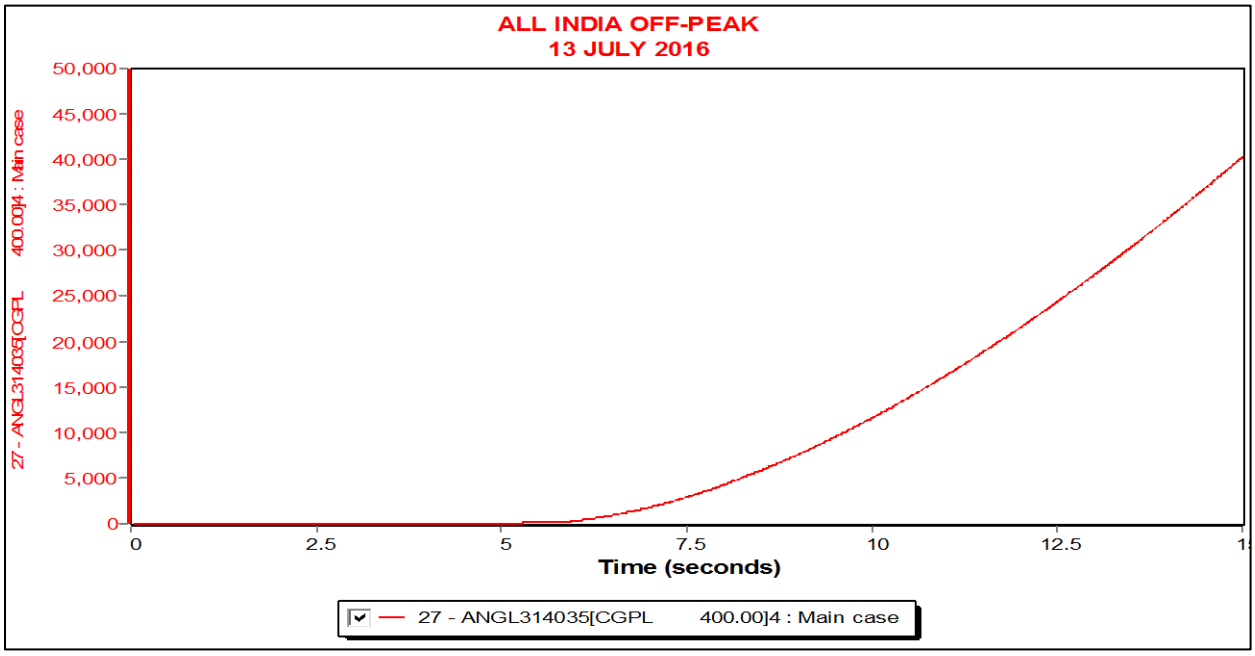


Figure: CGPL Unit 1 Machine Angle

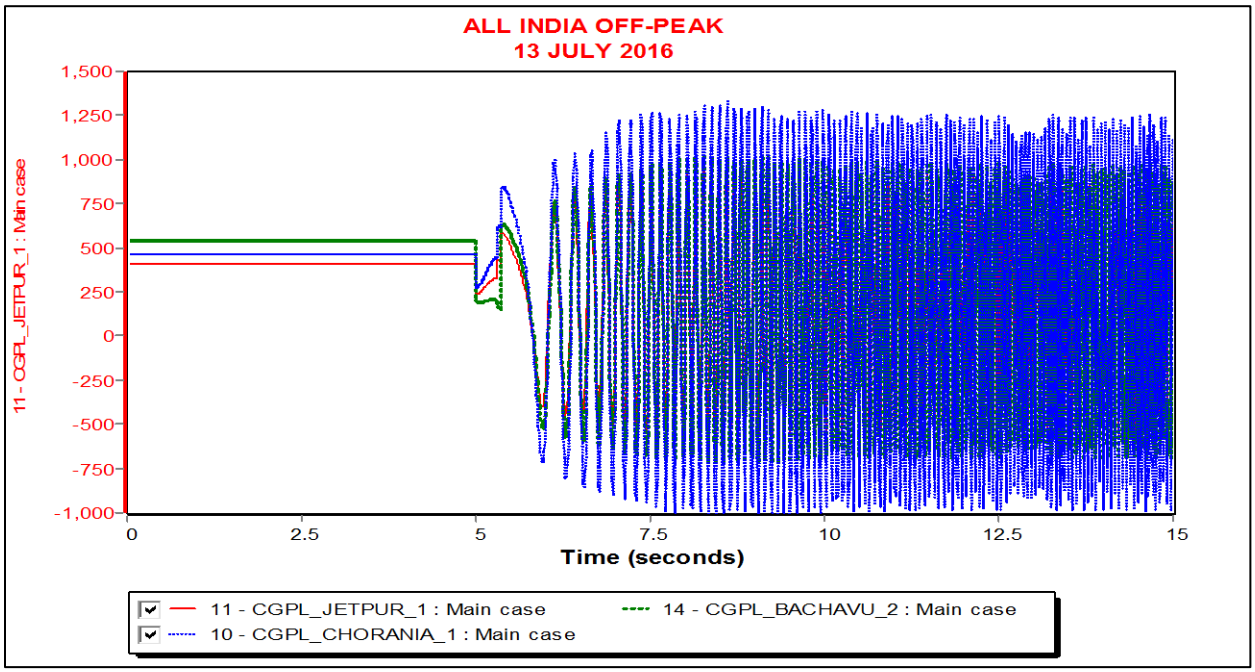


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It is observed that system is not stable for the above case.

Case 1: 3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV CGPL-Bhachau 1 at 300 ms

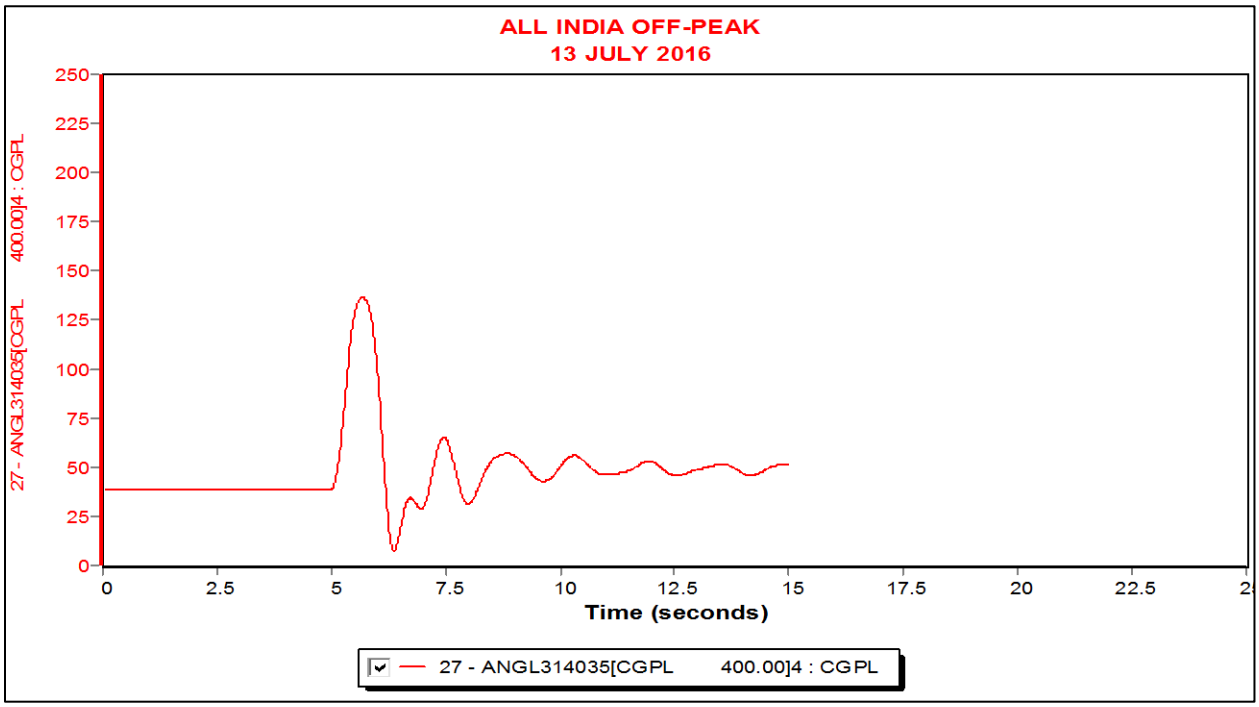


Figure: CGPL Unit 1 Machine Angle

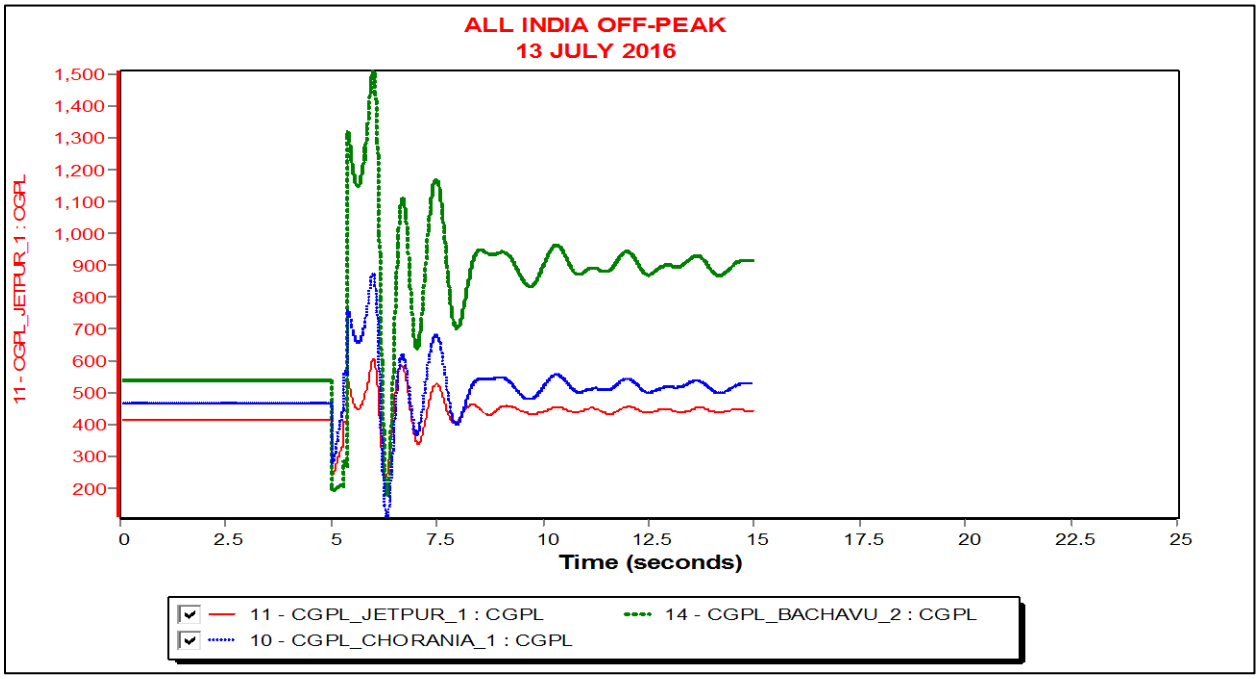


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It is observed that system is stable for the above case.

Base Case 2: 3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV Bhachau-Ranchodpura D/C at 300 ms.

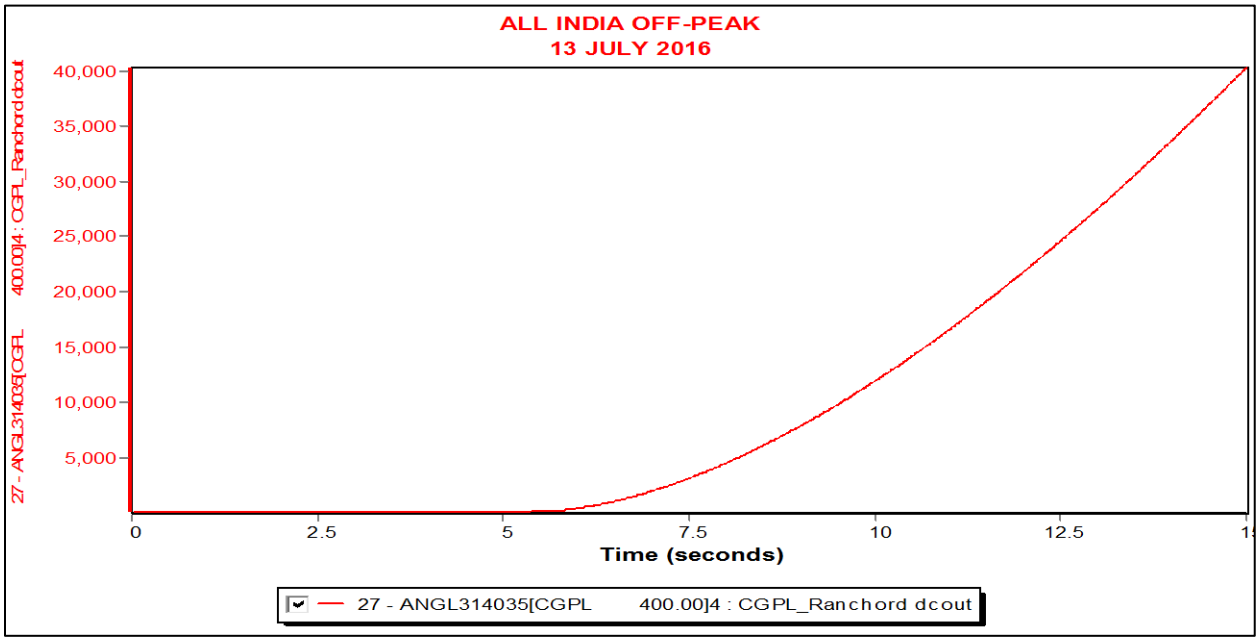


Figure: CGPL Unit 1 Machine Angle

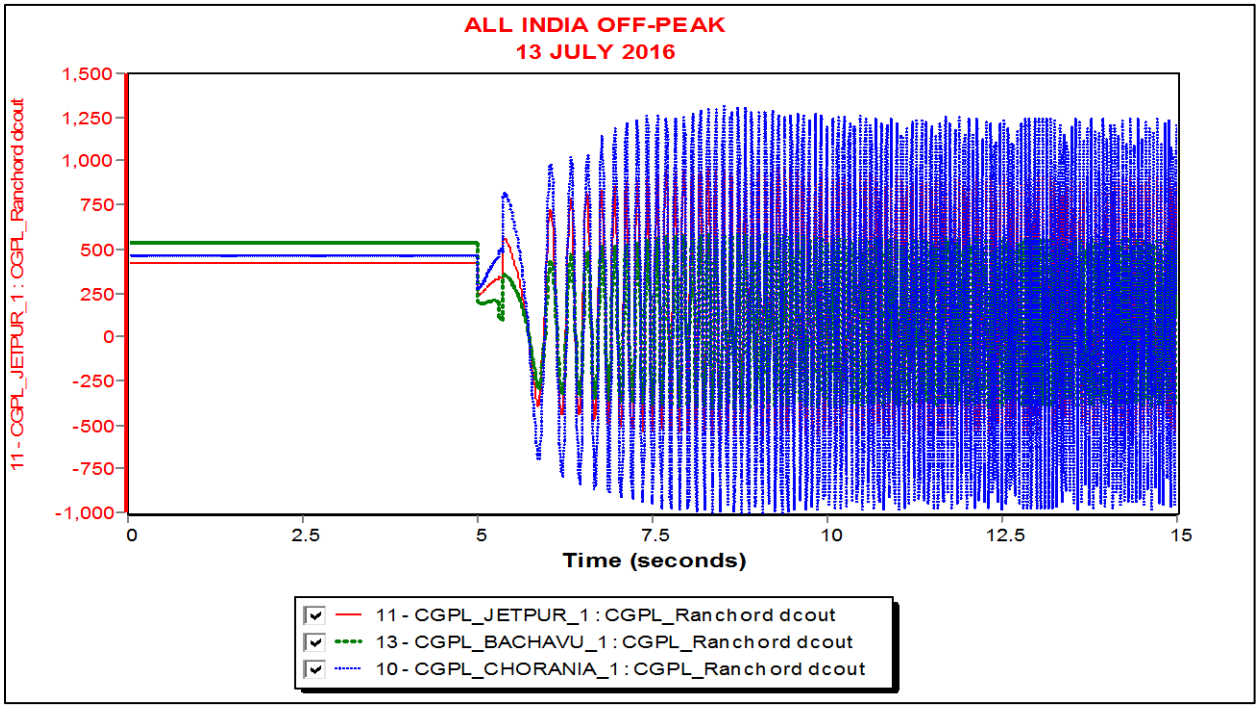


Figure: Power flow on 400 kV lines connected to CGPL Mundra

System is not stable in this case.

Case 3: 3 Phase Bus-Fault at 400kV Versana cleared in 300ms without tripping of any line

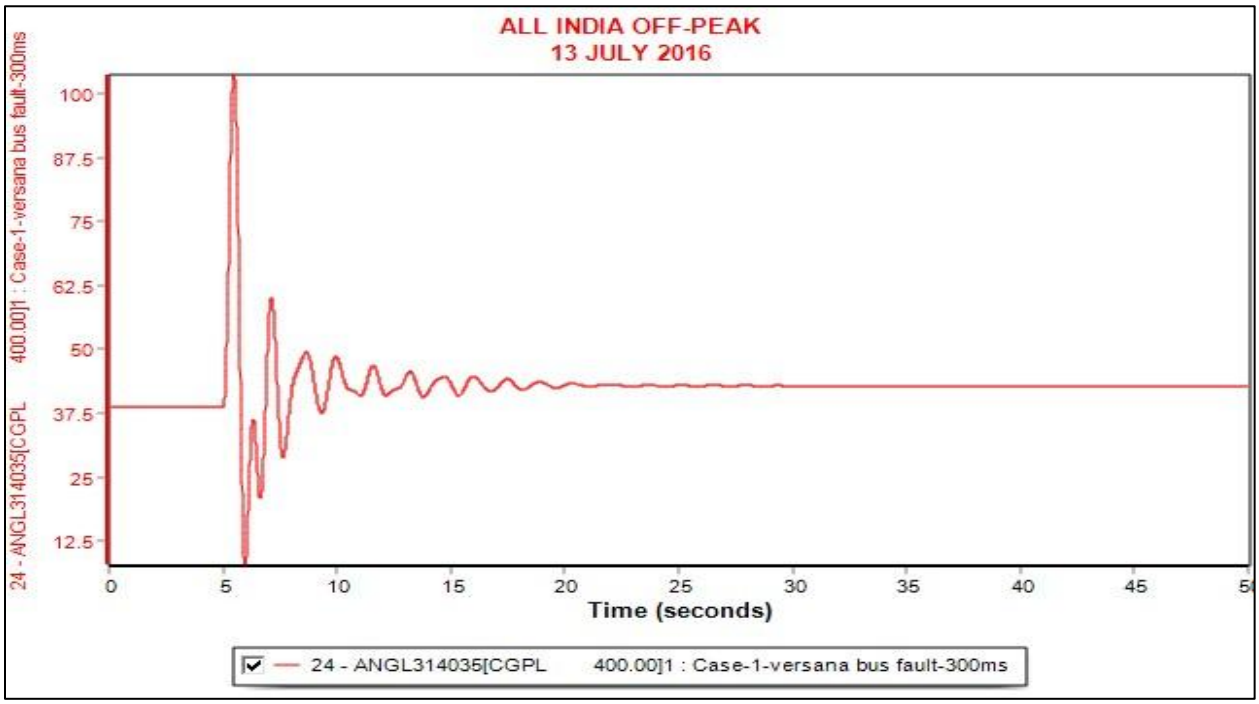


Figure: CGPL Unit 1 Machine Angle

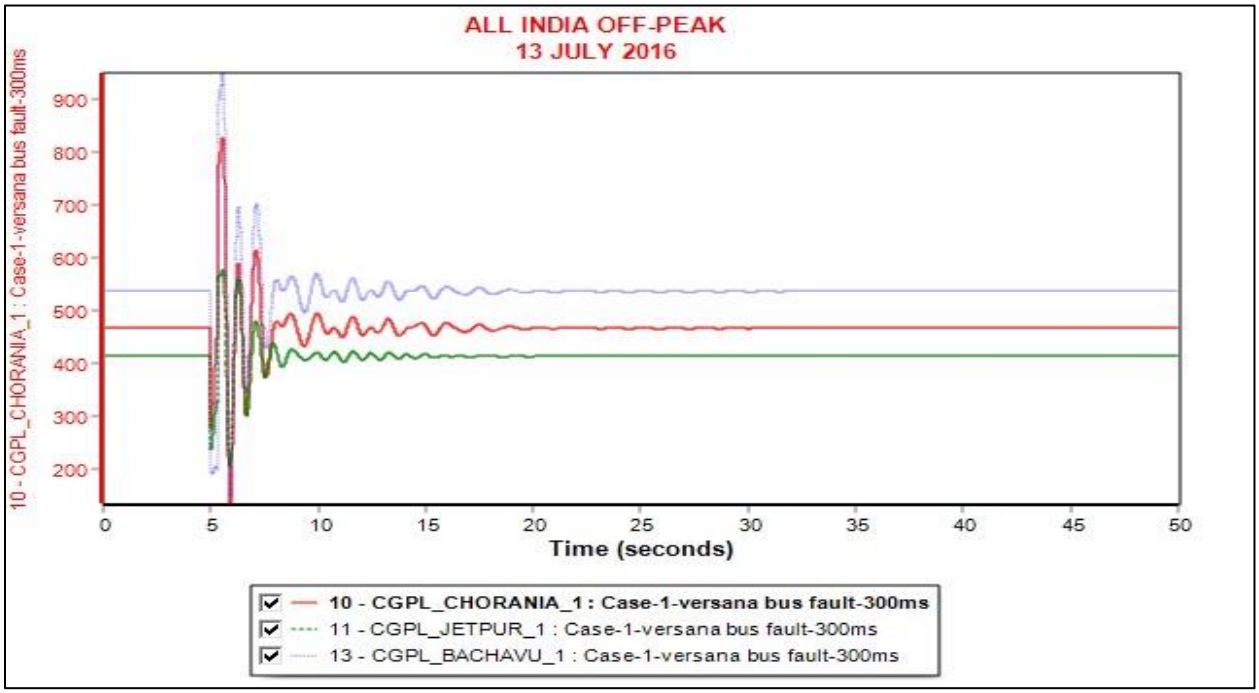


Figure: Power flow on 400 kV lines connected to CGPL Mundra

Case 4: 3 Phase Bus-fault at 400 kV Versana cleared in 370ms without tripping of any line

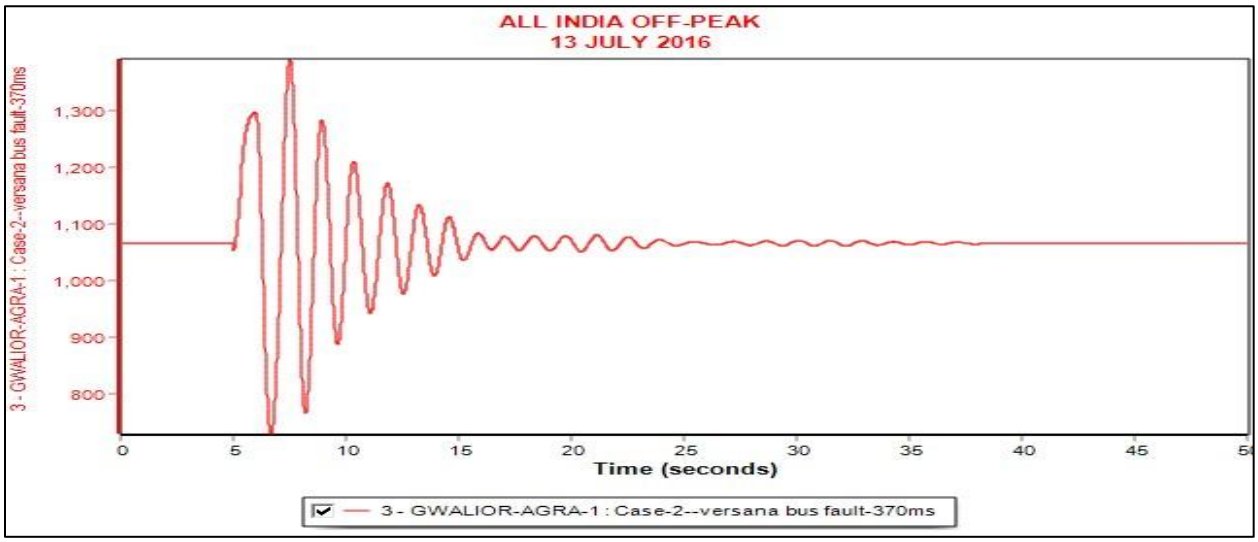


Figure: CGPL Unit 1 Machine Angle

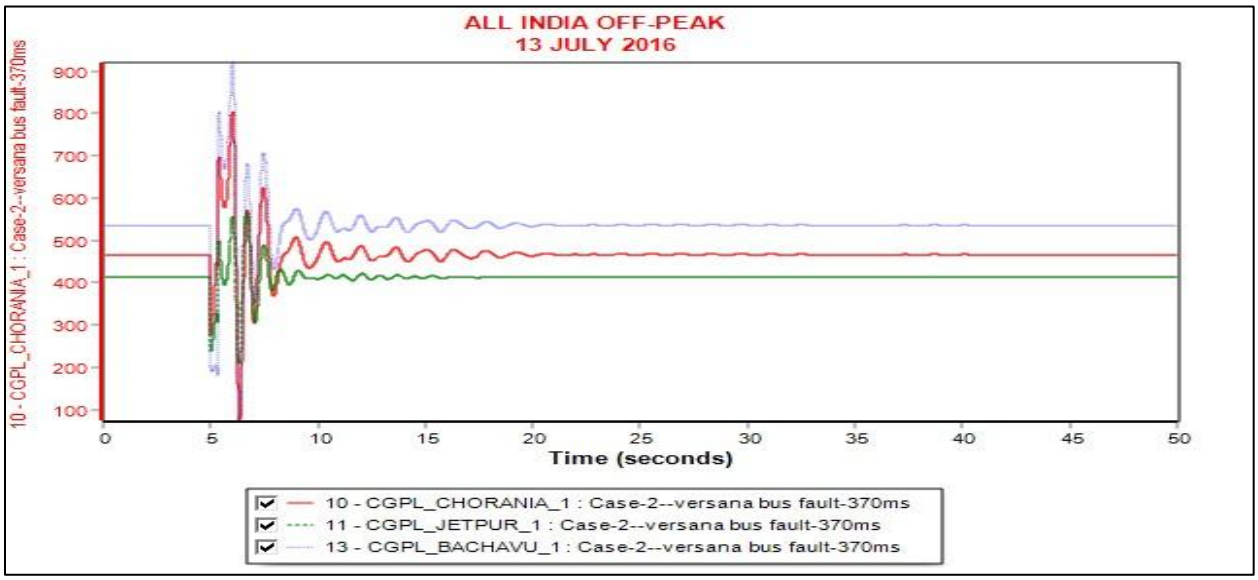


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It can be inferred from plots of Case-1 and Case-2 that the system is stable for fault clearing in 300 ms and in 370ms. Further, Stability studies are run to find the critical clearing time for 3-ph bus fault at 400kV Versana without tripping of any line. From the simulations it is found that if the fault is cleared after 370 ms, system is becoming unstable.

Case 5: 3 Phase Bus-fault at 400 kV Bhachau cleared in 250 ms without tripping of any line

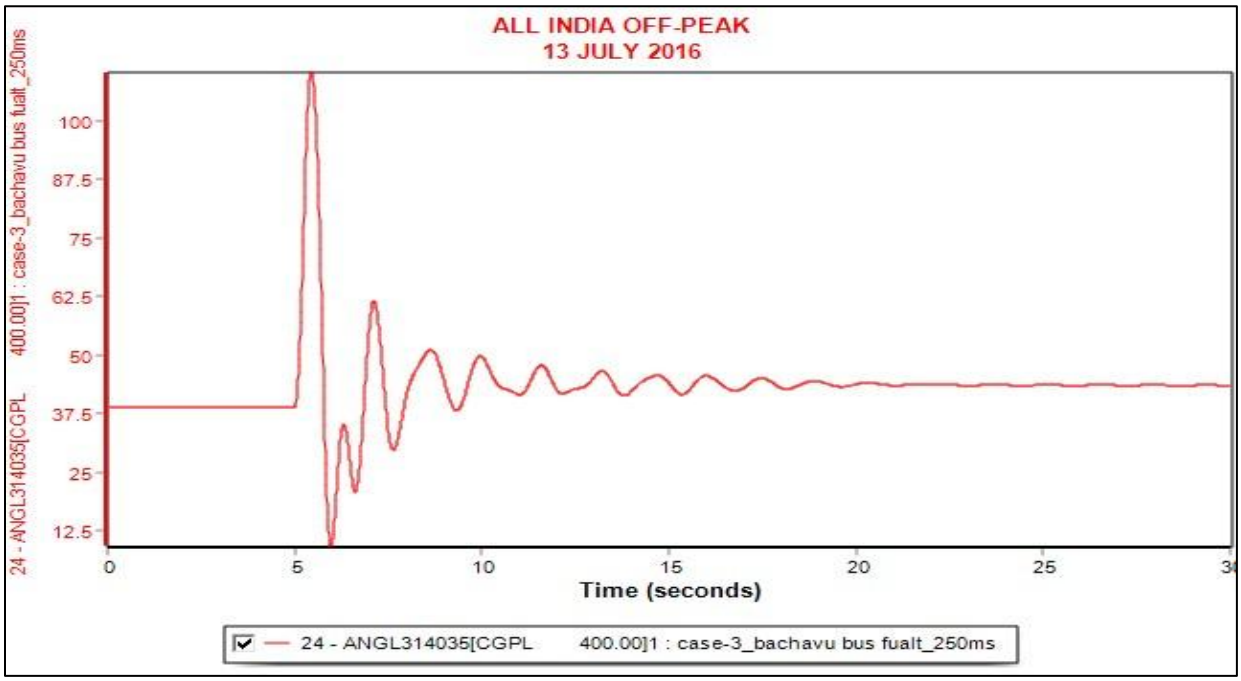


Figure: CGPL Unit 1 Machine Angle

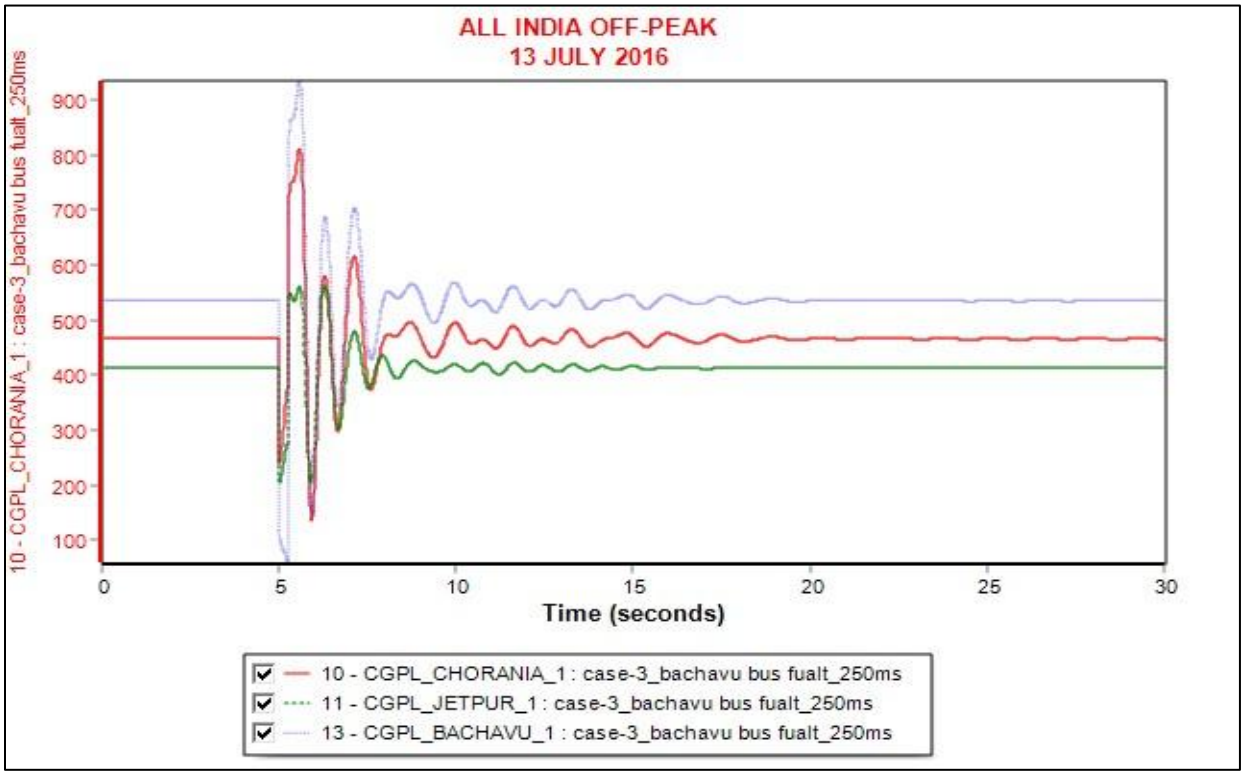


Figure: Power flow on 400 kV lines connected to CGPL Mundra

Case 6: 3 Phase Bus-fault at 400 kV Bhachau cleared in 300 ms without tripping of any line

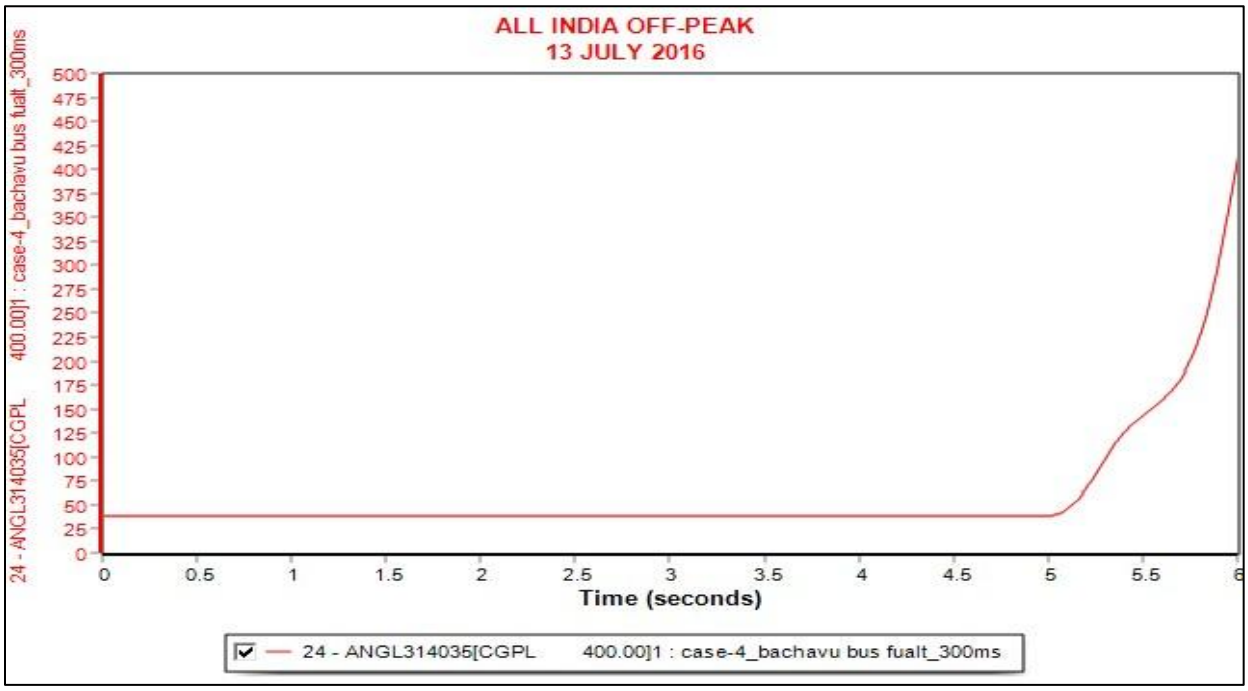


Figure: CGPL Unit 1 Machine Angle

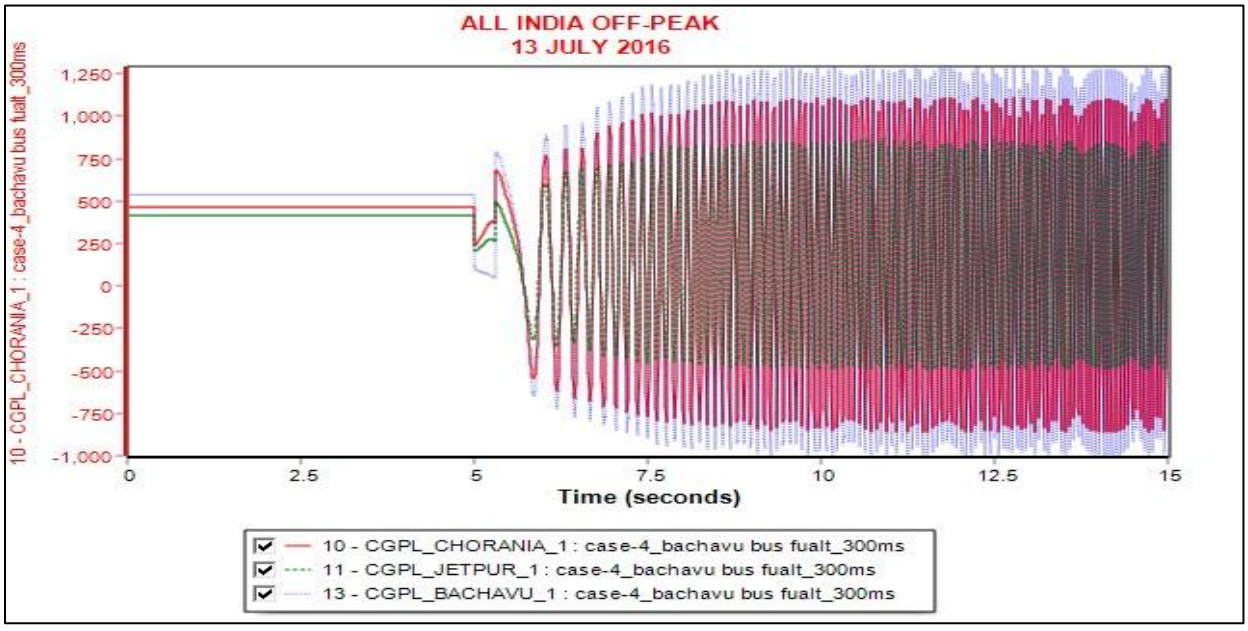


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It can be inferred from plots of Case-3 and Case-4 that the system is stable for fault clearing in 250 ms and unstable for fault clearing in 300ms.

Case 7: 3 Phase fault on 400kV CGPL-Bhachau 2 cleared in 250 ms by tripping of line

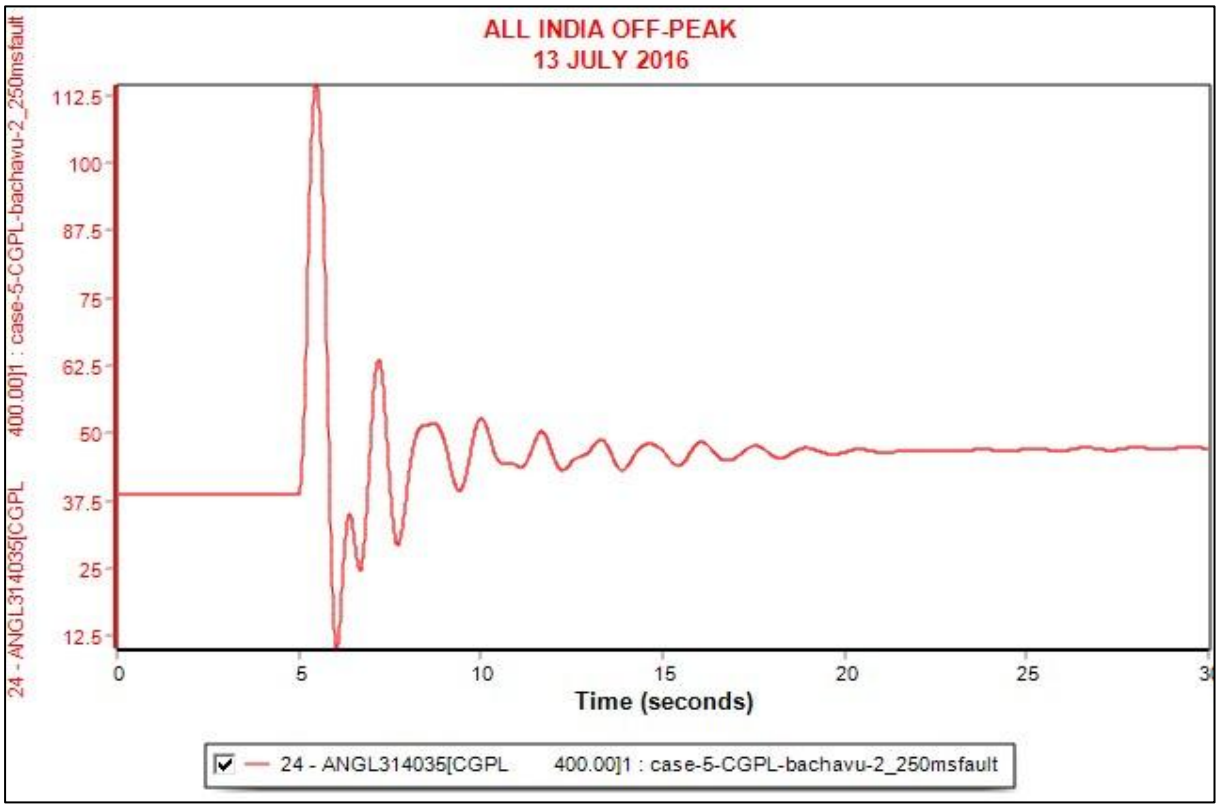


Figure: CGPL Unit 1 Machine Angle

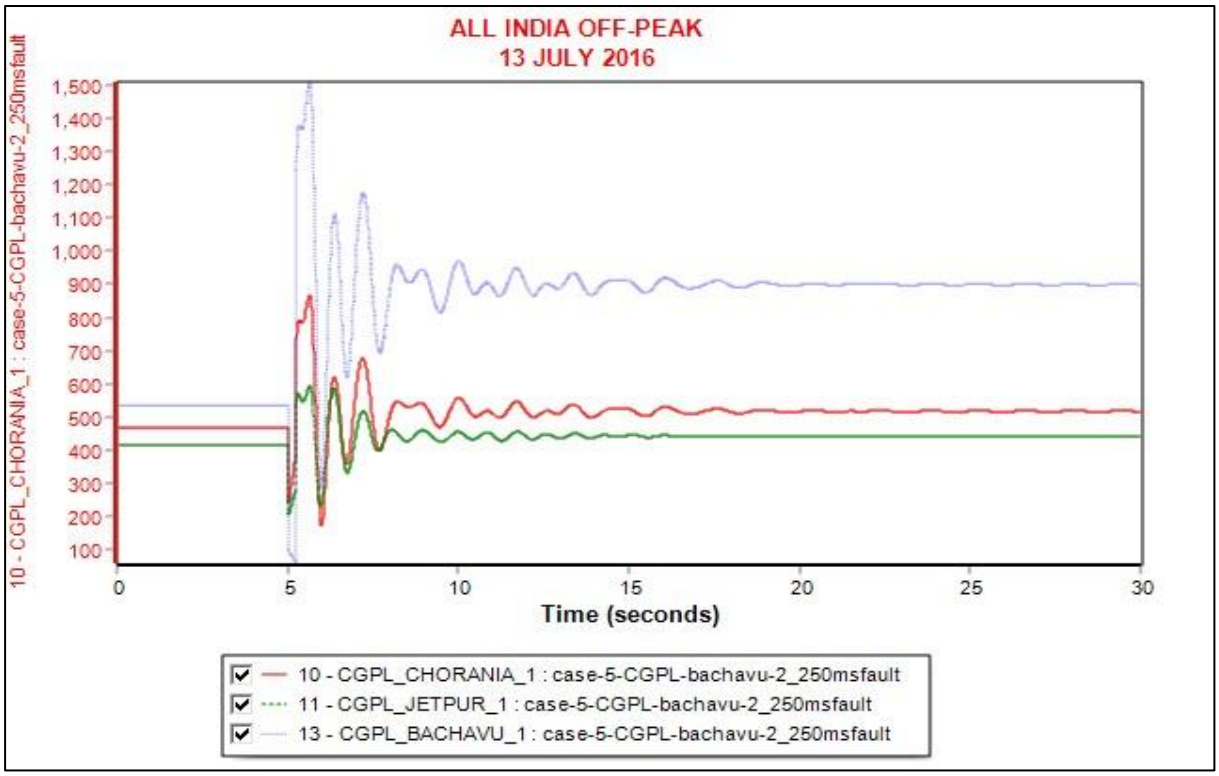


Figure: Power flow on 400 kV lines connected to CGPL Mundra

Case 8: 3 Phase fault on 400kV CGPL-Bhachau 2 cleared in 300 ms by tripping of line

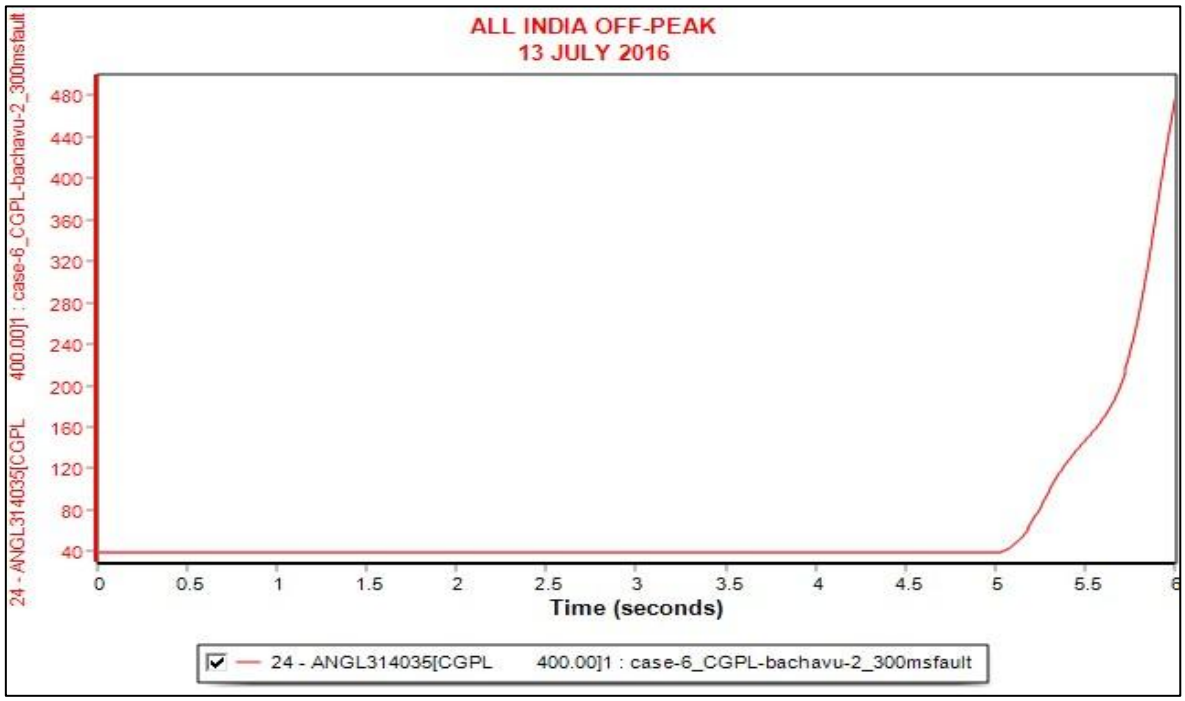


Figure: CGPL Unit 1 Machine Angle

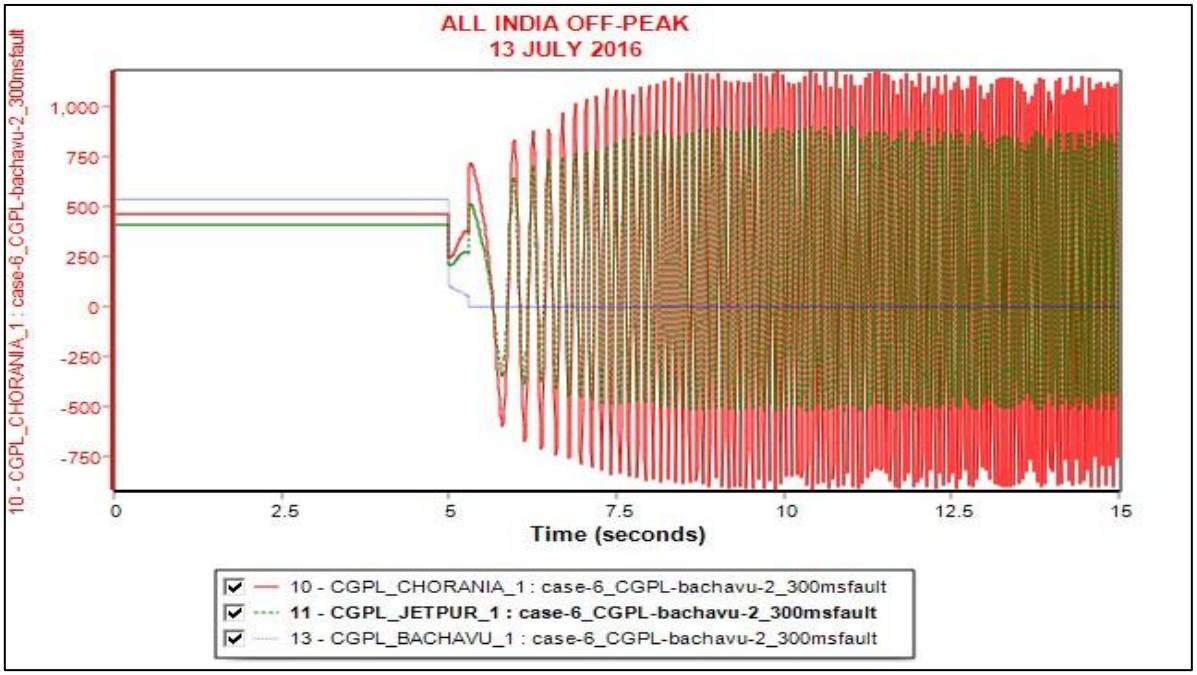


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It can be inferred from plots of Case-5 and Case-6 that the System is stable for fault clearing in 250 ms and unstable for fault clearing in 300 ms.

Case 9 : Base Case + One CGPL Unit tripping at 300 ms after fault at Versana

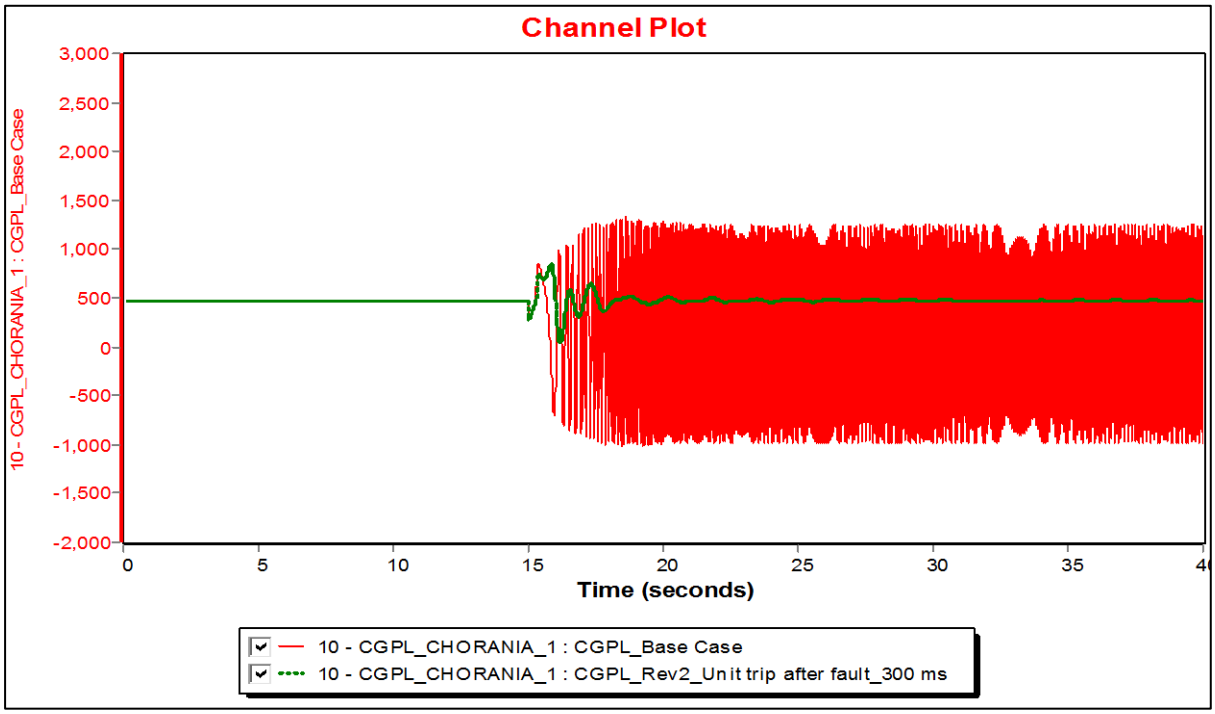


Figure: Power flow on 400 kV CGPL-Choronia

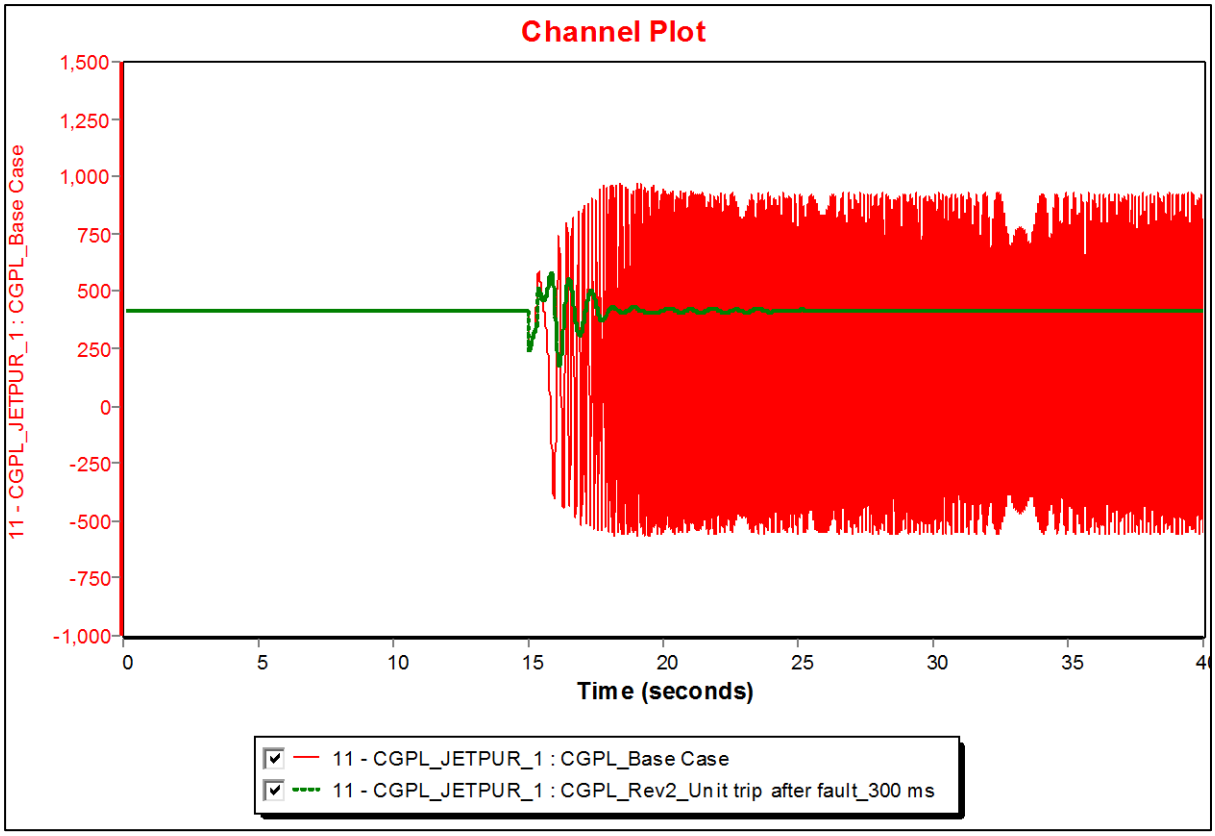


Figure: Power flow on 400 kV CGPL-Jetpur

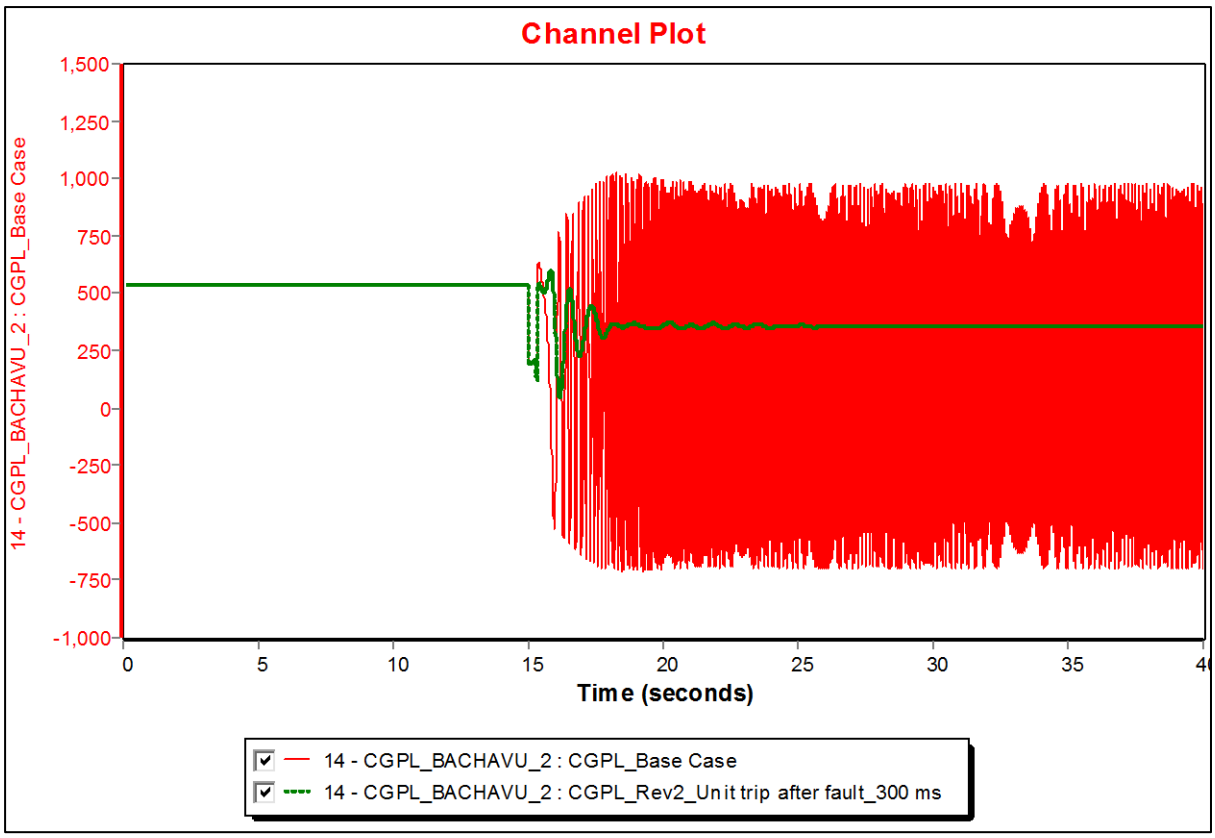


Figure: Power flow on 400 kV CGPL-Bhachau

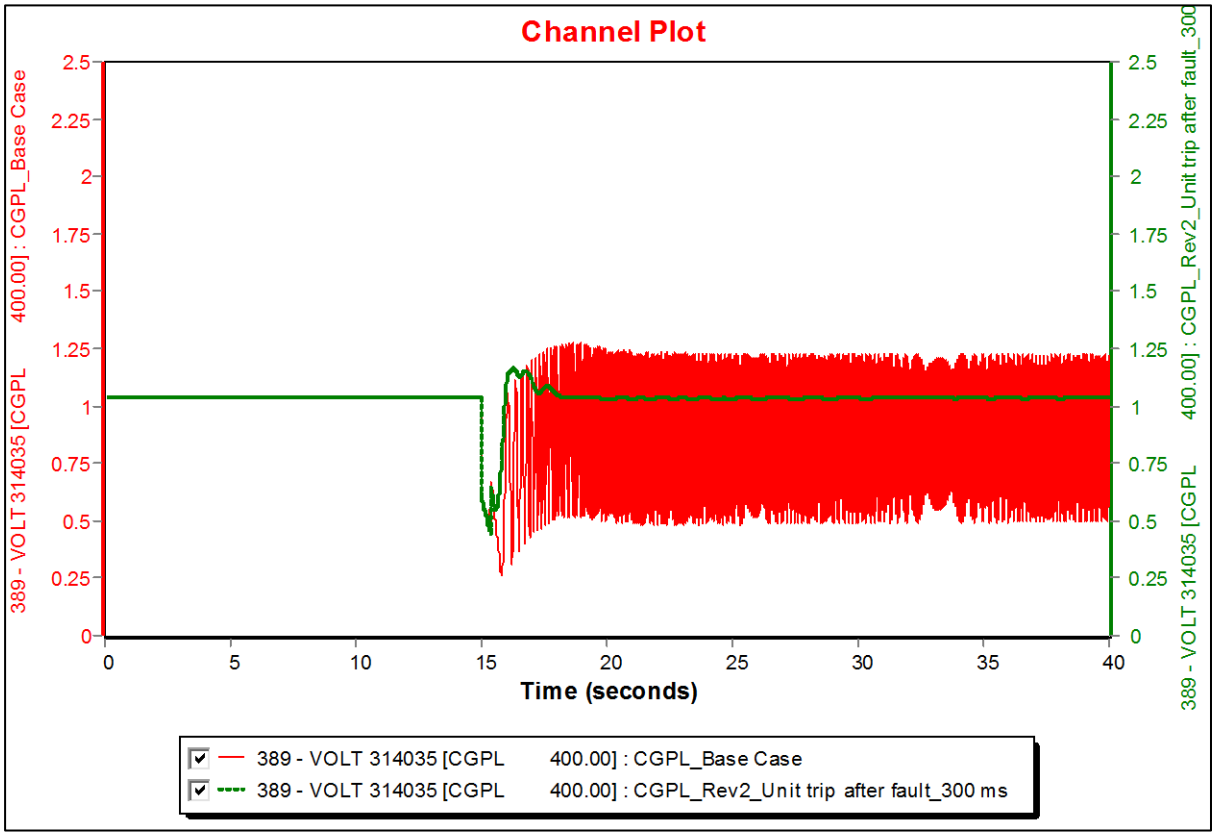


Figure: Voltage at CGPL

Case 10 : Base Case + One CGPL Unit tripping at 350 ms after fault at Versana

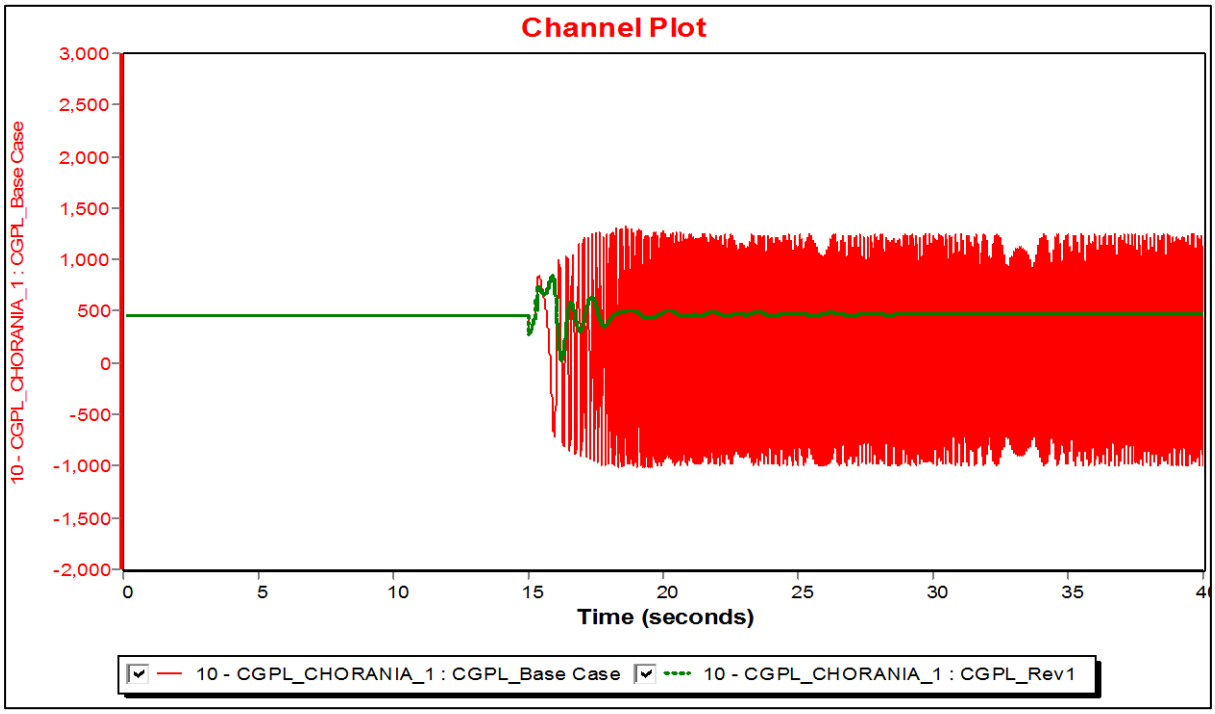


Figure: Power flow on 400 kV CGPL-Choronia

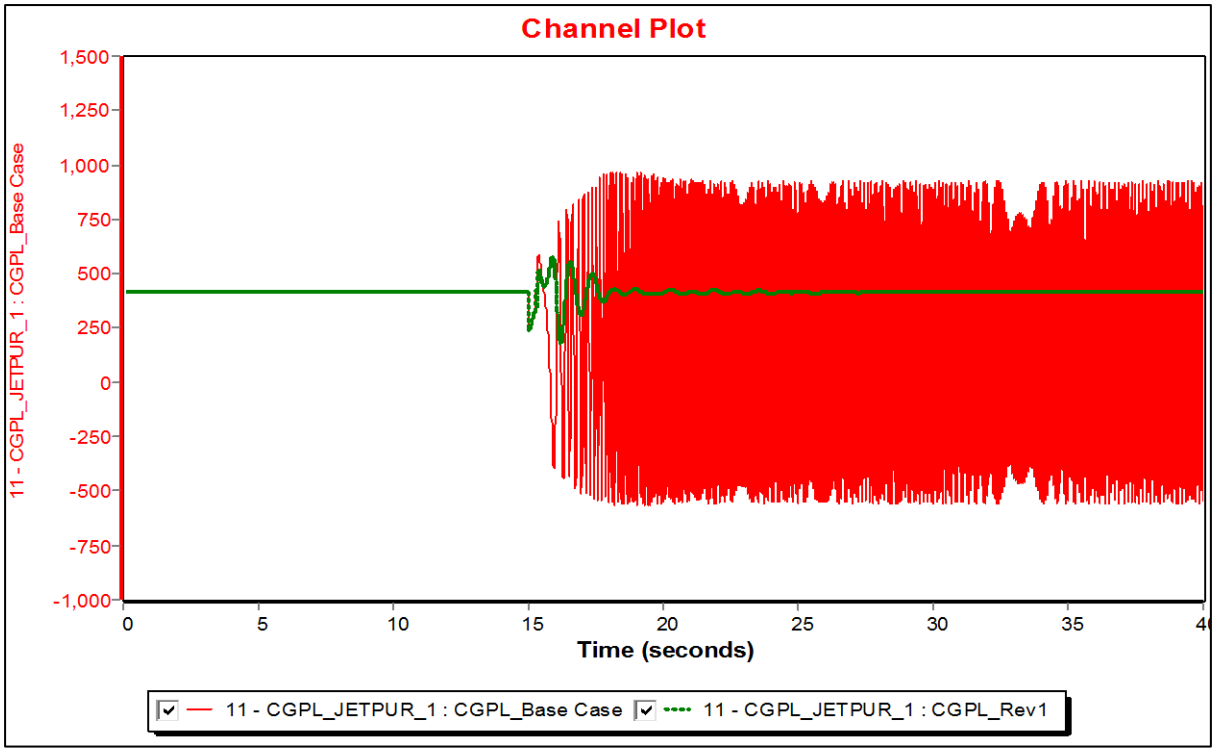


Figure: Power flow on 400 kV CGPL-Jetpur

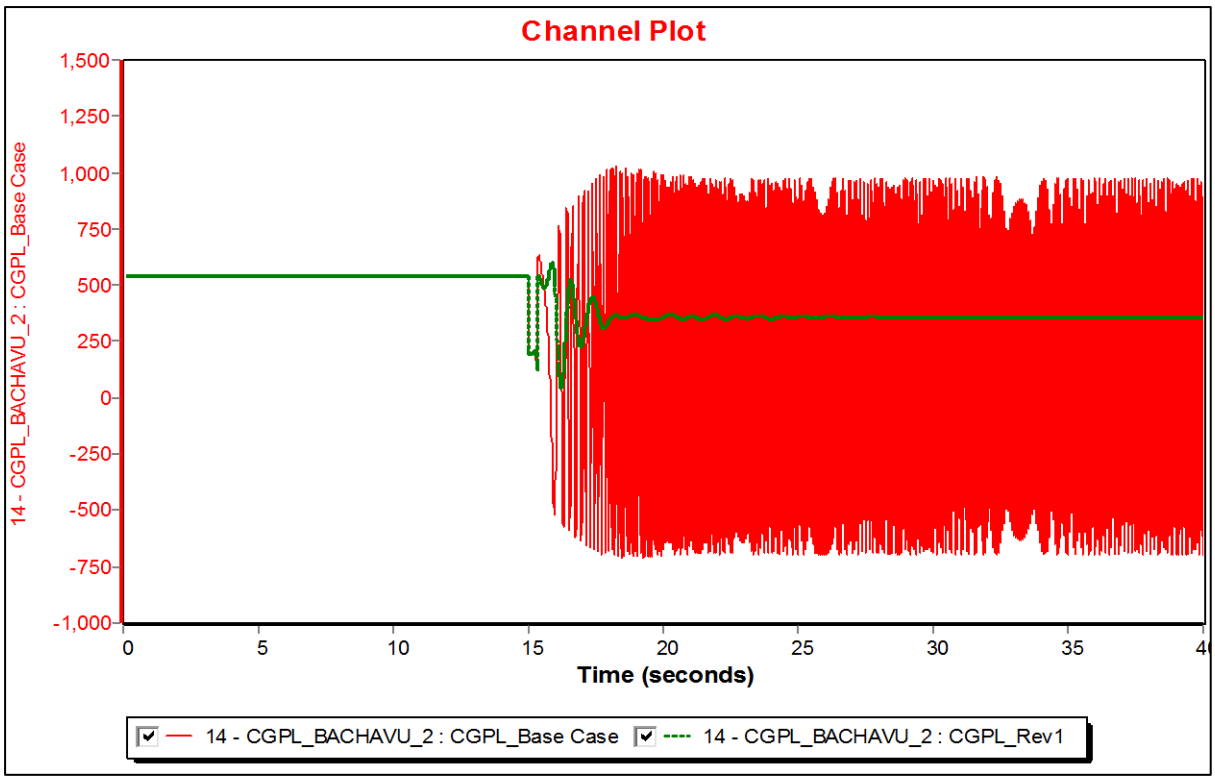


Figure: Power flow on 400 kV CGPL-Bhachau

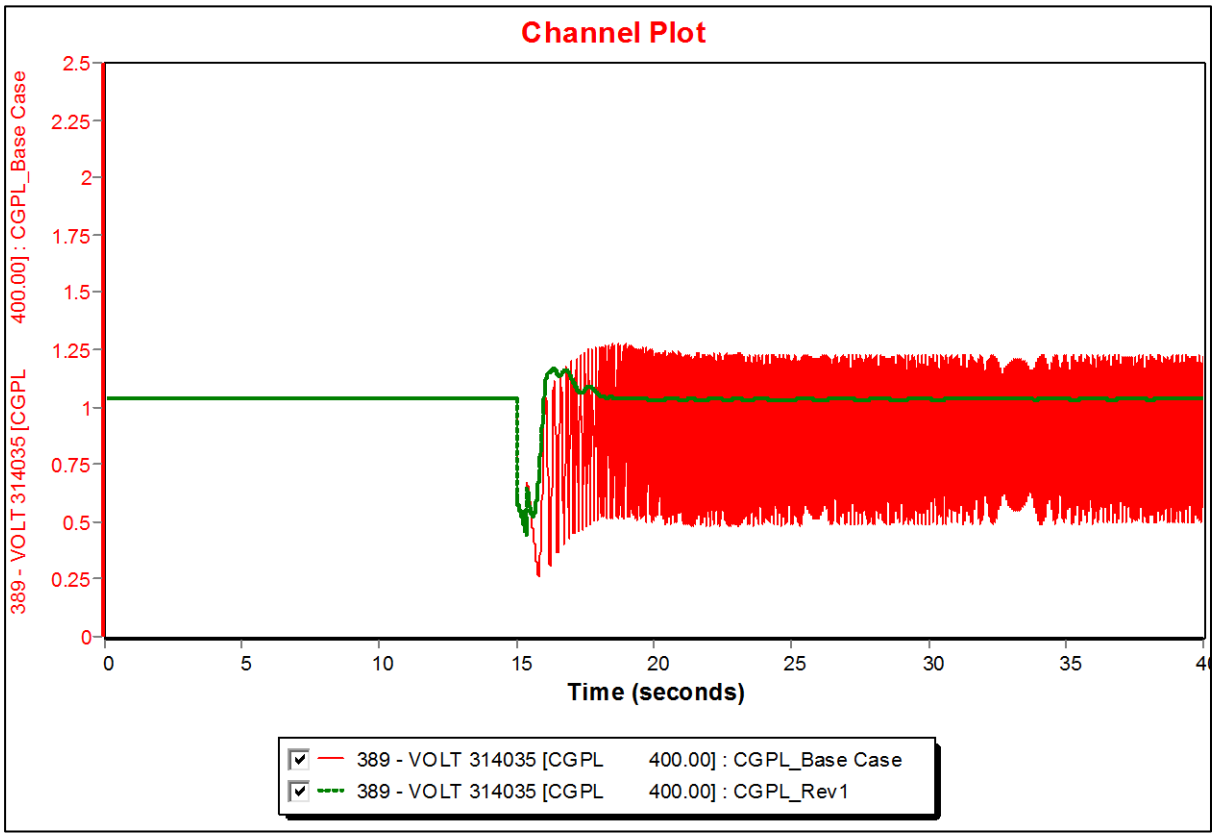


Figure: Voltage at CGPL

Case 11: Base Case + One CGPL Unit Tripping at 400 ms after fault at Versana

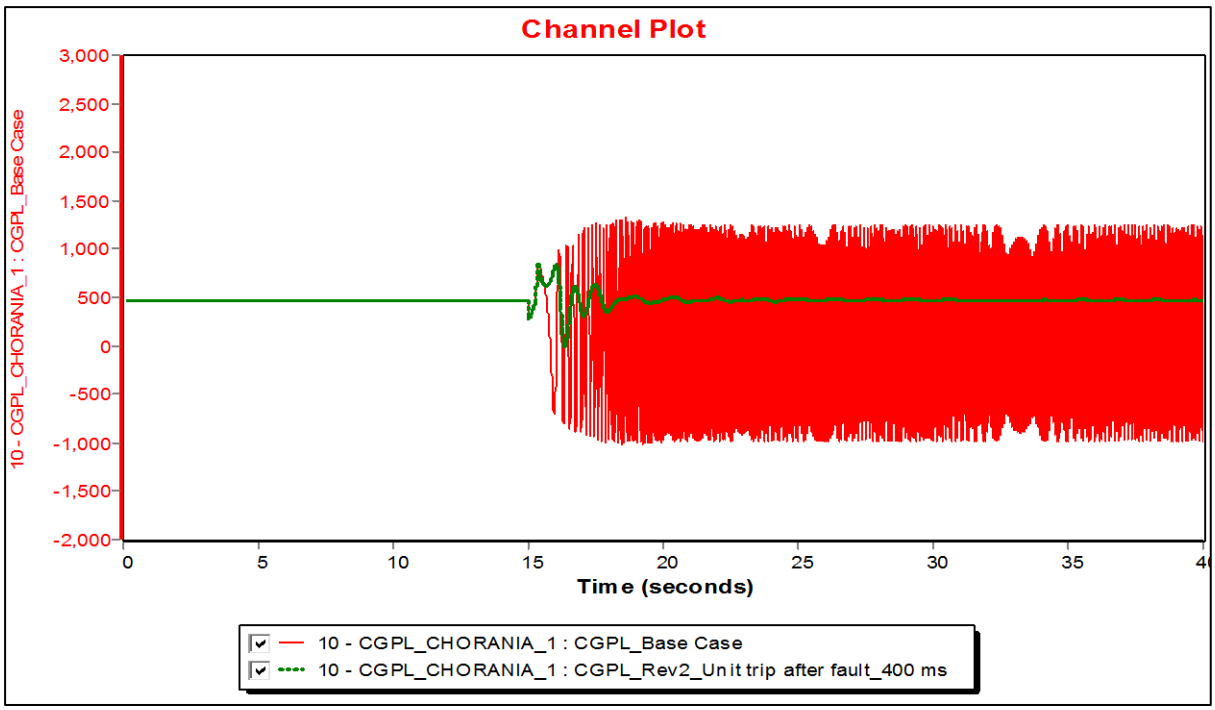


Figure: Power flow on 400 kV CGPL-Choronia

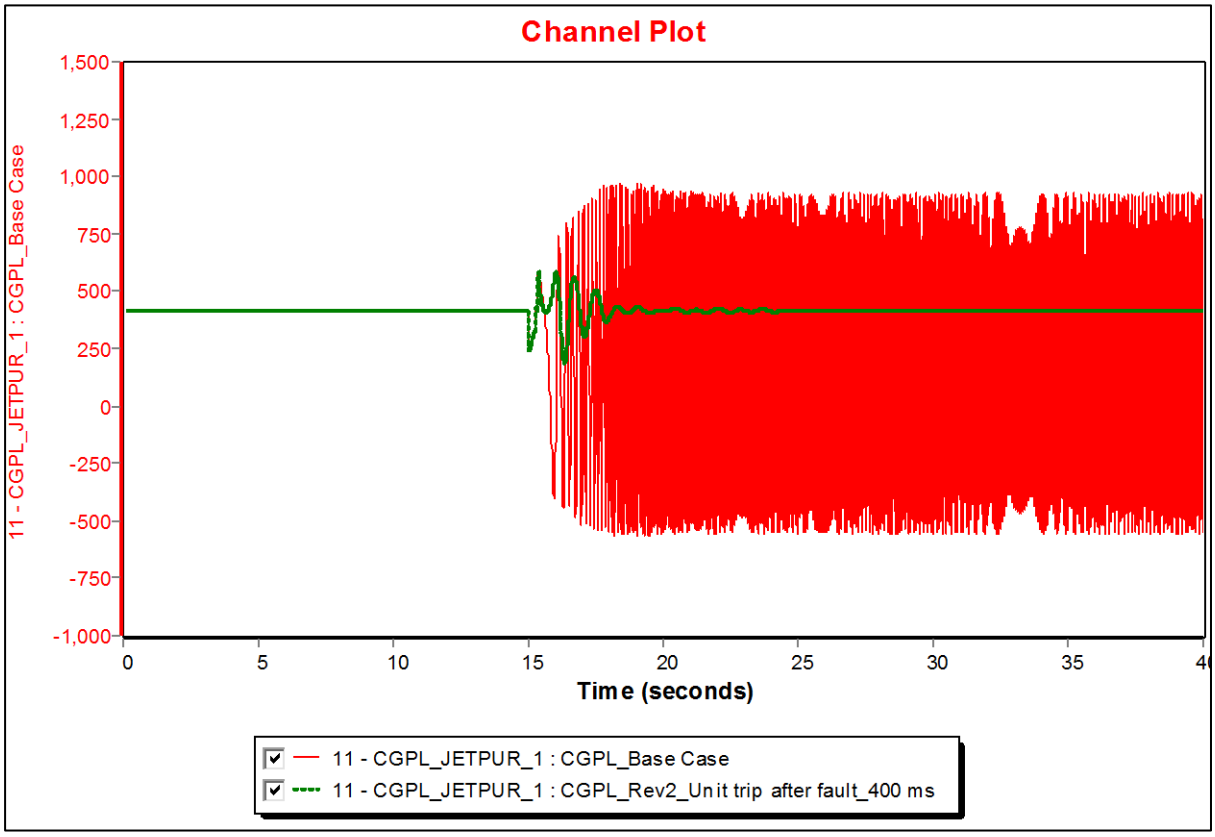


Figure: Power flow on 400 kV CGPL-Jetpur

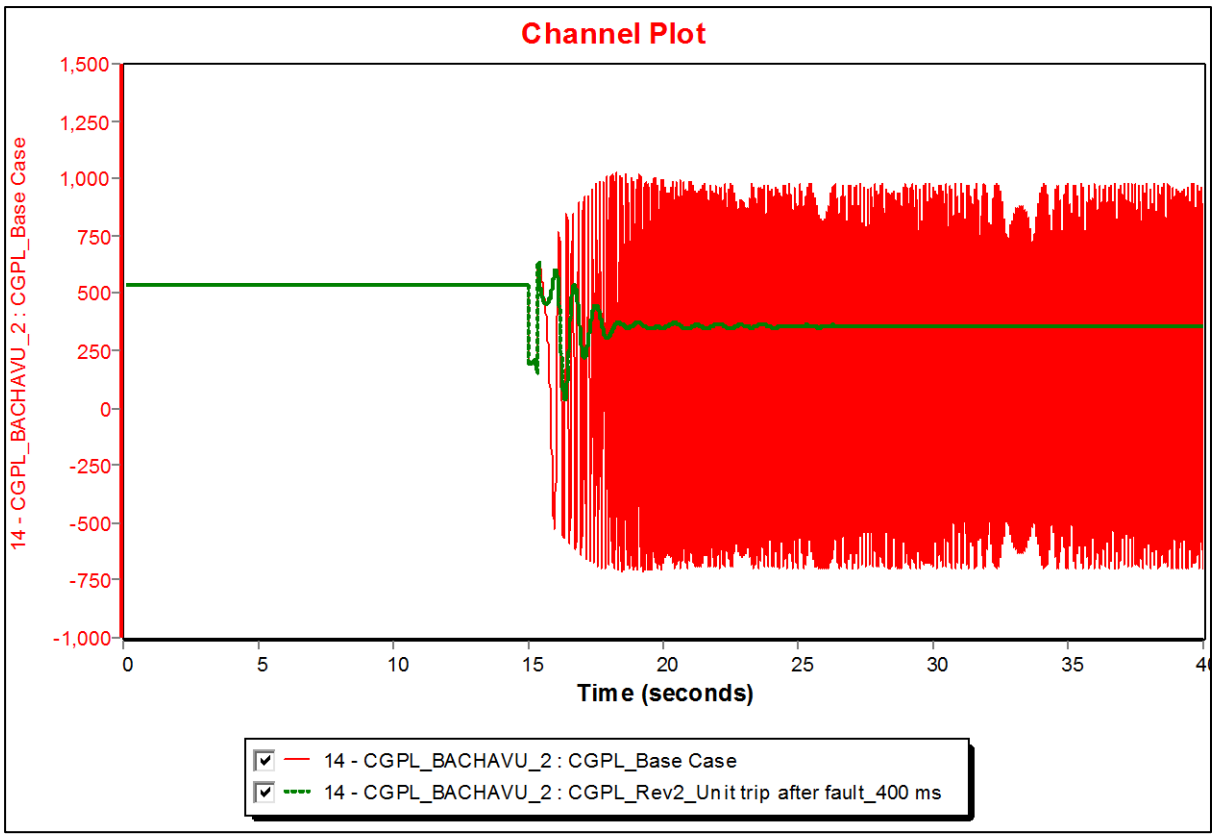


Figure: Power flow on 400 kV CGPL-Bhachau

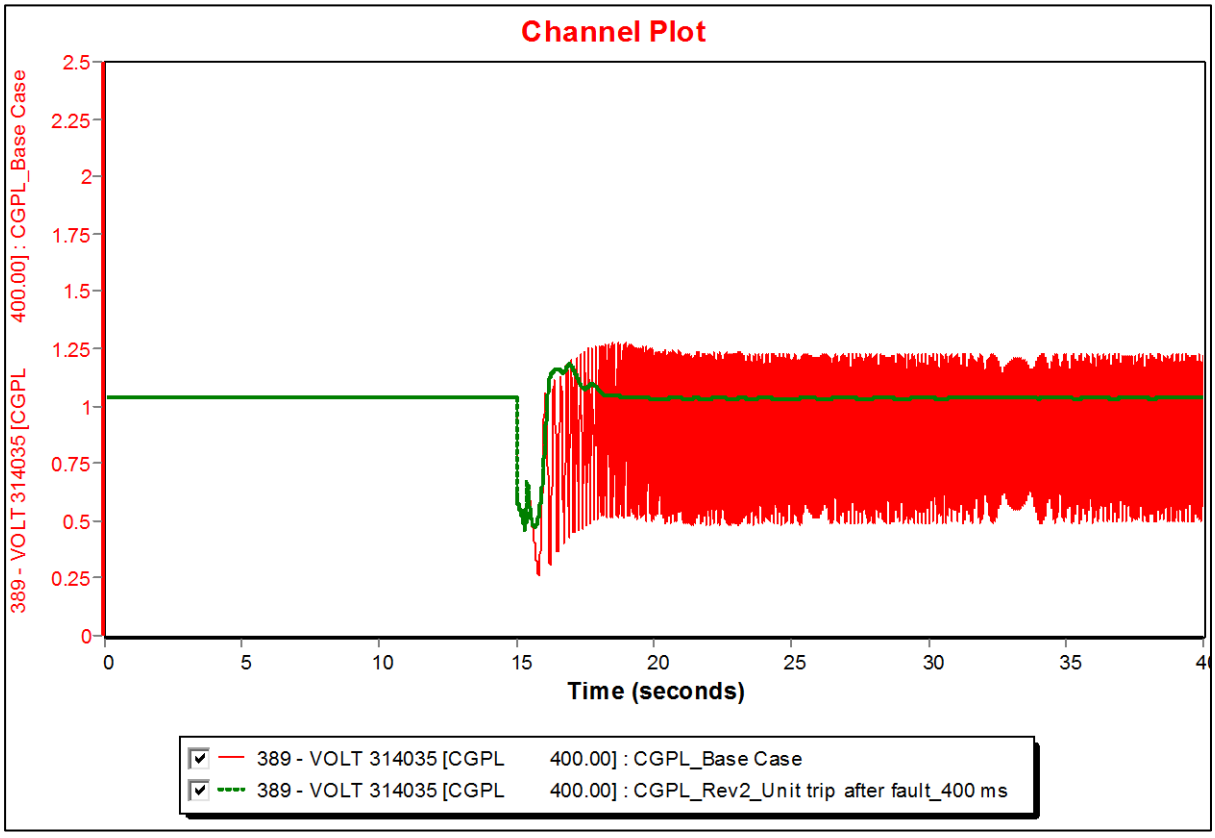


Figure: Voltage at CGPL

Case 12 : Base Case + One CGPL Unit Tripping at 500 ms after fault at Versana

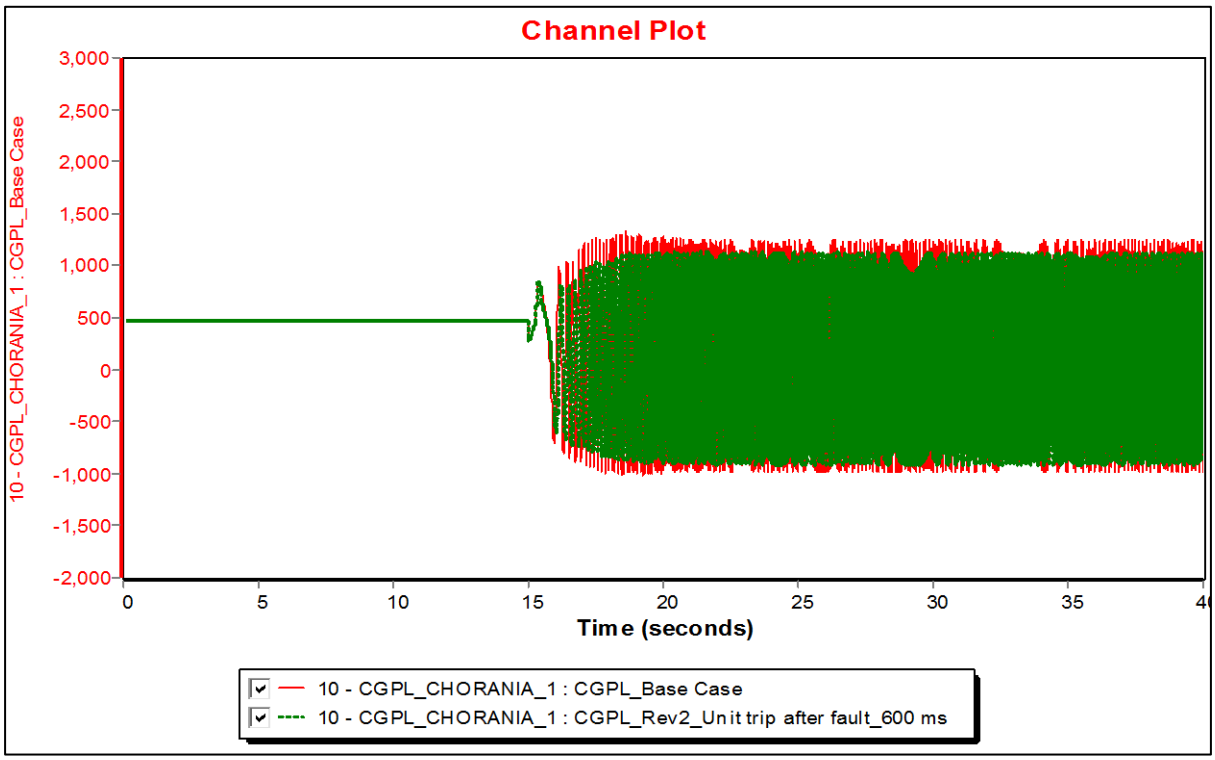


Figure: Power flow on 400 kV CGPL-Choronia

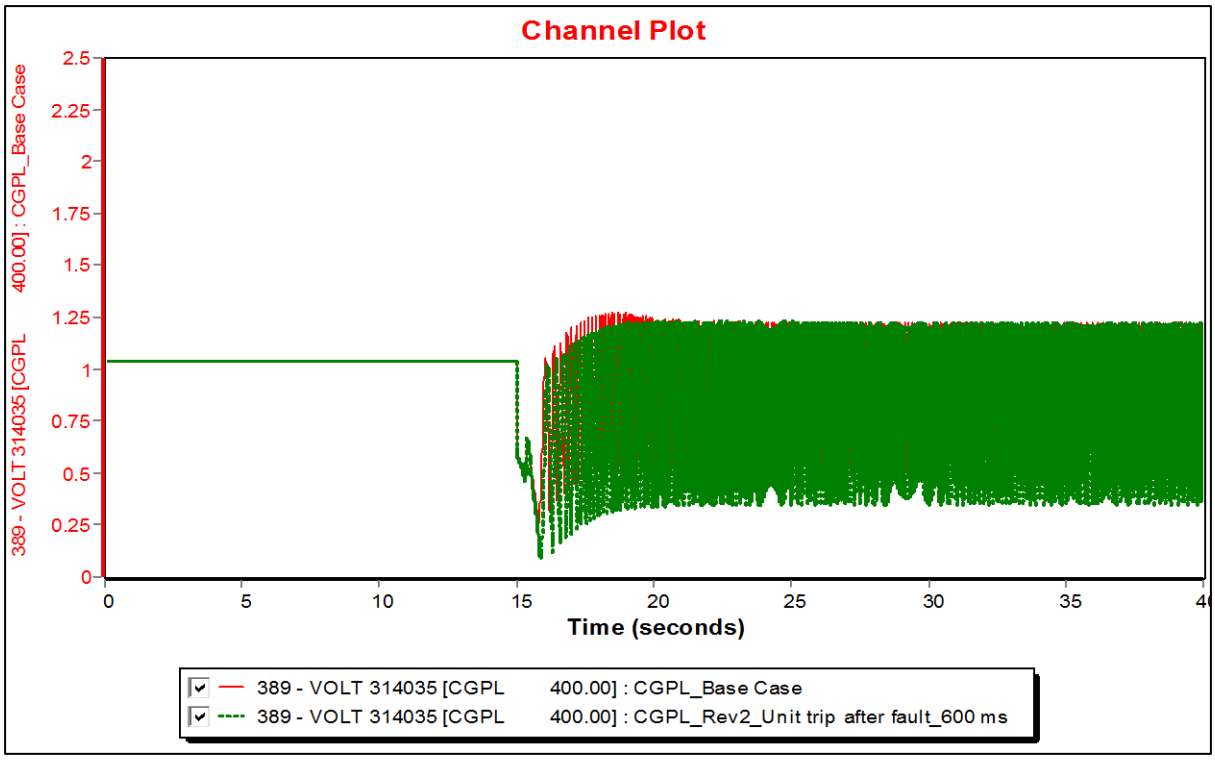


Figure: Voltage at CGPL

Case 13: Impact of Lines in service from Choronia , Jetpur and Ranchodpura

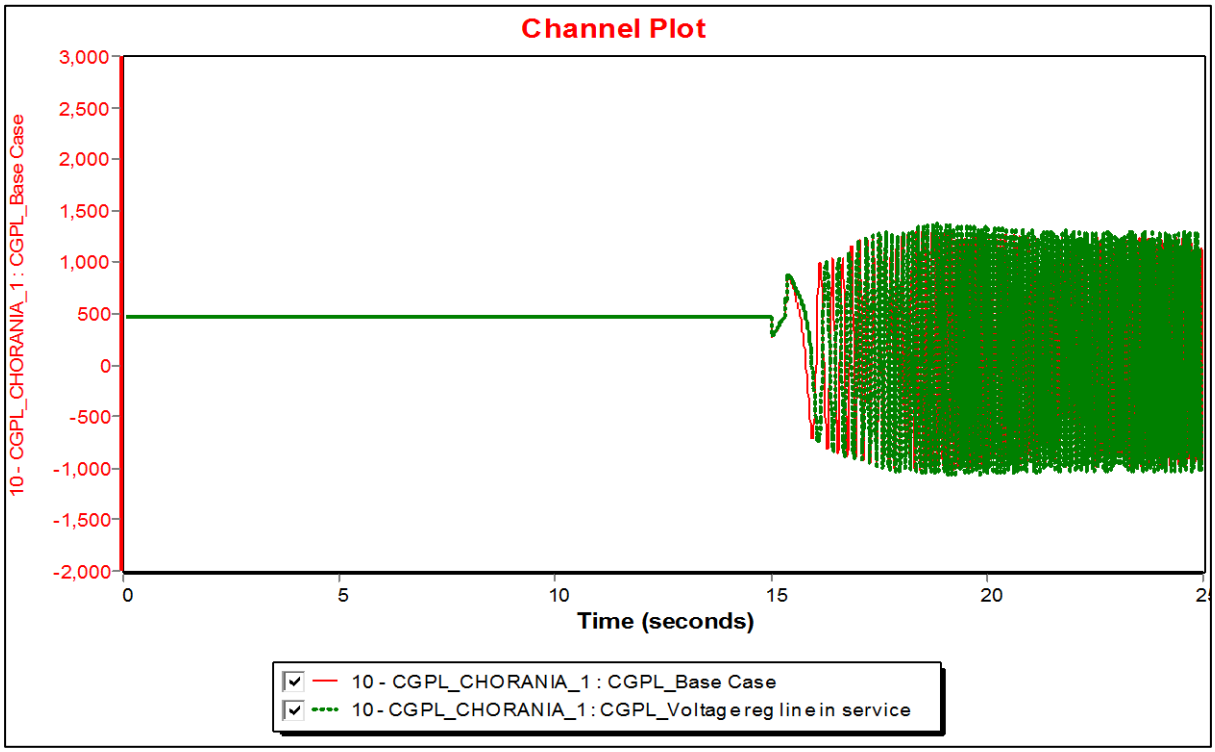


Figure: Power flow on 400 kV CGPL-Choronia

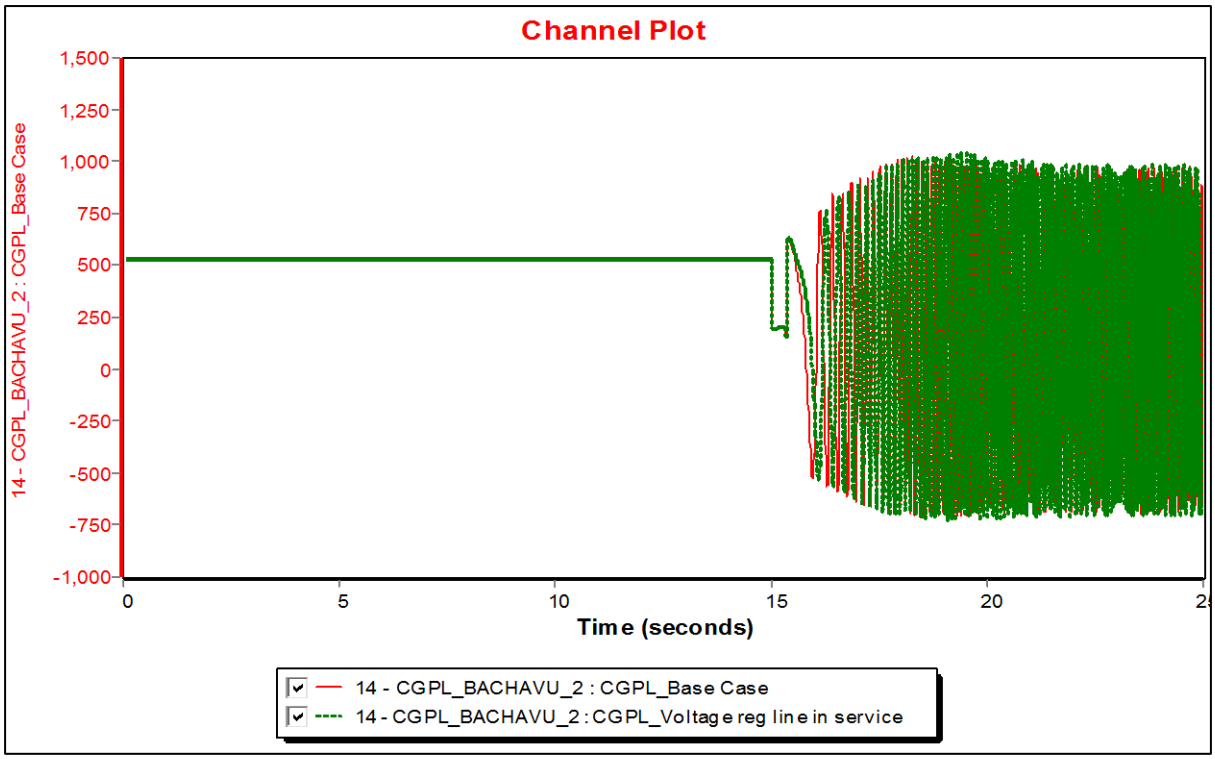


Figure: Power flow on 400 kV CGPL-Bhachau

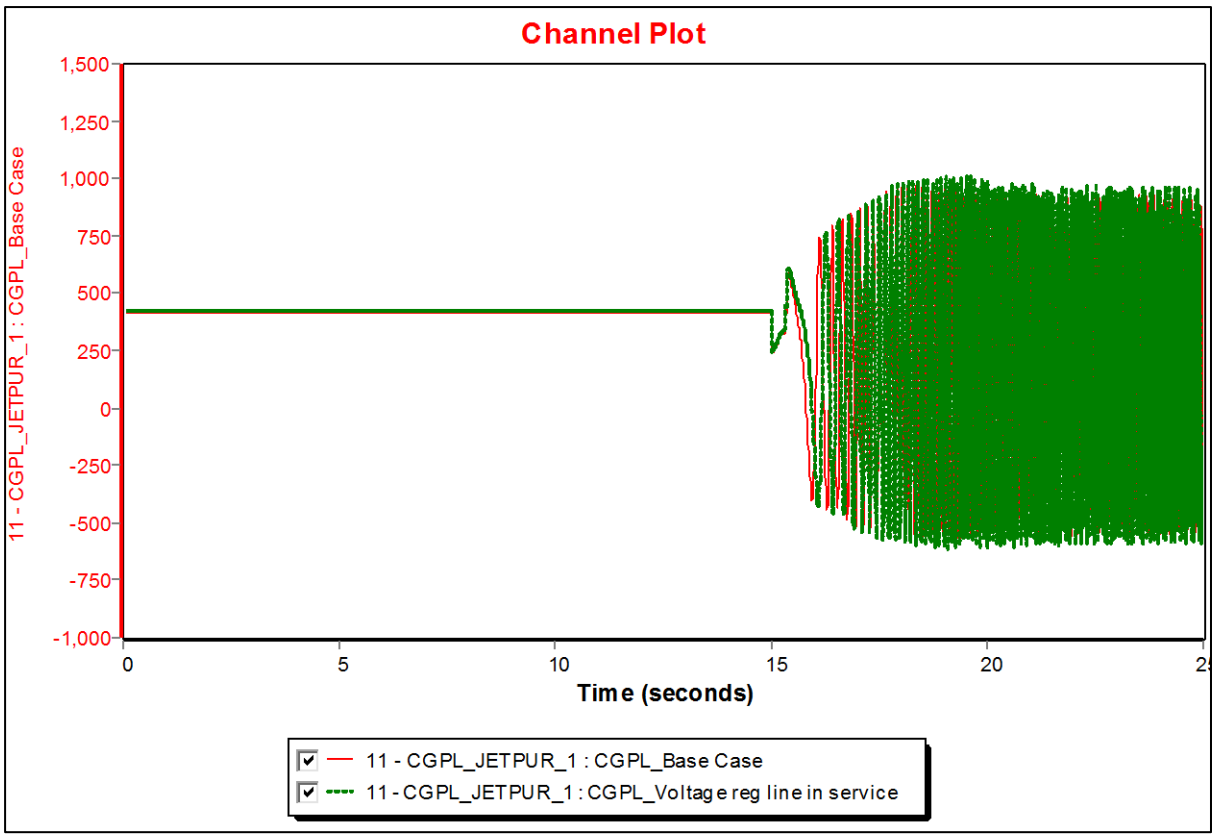


Figure: Power flow on 400 kV CGPL-Jetpur

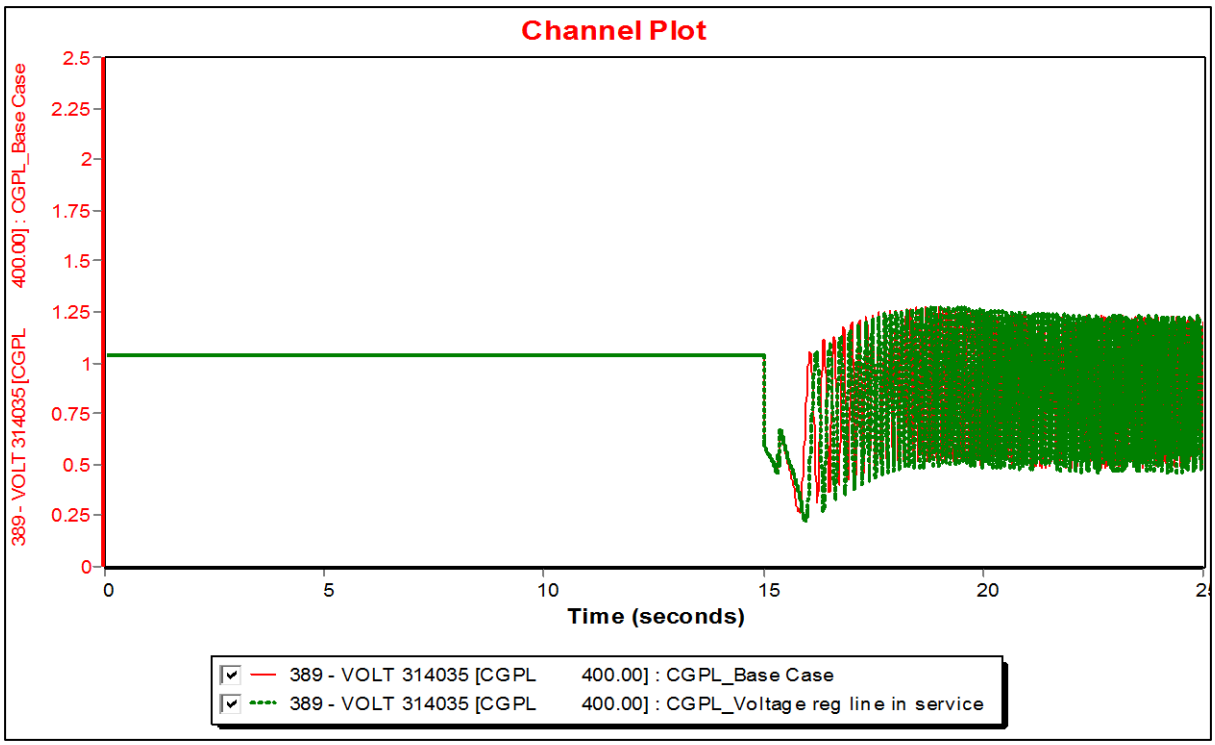


Figure: Voltage at CGPL

Case Study 14: 3 phase fault of 250 ms on each evacuating line from CGPL and to check the power swing observed on other lines and unit.

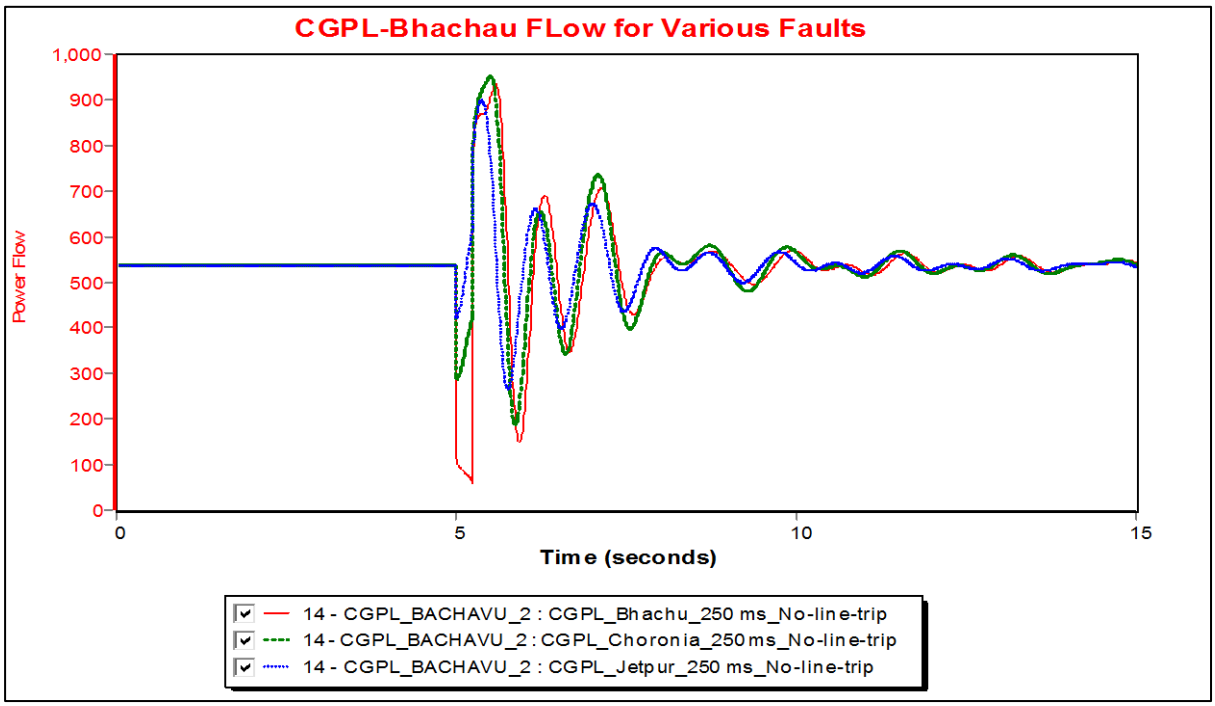


Figure: Power flow on 400 kV CGPL-Bhachau

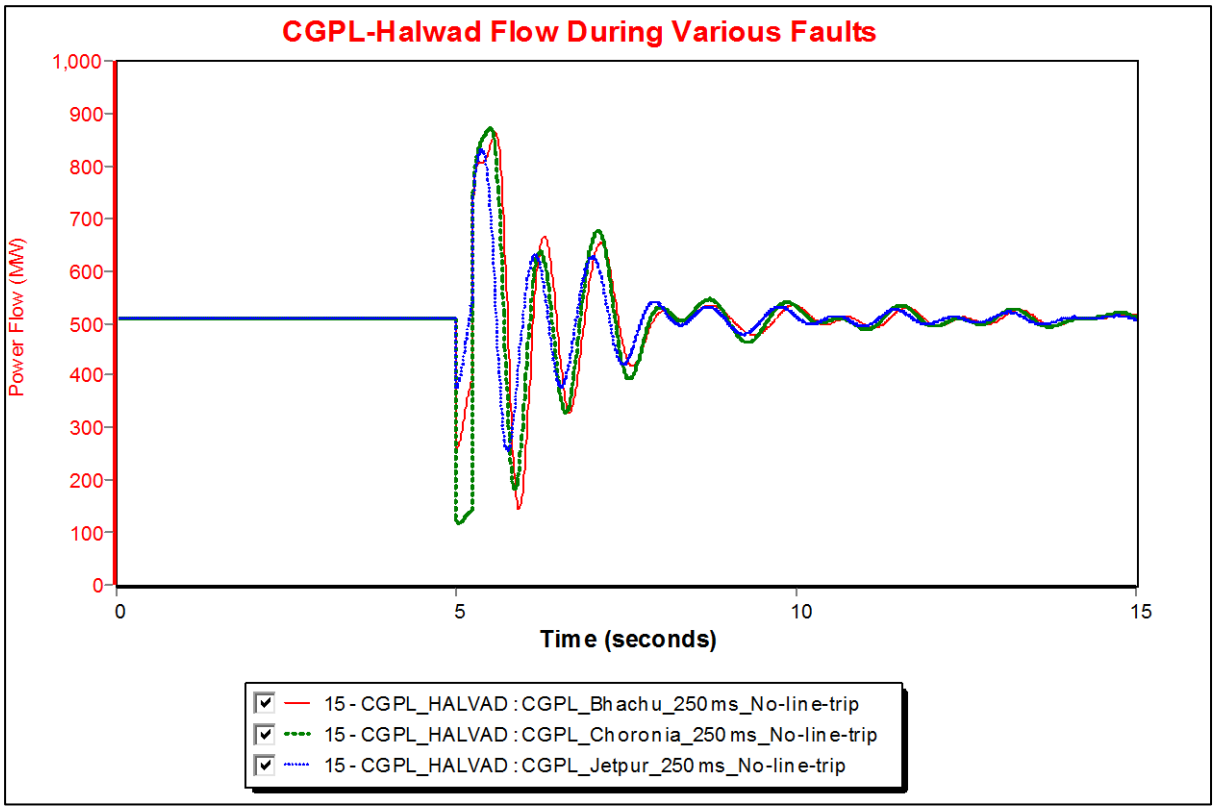


Figure: Power flow on 400 kV CGPL-Halwad

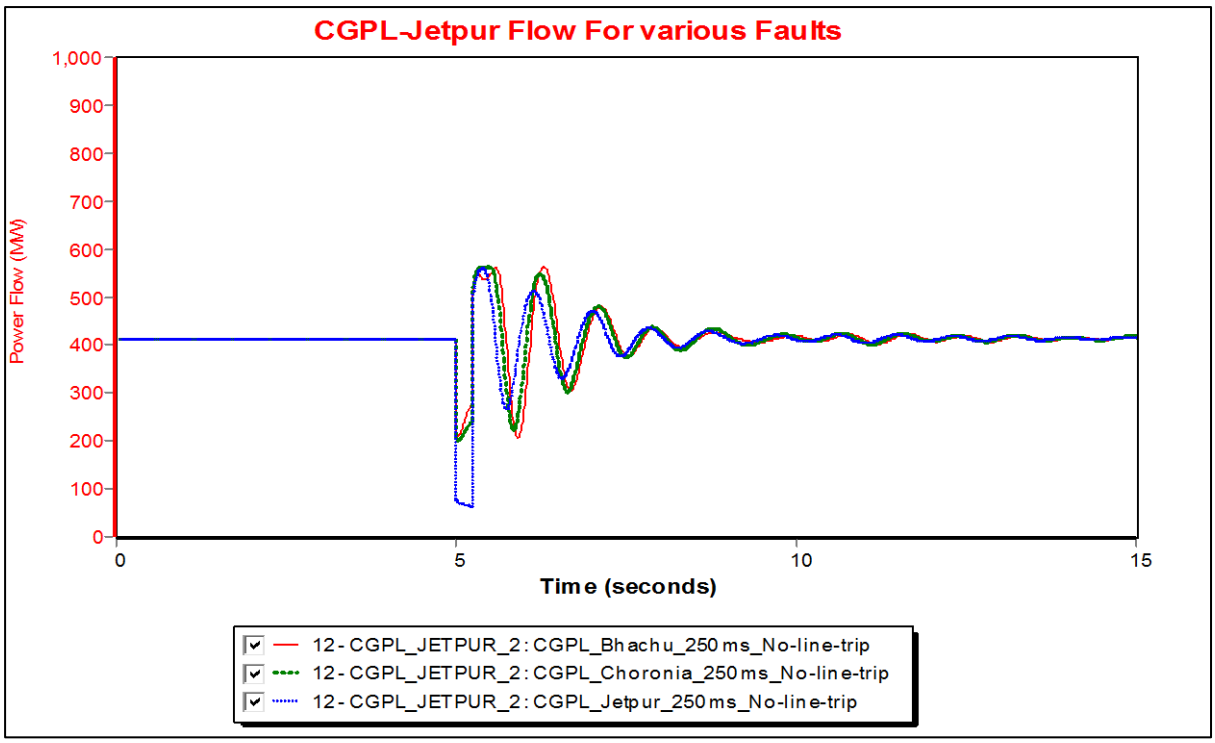


Figure: Power flow on 400 kV CGPL-Jetpur

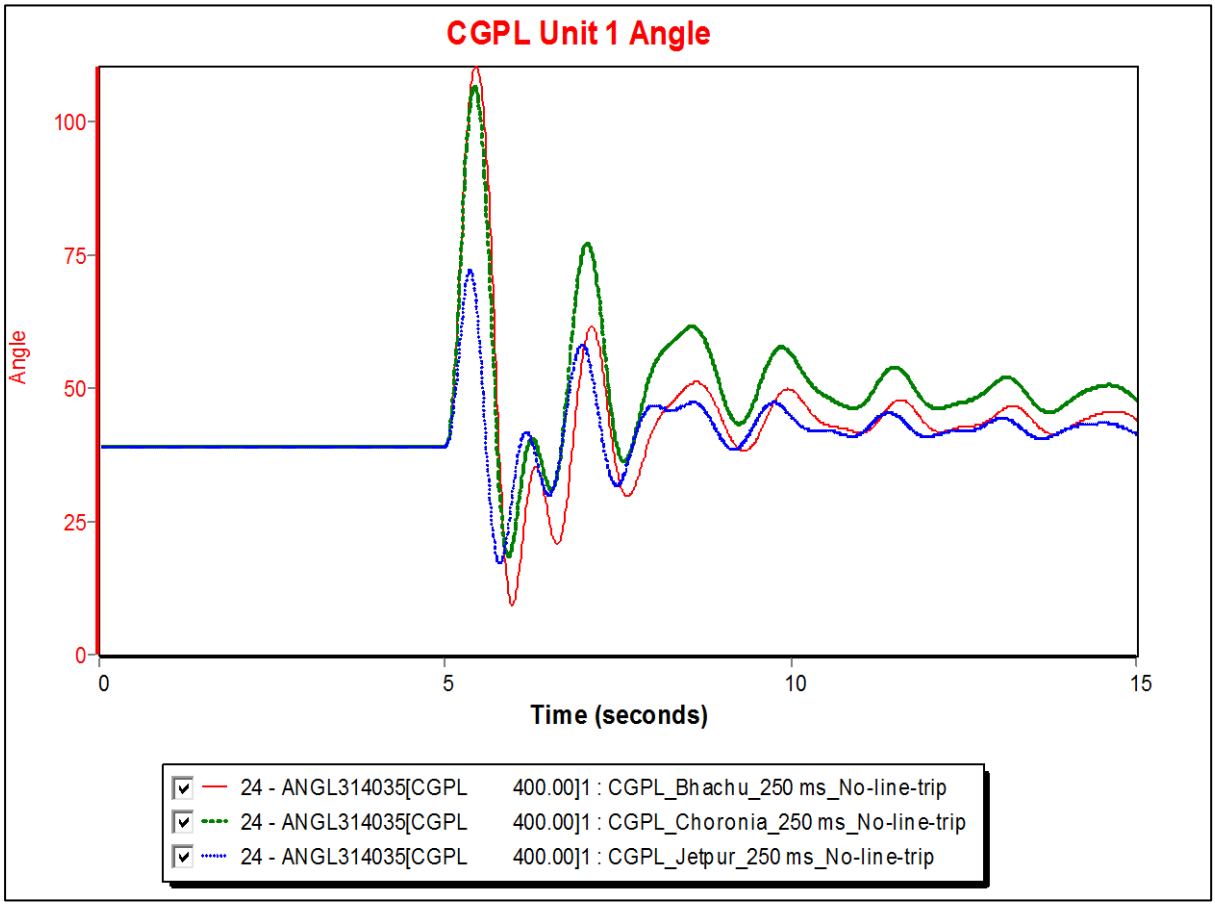


Figure: CGPL Unit 1 angle

Case Study 15: 3 phase fault of 250 ms on each evacuating line from CGPL and thereafter its tripping to check the power swing observed on other lines and unit

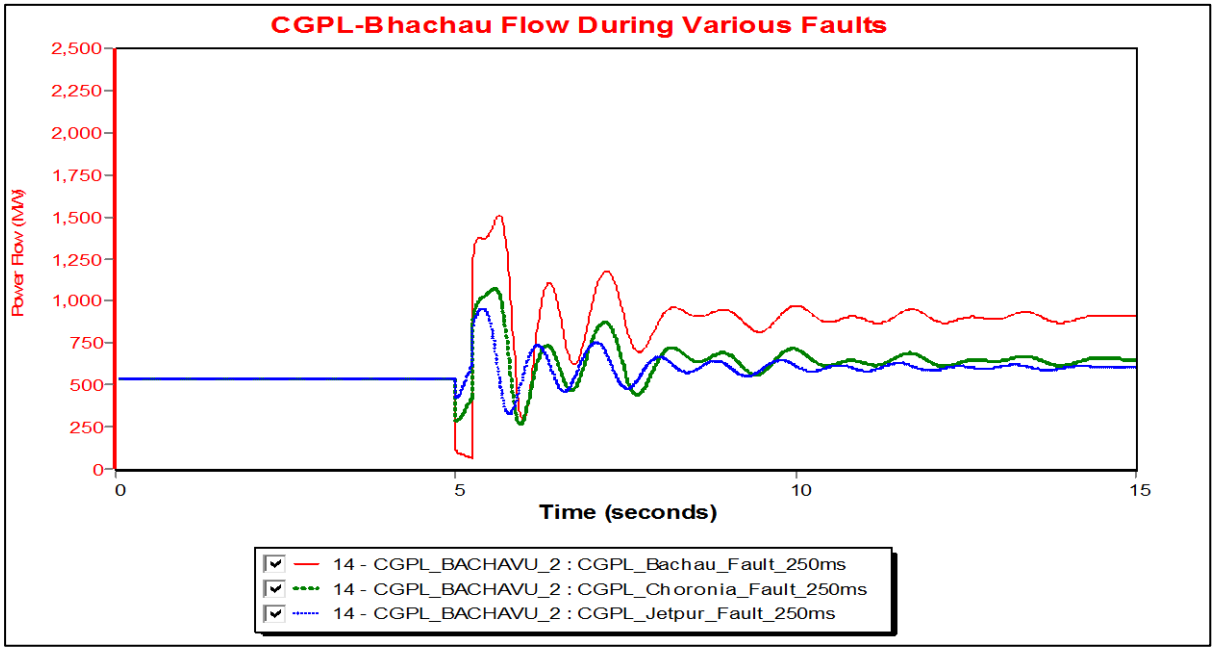


Figure: Power flow on 400 kV CGPL-Bhachau

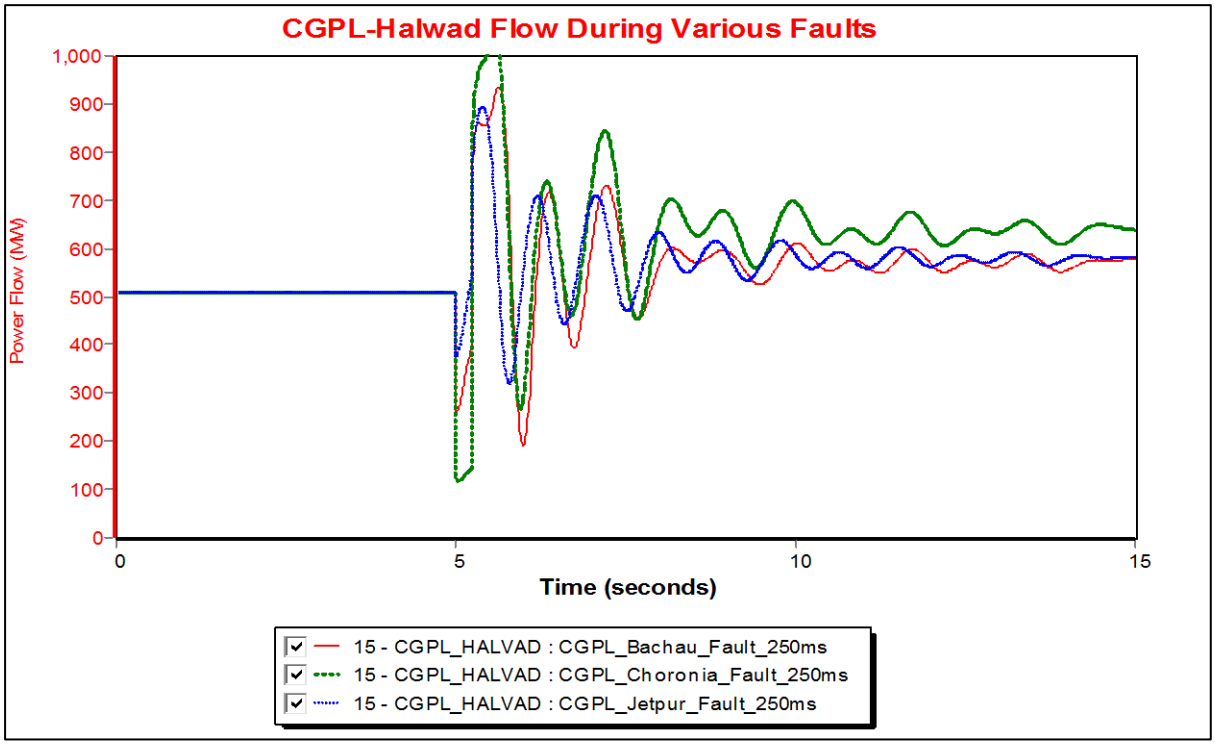


Figure: Power flow on 400 kV CGPL-Halwad

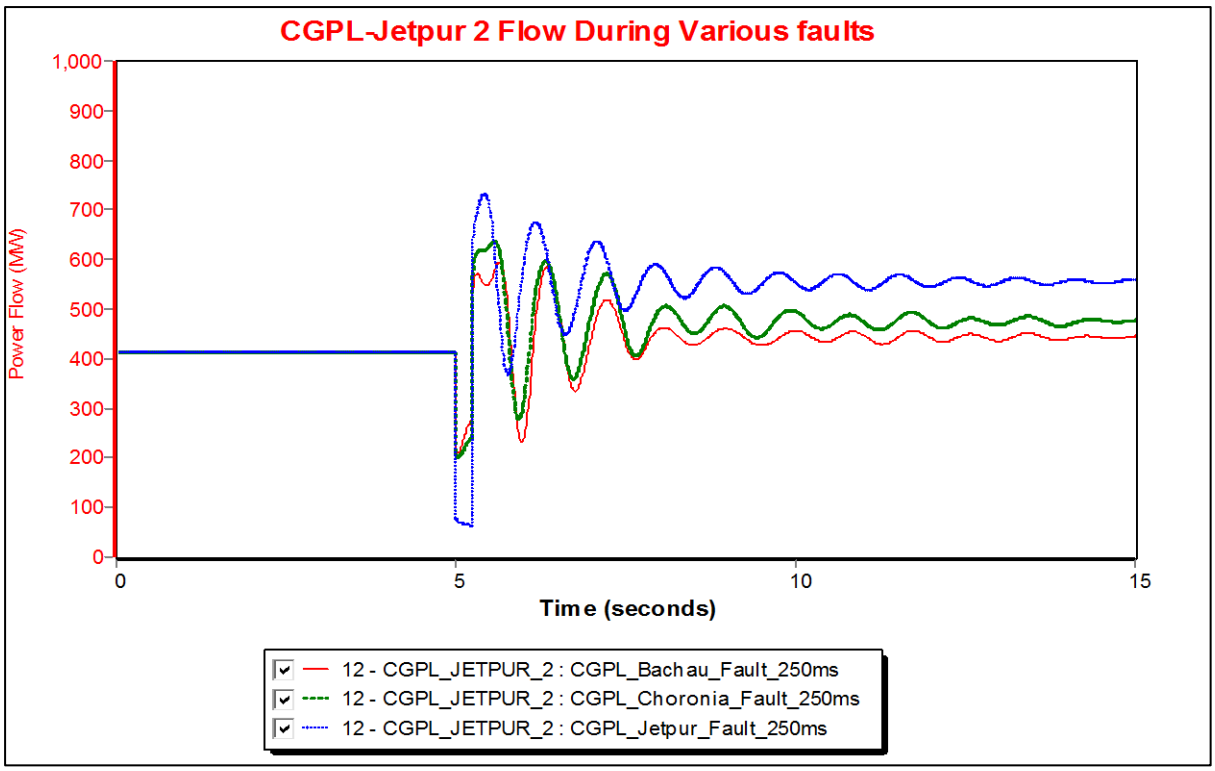


Figure: Power flow on 400 kV CGPL-Jetpur

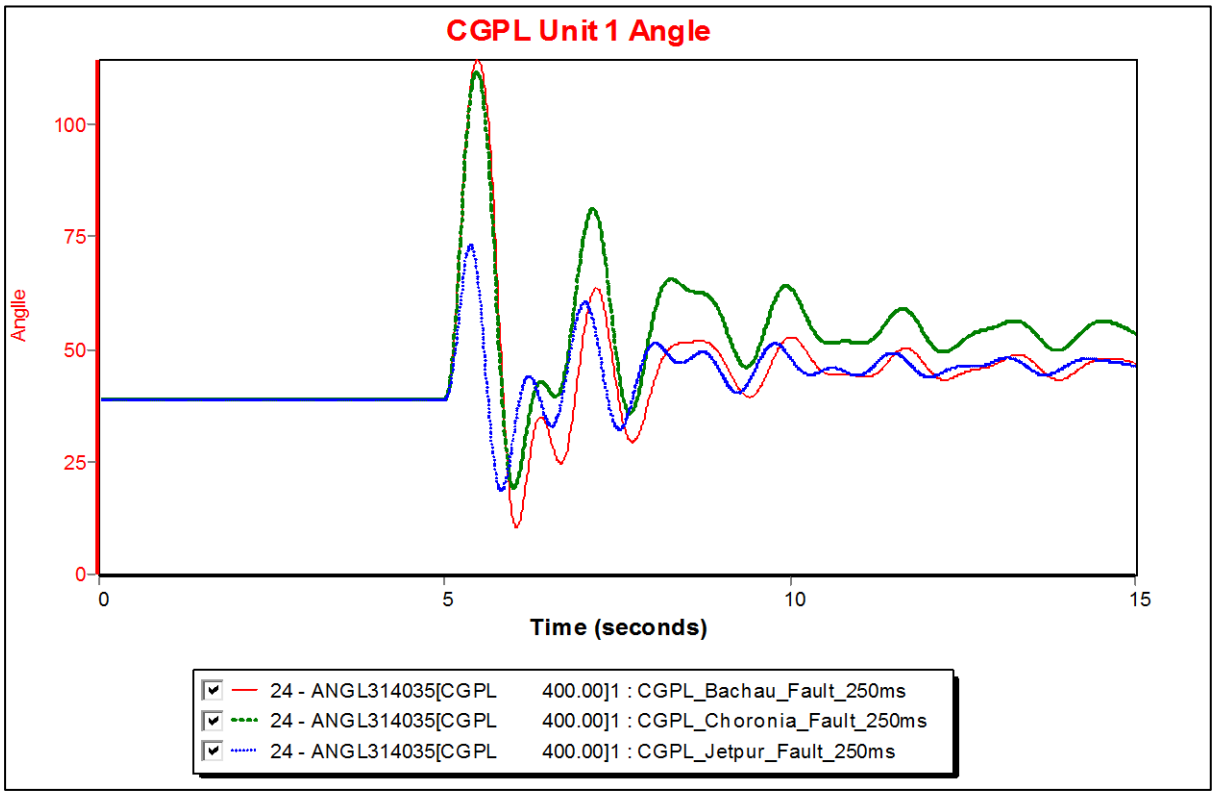


Figure: CGPL Unit 1 angle

Annexure-7C

Recommendation of the Expert Group on CGPL Event on 13th July 2016

1. In the first meeting held on 23.8.17, the Expert Group recommended that as WRLDC is having all study data , they may do the various studies for the CGPL event which has occurred on 13th July 2016 in order to find out the root cause. Based on this decision, WRLDC has carried out the dynamic simulation study in PSS/E (Siemens) software by creating the similar scenario which was existing just prior to the event at CGPL.
2. Base Case similar to the CGPL event on 13th July 2016 was simulated (with one Unit of CGPL out) and the results were compared and found to be matching.The recorded parameters from simulation and DR of the actual event were also compared and found to be matching.
    - The schematic diagram of CGPL and nearby area is provided in annexure 1.
    - The plots for base case which is the simulation of actual event based on sequence of event is attached as annexure 2.
    - The parameter comparison report for the actual event and its simulation is attached as annexure 3.
3. Based on the recommendation of the Expert Group during first meeting on 23rd August 2017 and in email exchanges, A total 15 simulation case studies have been performed in order to check the various scenarios and finding the root cause of the event. The simulation case study results along with various plots is attached as annexure 4.
4. It was found from the study result, that the major reason for the unstable system condition for CGPL is the three phase fault followed by the tripping of 400 kV Bhachau-Ranchodpura circuits at 300 ms in Zone 2 from Ranchodpura end. It is also observed that if these lineswould not have tripped in Zone 2 and if the fault at Versana is cleared within 370 ms; then the system is found to be stable in simulation study.
5. **During the second meeting of the expert group on 10th October 2017, all the case studies and simulation was discussed in details and based on which following recommendationshave been provided:**
    1. If one Unit of CGPL is tripped after 300 ms to 400 ms from thefault (Simultaneously with 400 kV Bhachau-Ranchodpura D/C and CGPL-Bhachau 1 ckt), the system was found to be stable in simulation results.

2. Based on the study, if the fault current contribution from CGPL end for lines emanating from CGPL is more than 3 kA and if any of these lines senses the fault in Zone 2 which is persistent for 300 ms, then it is desirable to trip one unit of CGPL.

   CGPL Commented that during this disturbance the fault current recorded for the 400 kV CGPL-Bhachau 2 was around 3.5 kA which is equal to the fault current observed in the simulation study. Therefore the above suggested measures may not help.

6. Based on the recommendation of the report on CGPL event dt. 13.10.16 submitted by the earlier group, relay coordination of the all the elements nearby CGPL complex has been carried out as decided in the PCM in order to avoid any unwanted/undesired tripping.
7. The Expert Group in the first meeting has recommended that line differential protection as Main 1 protection for 400 kV Bhachau-Versana 1 &2 (Short lines having line length 10km/ckt) should be provided.

   PGCIL has informed that these circuits do not have OPGW so, there is need of laying of optical fibre. The Expert Group suggested that the OPGW may be laid down to establish fibre optic communication between these two substations which will help in implementation of line differential protection.
8. After the first meeting of the group, it was decided to perform the simulation for the updated network case with LILO of 400 kV CGPL-Choronia and 400 kV CGPL-Halwad at Bhachau substation. Based on the above, 45 simulations case studies were carried out and as per the Transmission Planning criteria, the network was found to be stable for a fault of 100 ms. However, it was further observed from the study that the system is not stable for any three phase faults at CGPL/Bhachau if the fault clearance time is more than 150 ms.The detailed study report of the CGPL with the future network is attached as Annexure 5.

   CGPL opined the based on study the above LILO is not helping the transient stability at CGPL generating station during delayed fault clearance.
9. Expert Group opined that if CGPL is having any apprehension about this study and to implement the recommendation as suggested, they may approach external agency for further studies. However, it was strongly opined by the Expert group that it should be done without much delay and the studies to be completed on priority and suggested preventive measures to be implemented immediately.

10. With this, the Expert group thanked all the Members and specially WRLDC for carrying out the extensive study based on various inputs given by the members.

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Annexure 1:SLD of the CGPL and Nearby area.

Annexure 2:Simulation Plots for Base case.

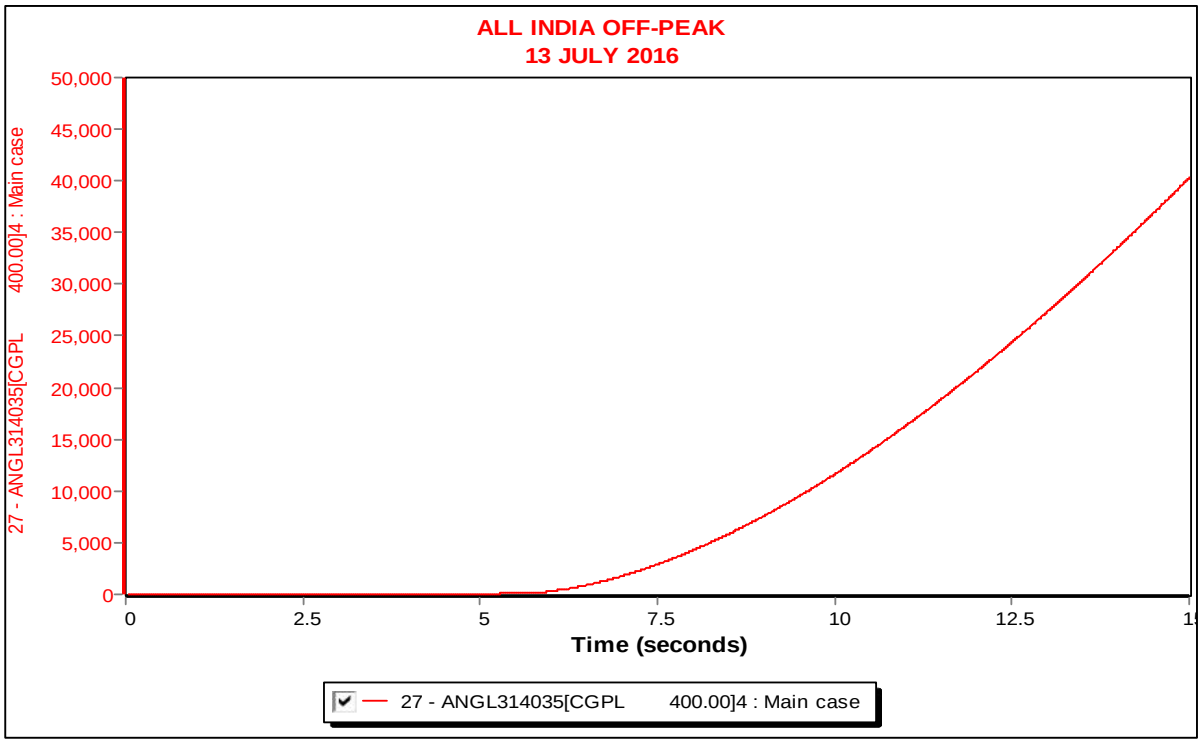

Fig: CGPL Unit 1 Machine Angle

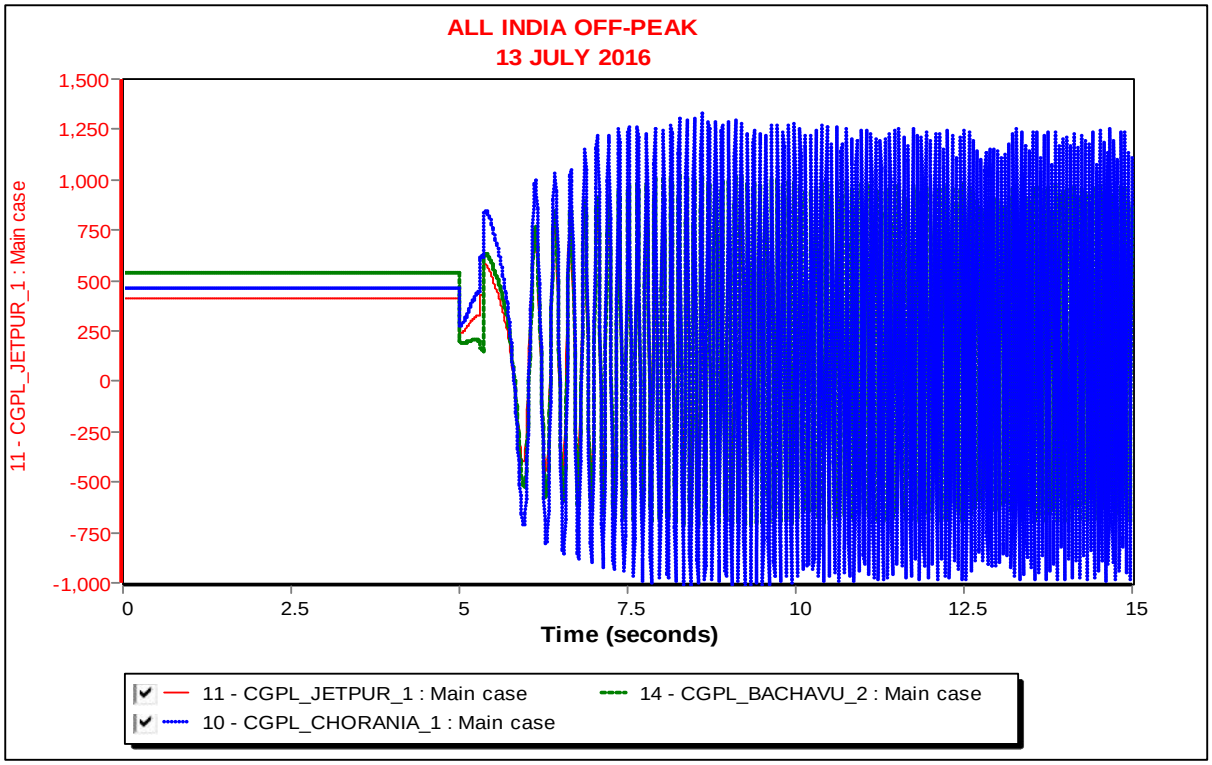

Fig: Power flow on 400 kV lines connected to CGPL Mundra

Annexure 3:Comparison of Base Case Plots with actual recording from DR files

Based on the discussion of PCM Forum, the Voltage and Active and reactive power of 400 kV CGPL-Bhachau 2 obtained from simulation (which was done based on sequence of event) and obtained from the CGPL Disturbance recorder file during the event. The parameters obtained from simulation and actual event were found to be similar and matching.

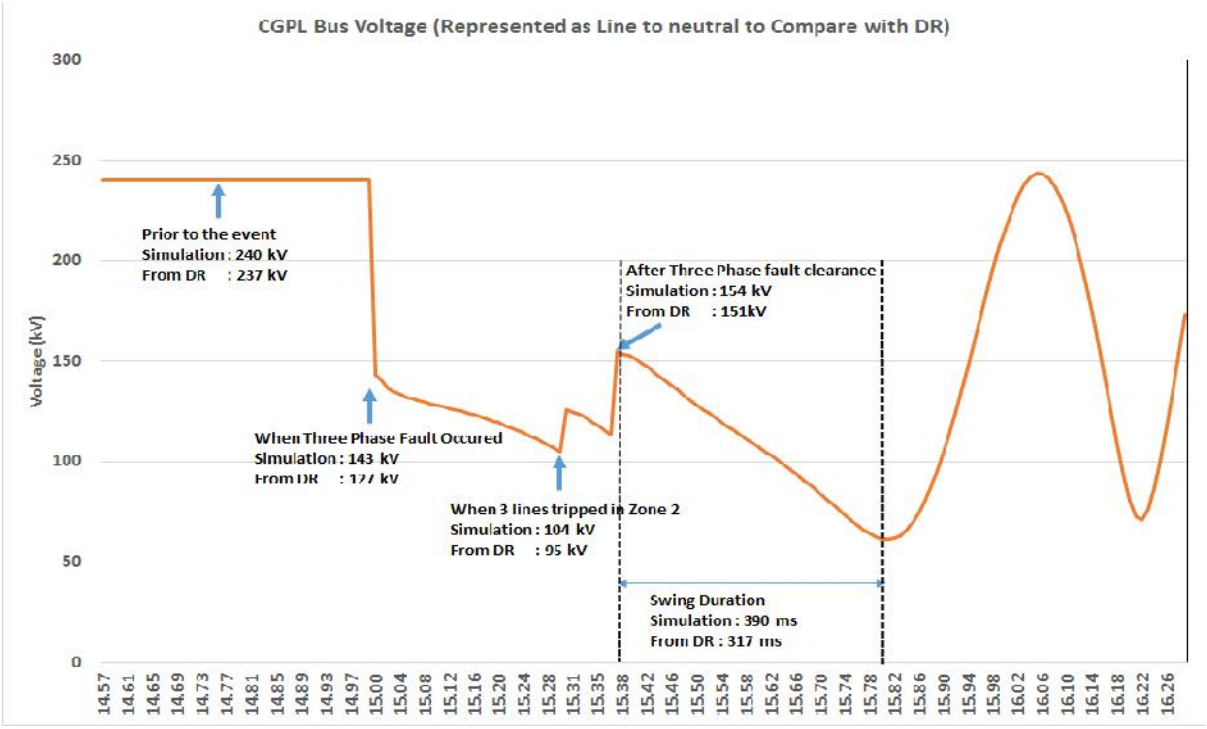

Fig: CGPL Voltage from Simulation

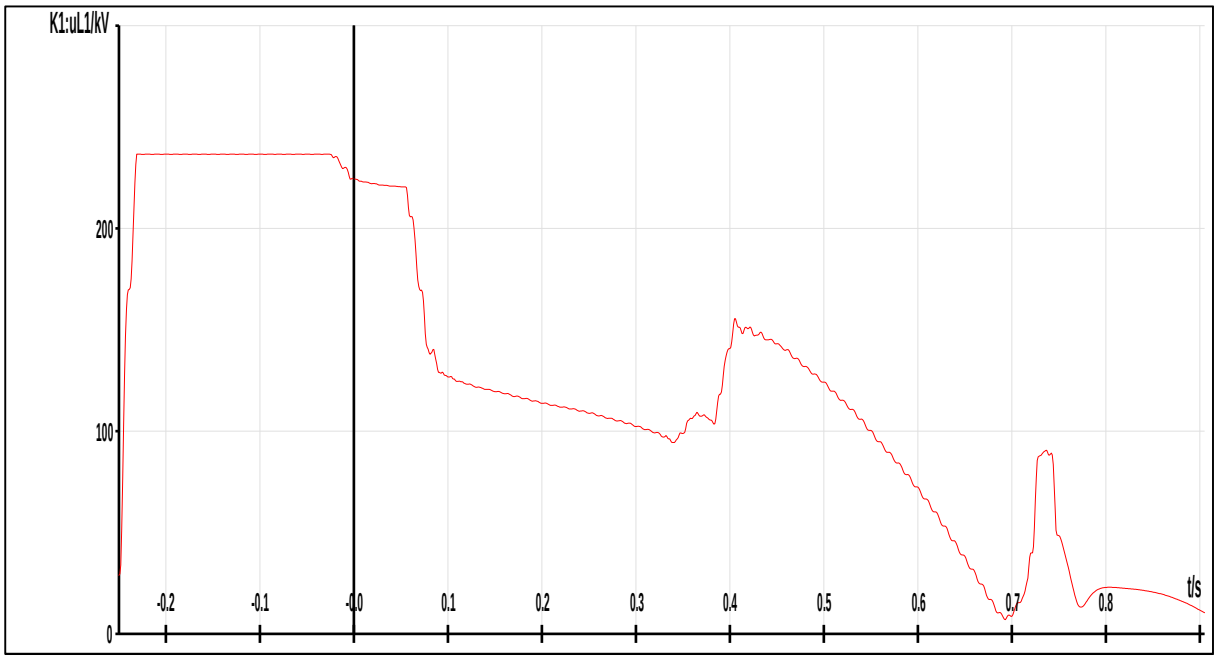

Fig: CGPL Voltage from DR of 400 kV CGPL-Bhachau from CGPL end.

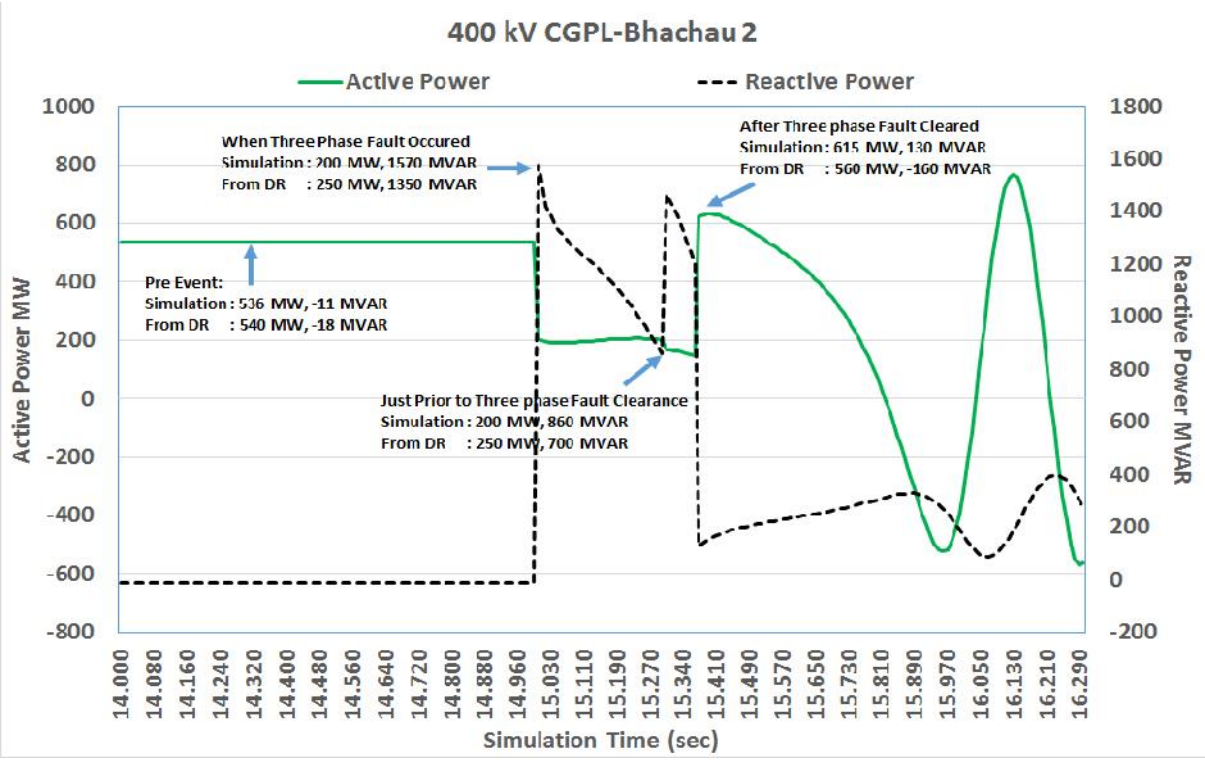

Fig: 400 kV CGPL-Bhachau 2 Active and Reactive Power from Simulation compared with actual recording during the event from the DR at different interval

Apart from these, current on various circuits during the various instant in the course of event were compared from the simulation and actual event Disturbance recorder file and found to matching as shown in the given below table 1.

Table 1: Comparison of Current from Simulation and as recorded during event from the Disturbance recorder

Current Comparison	Prior to event (kA)		At the start of 3 Phase Fault at Varsana (kA)		After 300 ms Three Phase fault at Varsana (kA)	
Circuit Name	Simulation	Actual	Simulation	Actual	Simulation	Actual
Bhachau-Versana	0.008	0.012	11.8	12.0	9.02	8.88
CGPL-Bhachau	0.745	0.790	3.45	3.30	2.81	2.50
CGPL-Jetpur	0.574	NA	0.66	0.67	1.03	0.98
CGPL-Halwad	0.705	NA	0.848	NA	1.51	1.64
CGPL-Choronia	0.647	NA	0.842	NA	1.43	1.35
Bhachau-Ranchodpura	0.541	0.51	1.77	1.83	1.79	1.77

***NA: Not Available as DR do not contain information for that interval.**

Annexure 4: Summary of studies carried out for CGPL event.

Attached Separately

Annexure 5:Summary of study carried out for CGPL Network including future network modification.

Attached Separately

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Study report for Submission to the Expert Group on Power Swing for the event at CGPL on 13th July'16.

Base-case has been set-up based on Load-Generation balance data available in NLDC SCADA on 13.7.16. While preparing the base-case it has been ensured that the lines which are opened on O/V prior to the CGPL blackout are kept open. Further, all the lines and ICT's connected to 400kV Versana sub-station except 400kV Bhachau-Versana 1 are kept in open condition.

Load-Generation prior to blackout of CGPL is as follows:

S. No.	Region	Generation	Demand
1	NR	39900	46100
2	ER	22470	16200
3	WR	38400	32000
4	SR	27000	29450
5	NER	2100	1900

Inter-Regional flows on each corridor are given below.

S. No.	Region	IR flow
1	WR →NR	4300
2	ER →NR	2900
3	WR →SR	1260
4	ER →SR	2100
5	ER →NER	380
6	NER→NR	500

Base case is prepared with the scenario of system prior to blackout of CGPL. The following events are simulated:

1. T=0-15 Sec : Initiation of the case
2. T=15 sec, Three phase Bus Fault at Versana
3. T=15.3 sec, Tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodpura D/C
4. T=15.37 Sec, Clearance of Bus fault at Versana

Studies are carried out to analyse the following aspects in view of the above disturbance:

1. Critical clearing time for CGPL for 3 phase bus fault at Bhachau and Versana and 3 phase fault on 400 kV CGPL-Bhachau circuit.
2. Whether non-tripping of 400 kV CGPL-Bhachau in Zone 2 (300 ms) could have stabilised the system.
3. Whether non-tripping of 400 kV Bhachau-Ranchodpura D/C in Zone 2 (300 ms) could have stabilised the system.

Based on the above, total 9 case studies have been carried out and results are given in table 1. The plots for these simulation are also attached in annexure.

Table 1: CGPL Event study for root case and critical clearing time

Study No.	Criteria	Results
Base Case 0	Exact scenario of event based on SOE.	**System is not stable**
Case 1	3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV CGPL-Bhachau 1 at 300 ms	System is stable

Case 2	3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV Bhachau-Ranchodpura D/C at 300 ms	**System is not stable**.
Case 3	3 Phase Bus Fault at 400 kV Versana cleared in 300 ms without tripping of any line	System is stable
Case 4	3 Phase Bus Fault at 400 kV Versana cleared in 370 ms without tripping of any line	System is stable.
Case 5	3 Phase Bus Fault at 400 kV Bhachau cleared in 250 ms without tripping of any line	System is Stable.
Case 6	3 Phase Bus Fault at 400 kV Bhachau cleared in 300 ms without tripping of any line	**System is not stable**.
Case 7	3 Phase fault on 400 kV CGPL- Bhachau ckt-2 cleared in 250 ms by tripping of line	System is Stable.
Case 8	3 Phase fault on 400 kV CGPL- Bhachau ckt-2 cleared in 300 ms by tripping of line	**System is not stable.**

As per the discussion held in the meeting of Committee on Power Swing at CGPL on 23rd August 2017, it was decided to include other case studies as given below:-

1. Impact of tripping of units after the tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodpura D/C and prior to clearance of the Versana fault.
2. Impact of tripping of units after the tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodpura D/C and clearance of the Versana fault.
3. Impact of Connectivity of all lines outside CGPL complex in Gujarat System keeping the event as it is.

The results of the additional 5 case studies carried out are given in table 2. The plots for these simulation are also attached in annexure.

Table 2: CGPL Event study with Unit Tripping

Study No.	Criteria	Results
Case 9	Base Case + One CGPL Unit tripping at 300 ms after fault at Versana	System is stable
Case 10	Base Case + One CGPL Unit tripping at 350 ms after fault at Versana	System is stable
Case 11	Base Case + One CGPL Unit Tripping at 400 ms after fault at Versana	System is stable
Case 12	Base Case + One CGPL Unit Tripping at 500 ms after fault at Versana	**System is not stable**.
Case 13	Base Case + All Line from Choronia, Jetpur and Ranchodpura in service	**System is not stable however, the power swing is slow during initial period after fault clearance at Versana.**

The Following additional studies have been suggested by Sh. Uday Trivedi, ATIL through email:

1. **Case 14:** Creating a 3 phase fault of 250 ms on each evacuating line from CGPL and to check the power swing observed on other lines and unit.
2. **Case 15:** Creating a 3 phase fault of 250 ms on each evacuating line from CGPL and thereafter its tripping to check the power swing observed on other lines and unit.

Accordingly 250 ms 3 Phase fault at remote end was simulated for 400 kV CGPL-Bhachau 1, 400 kV CGPL-Choronia and CGPL-Jetpur 1 circuit and the relevant plots of power flow on the lines and CGPL Machine angle is attached.

Inferences from Simulation Results:

1. **The major reason for the unstable system condition for CGPL is the tripping of 400 kV Bhachau-Ranchodpura circuits at 300 ms in Zone 2. This can be inferred from Base Case 1 and 2. It is also observed that if these lines would not have tripped in Zone 2 and if the fault at Versana got have cleared within 370 ms, then the system was stable.**
2. Critical Clearing time (Tc) for a 3 phase bus fault on 400 kV Versana or for the line fault on 400 kV Bhachau-Versana line near to Versana end is 370 ms.
3. Critical Clearing time (Tc) for a three phase fault on 400 kV CGPL-Bhachau circuit is ~250 ms.
4. From the sequence of events, fault in the system is cleared after 400 kV Bhachau-Versana line tripping after ~400ms (Start time - 02:37:10.453, End time-02:37:10.862, Time delay for Zone 2: 350 ms, Breaker operation time :45 ms) which is more than the critical clearing time of 370 ms.
5. For a fault cleared after 370 ms, system is going to oscillate which would ultimately trip the lines on PSB.
6. **Further, it is observed that the system is stable if One Unit of CGPL is tripped**
    a. After 300 ms of fault (Simultaneous with 400 kV Bhachau-Ranchodpura D/C and CGPL-Bhachau 1 ckt)
    b. After 350 ms of fault (after 50 ms of tripping of 400 kV Bhachau-Ranchodpura D/C and CGPL-Bhachau 1 ckt)
    c. After 400 ms of fault (After 30 ms of clearance of the fault)
7. Apart from this, it is observed that system is not stable if unit is tripped after 100 ms of fault clearance at Versana.
8. Along with this, it is observed that even if all the 400 kV Lines from CGPL, Bhachau and Jetpur would have been in service then also, system is unstable. **However, it is to be noted that the availability of these lines reduce the impact of swing.**

9. It is observed that large swing is observed in case of Fault on 400 kV CGPL-Bhachau circuit and 400 kV CGPL-Choronia circuit compared to fault on 400 kV CGPL Jetpur circuit.
10. Power Flow in initial swing is highest for 400 kV CGPL-Bhachau circuit followed by 400 kV CGPL –Choronia and lowest for 400 kV CGPL-Jetpur circuit during the faults.
11. In terms of CGPL unit angular stability, large swings are observed from 400 kV CGPL-Bhachau and CGPL-Choronia circuit compared with 400 kV CGPL-Jetpur circuits.

Study Plots

Base Case 0: 3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV CGPL-Bhachau 1 and 400 kV Bhachau-Ranchodrpura D/C at 300 ms

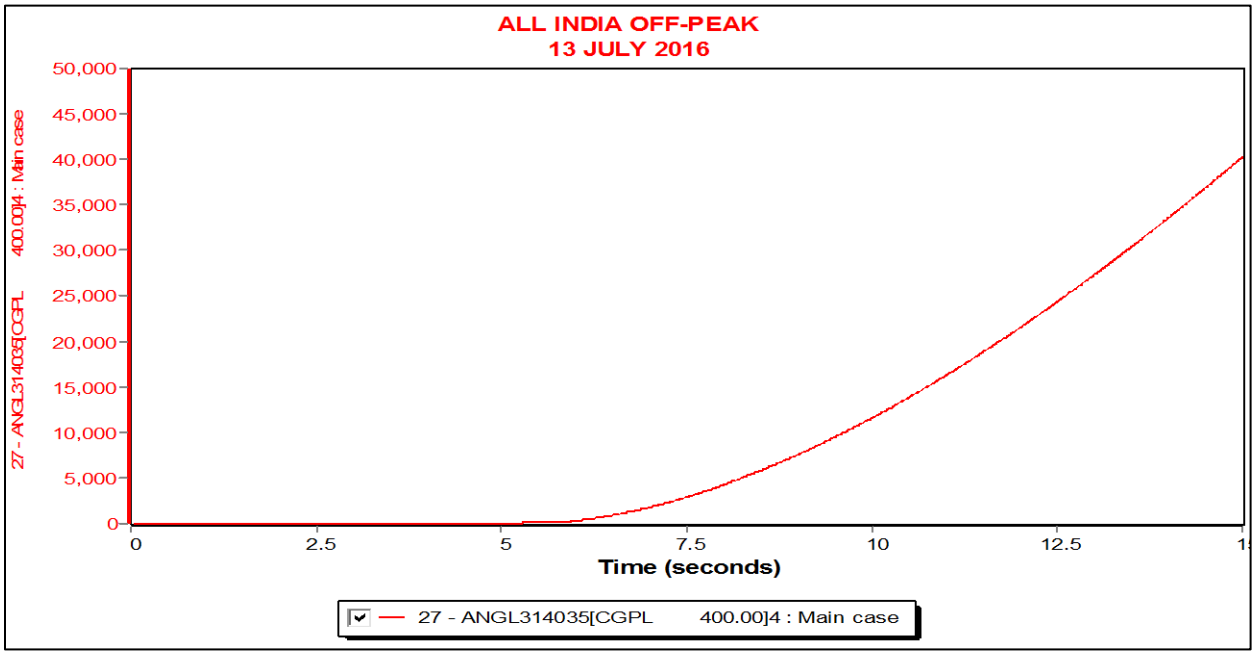


Figure: CGPL Unit 1 Machine Angle

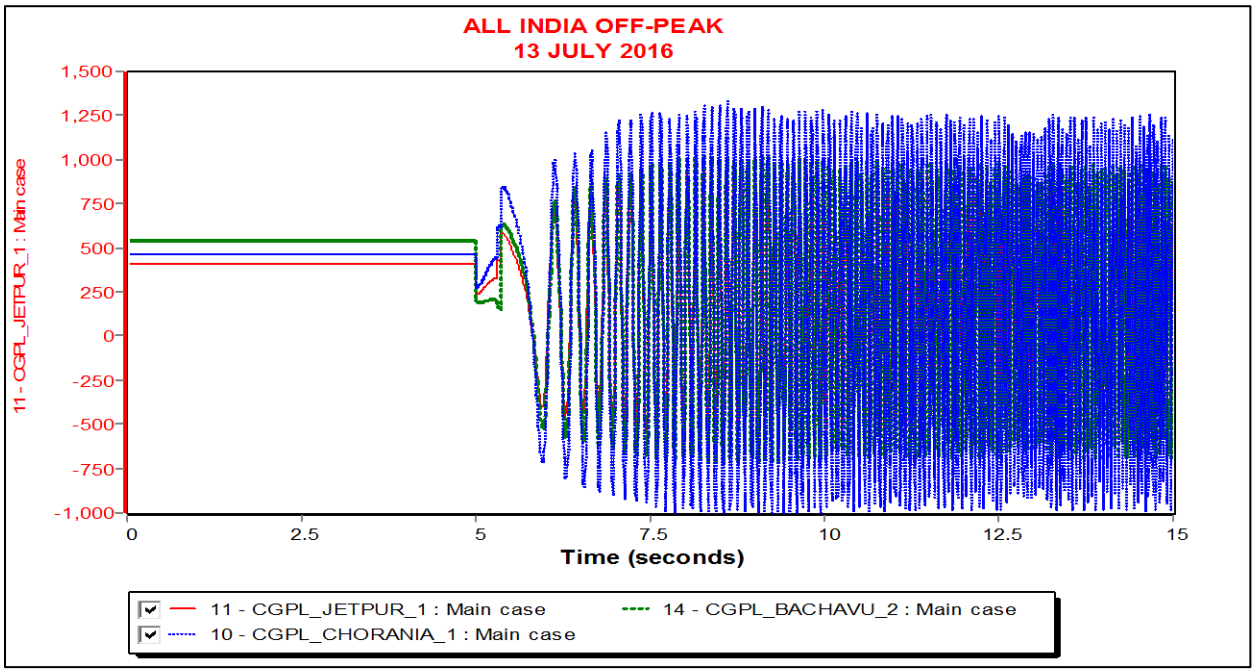


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It is observed that system is not stable for the above case.

Case 1: 3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV CGPL-Bhachau 1 at 300 ms

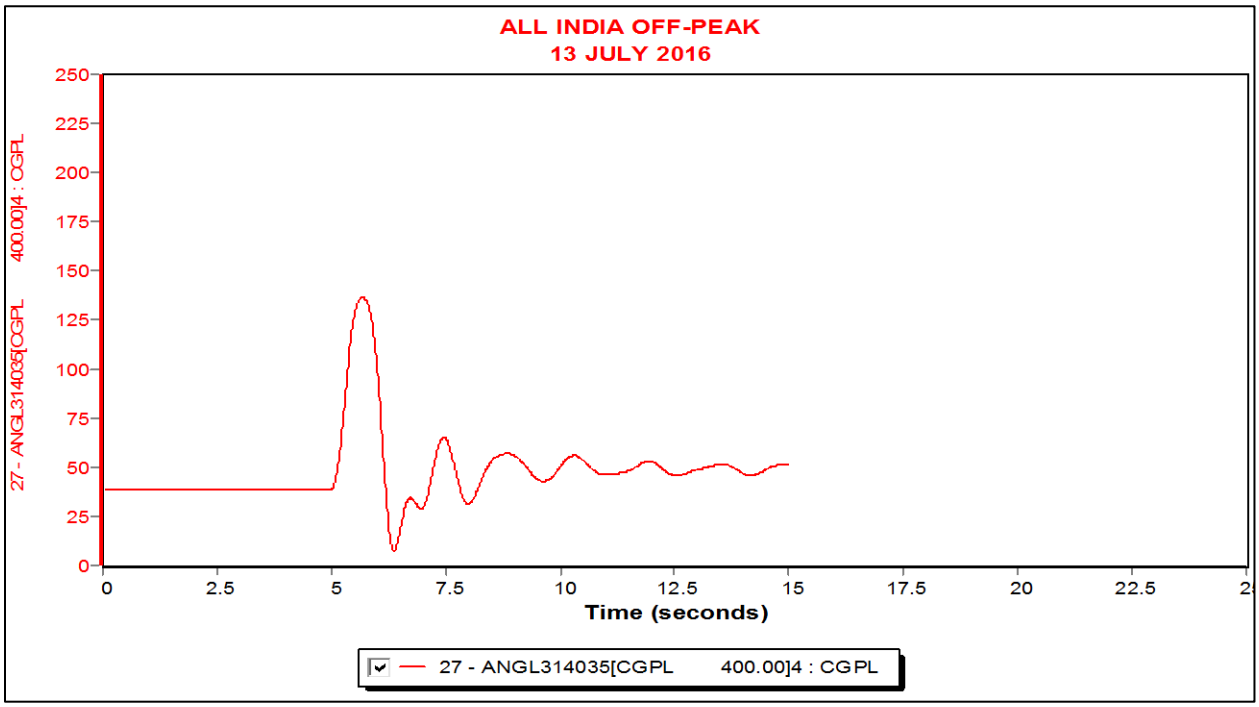


Figure: CGPL Unit 1 Machine Angle

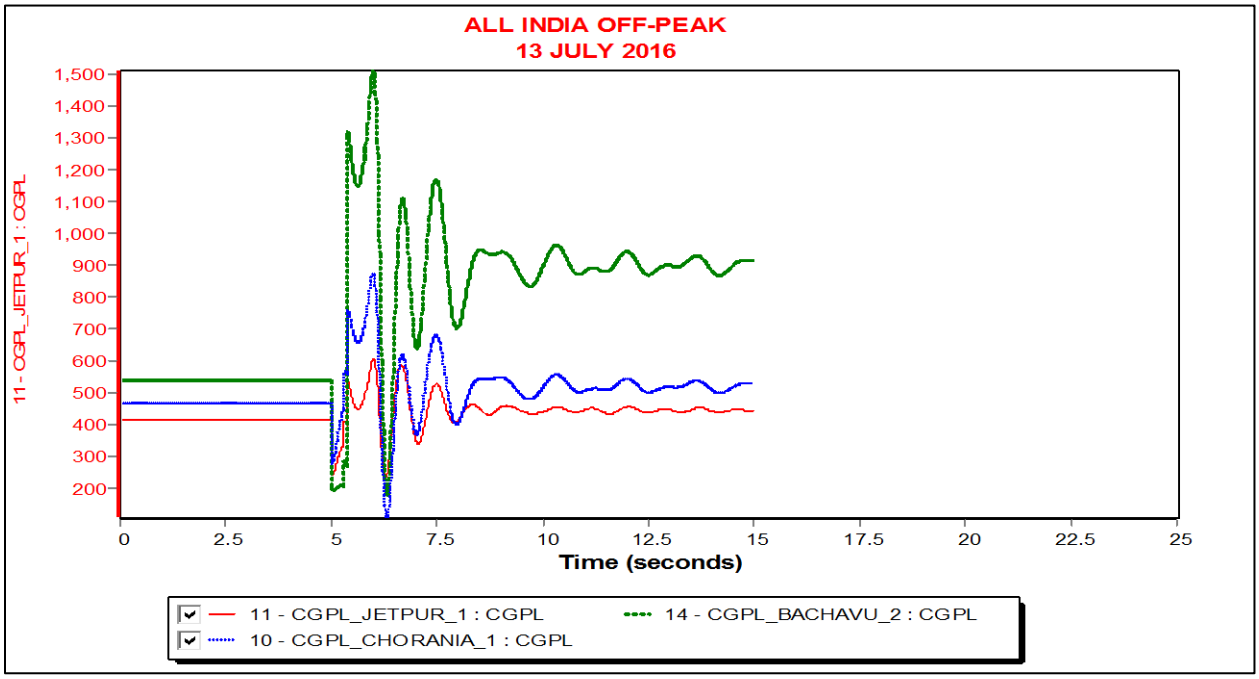


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It is observed that system is stable for the above case.

Base Case 2: 3 phase Bus fault at 400 kV Versana for 370 ms and tripping of 400 kV Bhachau-Ranchodpura D/C at 300 ms.

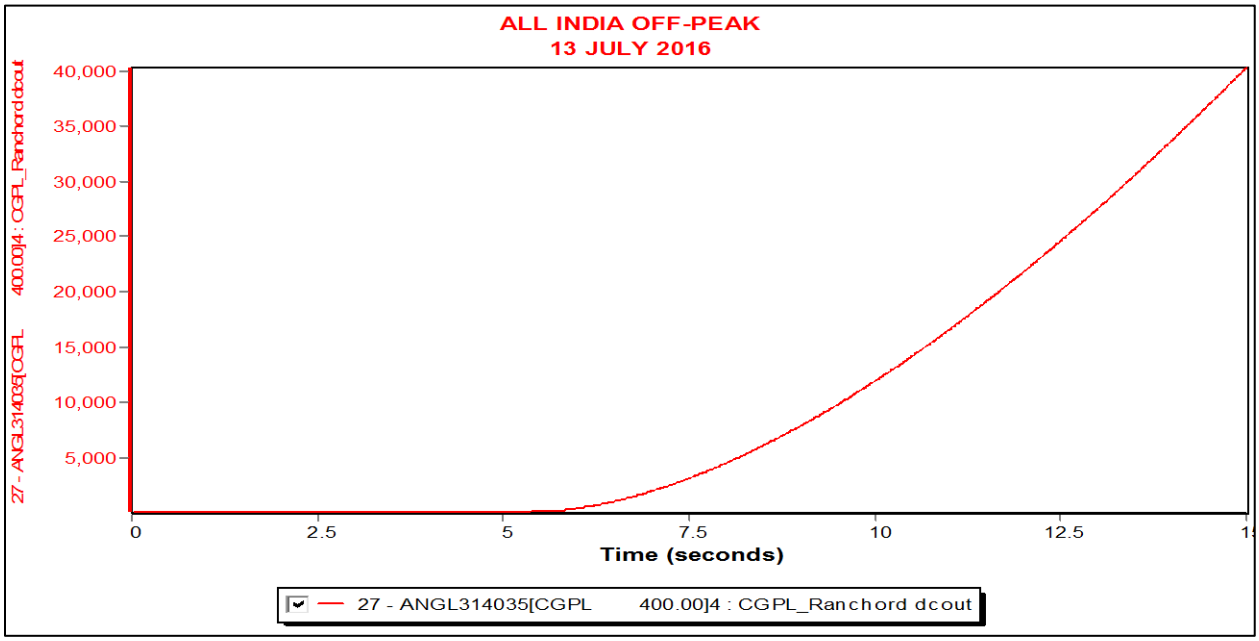


Figure: CGPL Unit 1 Machine Angle

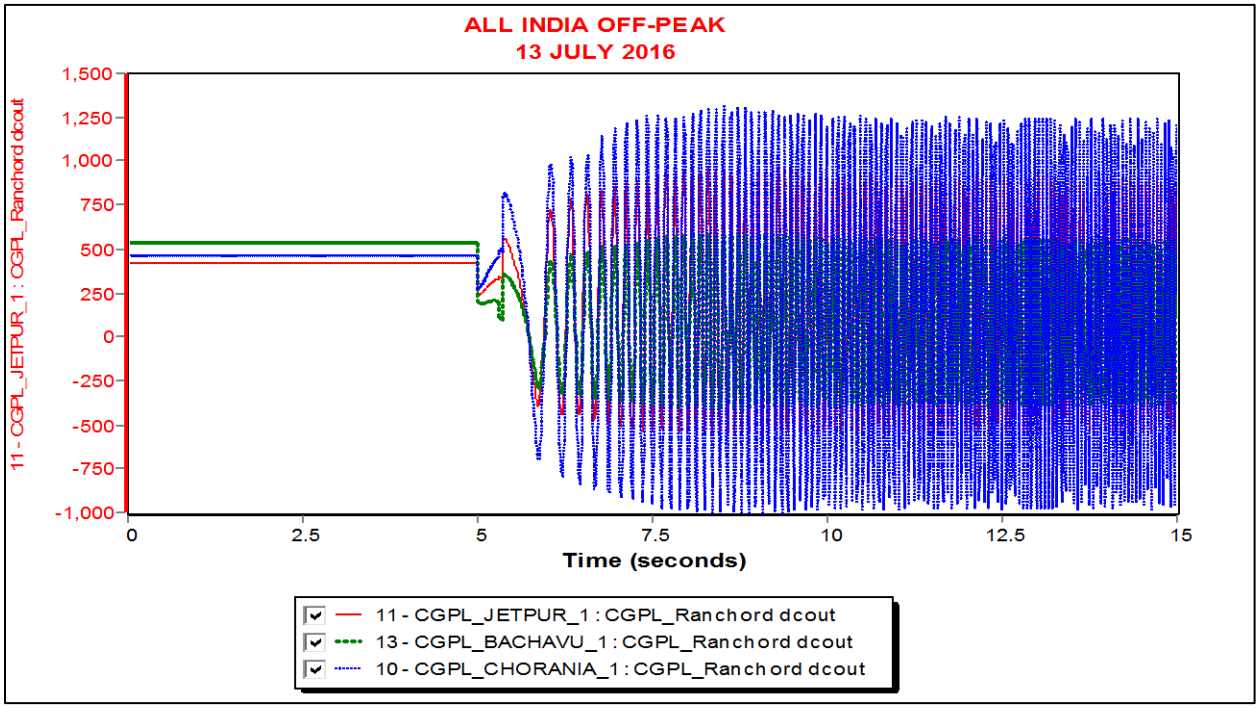


Figure: Power flow on 400 kV lines connected to CGPL Mundra

System is not stable in this case.

Case 3: 3 Phase Bus-Fault at 400kV Versana cleared in 300ms without tripping of any line

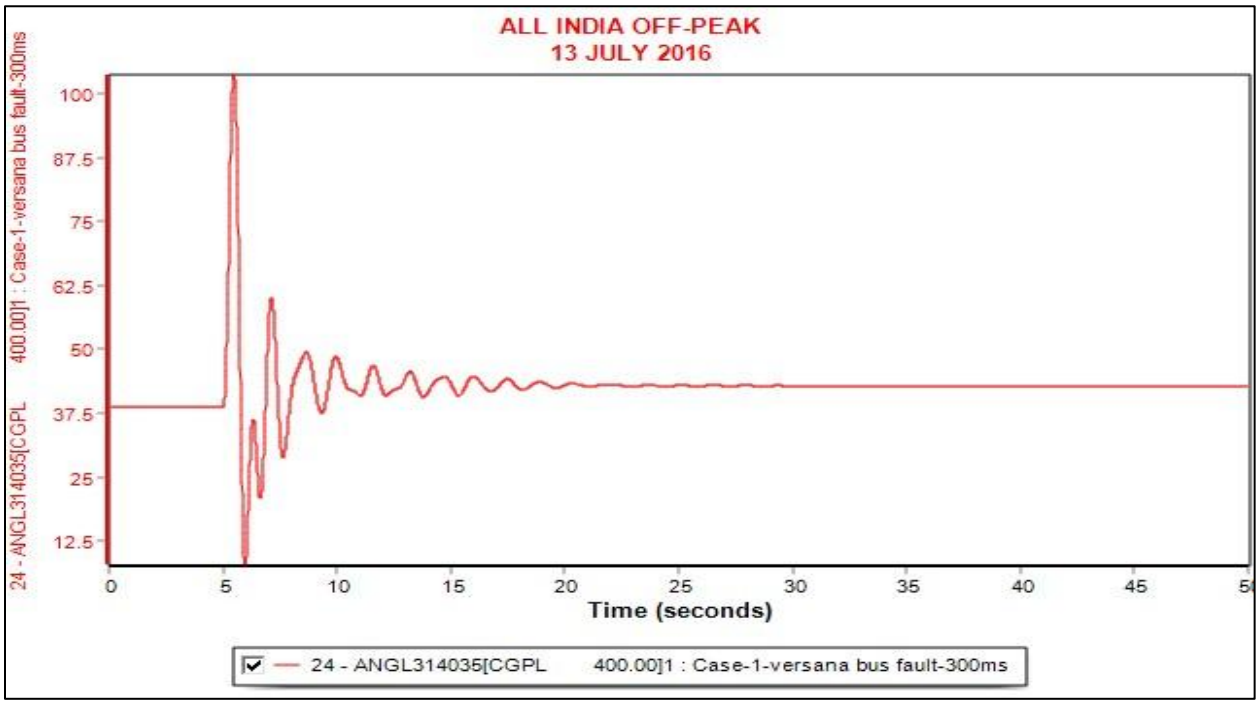


Figure: CGPL Unit 1 Machine Angle

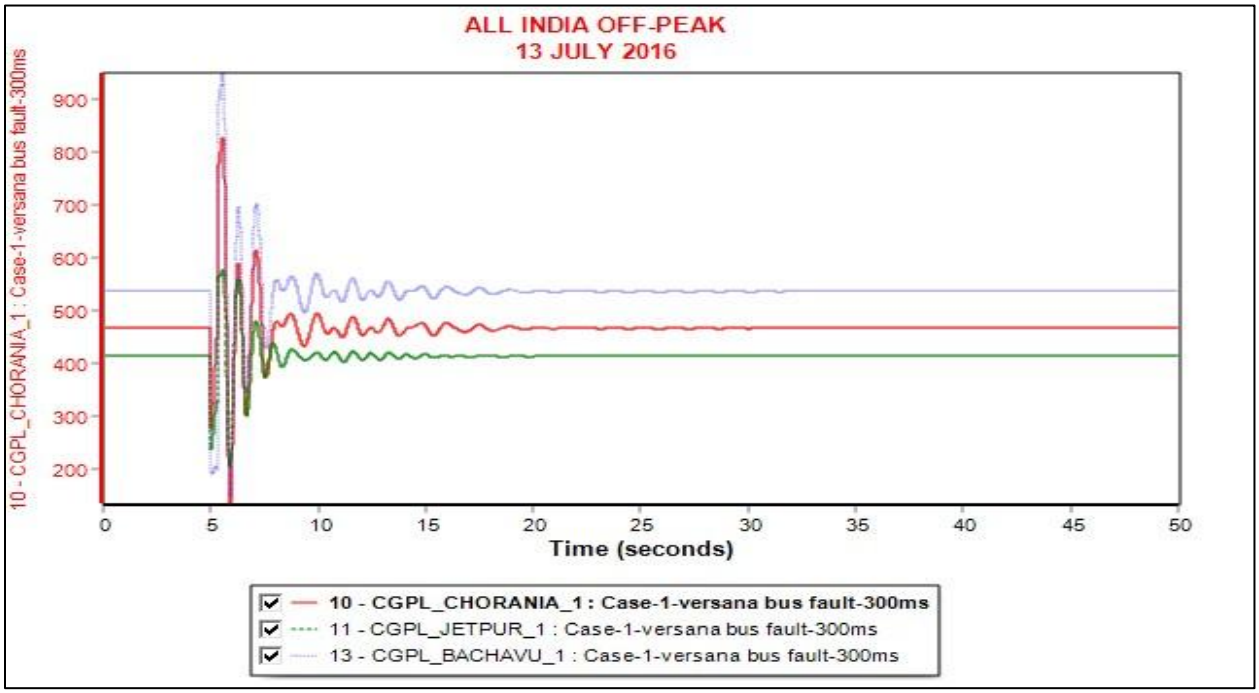


Figure: Power flow on 400 kV lines connected to CGPL Mundra

Case 4: 3 Phase Bus-fault at 400 kV Versana cleared in 370ms without tripping of any line

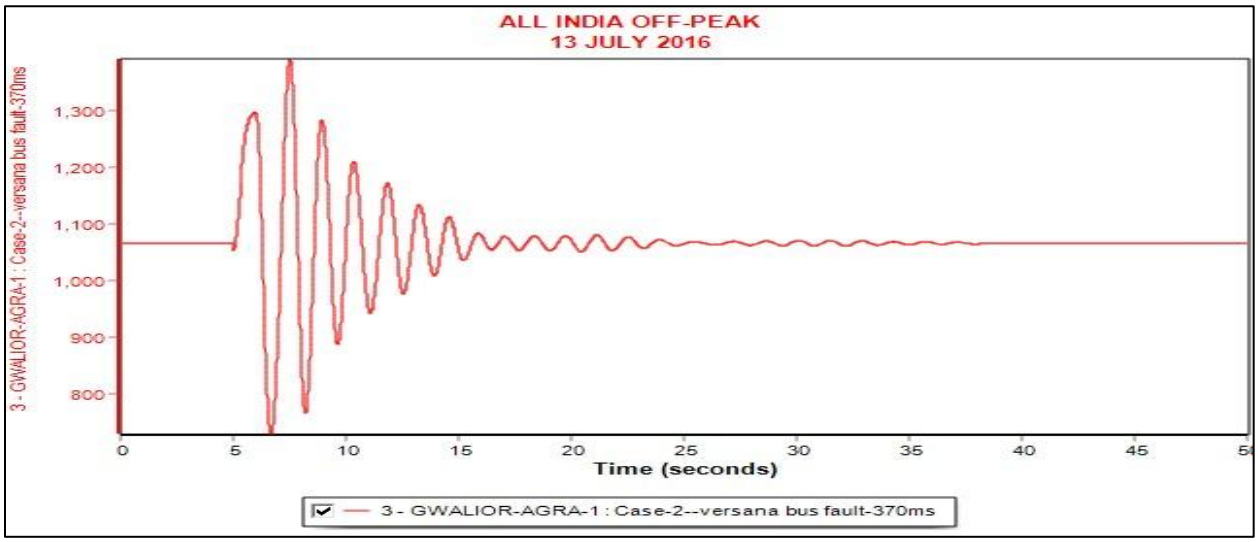


Figure: CGPL Unit 1 Machine Angle

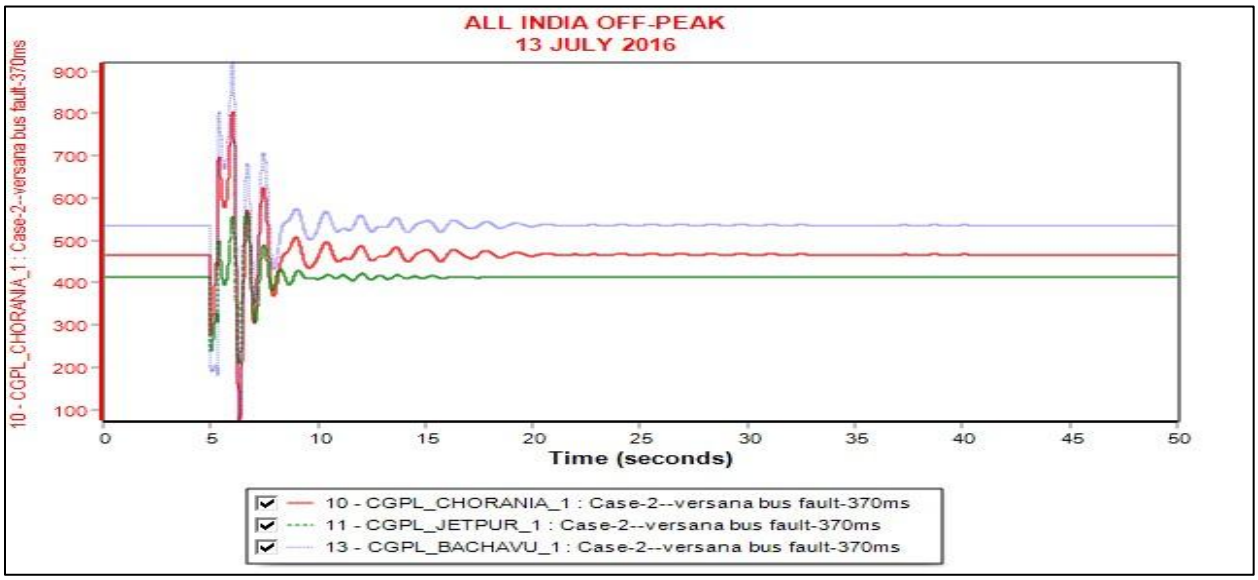


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It can be inferred from plots of Case-1 and Case-2 that the system is stable for fault clearing in 300 ms and in 370ms. Further, Stability studies are run to find the critical clearing time for 3-ph bus fault at 400kV Versana without tripping of any line. From the simulations it is found that if the fault is cleared after 370 ms, system is becoming unstable.

Case 5: 3 Phase Bus-fault at 400 kV Bhachau cleared in 250 ms without tripping of any line

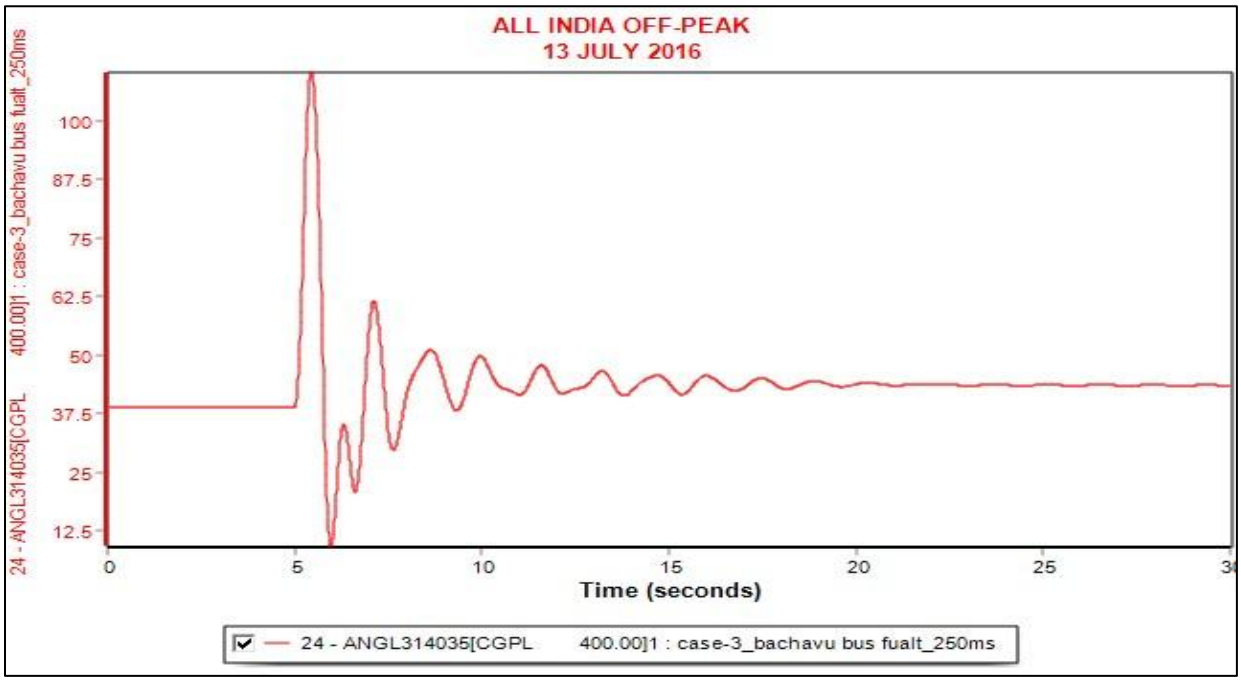


Figure: CGPL Unit 1 Machine Angle

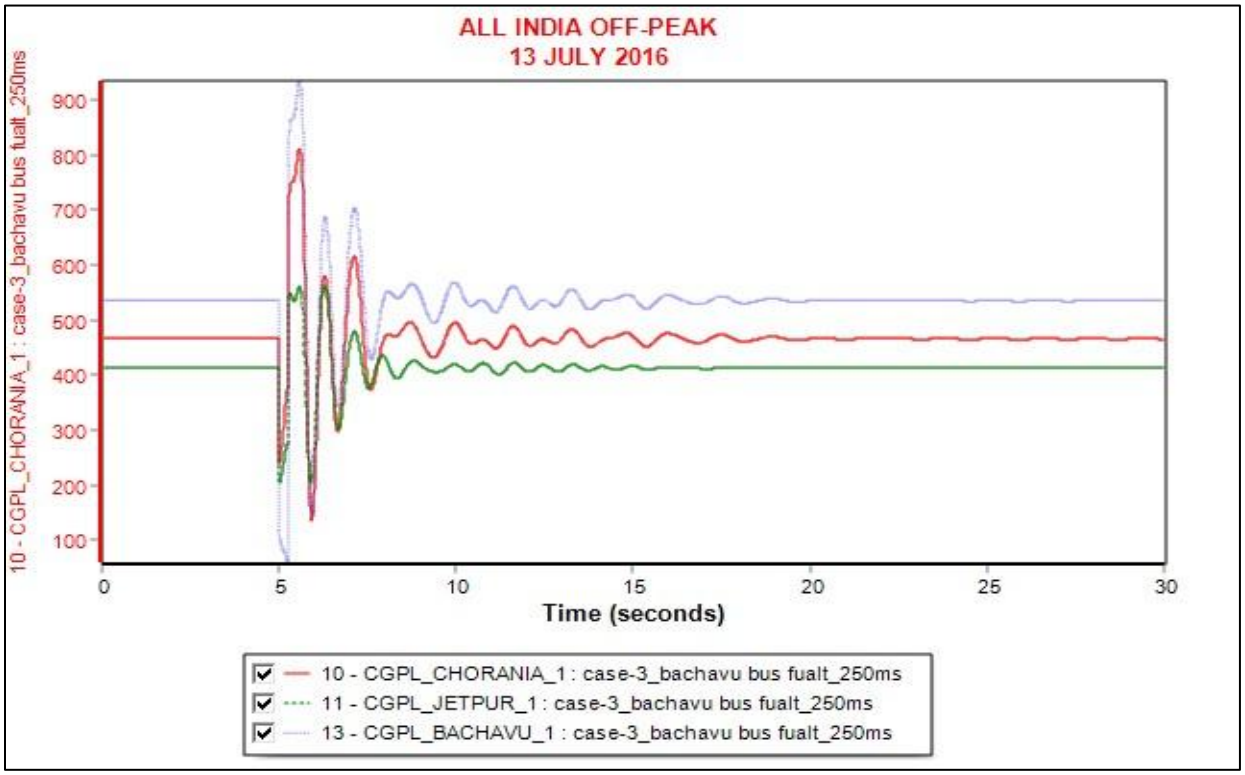


Figure: Power flow on 400 kV lines connected to CGPL Mundra

Case 6: 3 Phase Bus-fault at 400 kV Bhachau cleared in 300 ms without tripping of any line

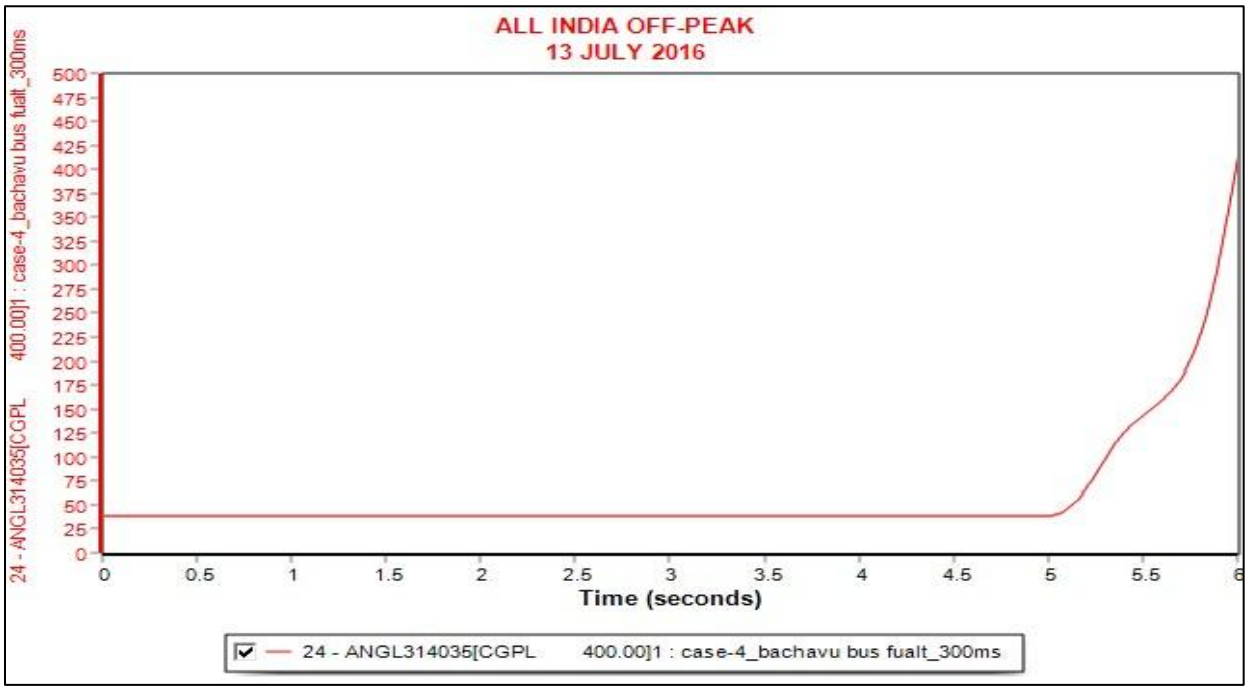


Figure: CGPL Unit 1 Machine Angle

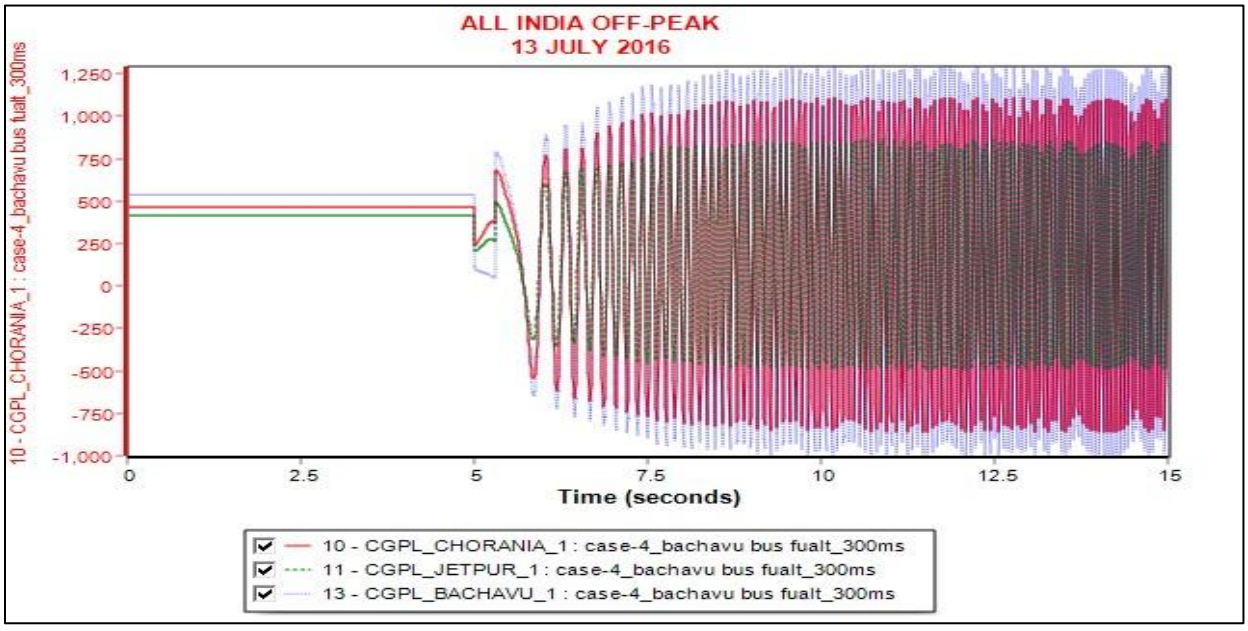


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It can be inferred from plots of Case-3 and Case-4 that the system is stable for fault clearing in 250 ms and unstable for fault clearing in 300ms.

Case 7: 3 Phase fault on 400kV CGPL-Bhachau 2 cleared in 250 ms by tripping of line

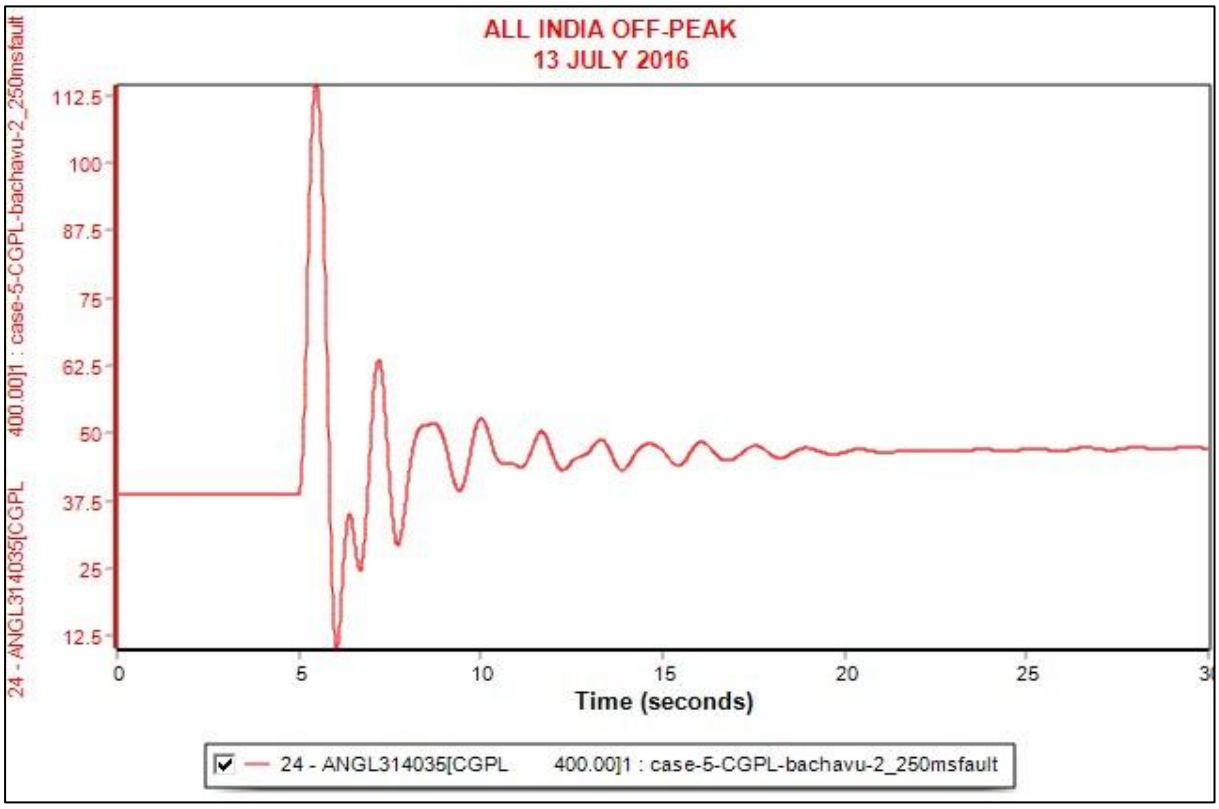


Figure: CGPL Unit 1 Machine Angle

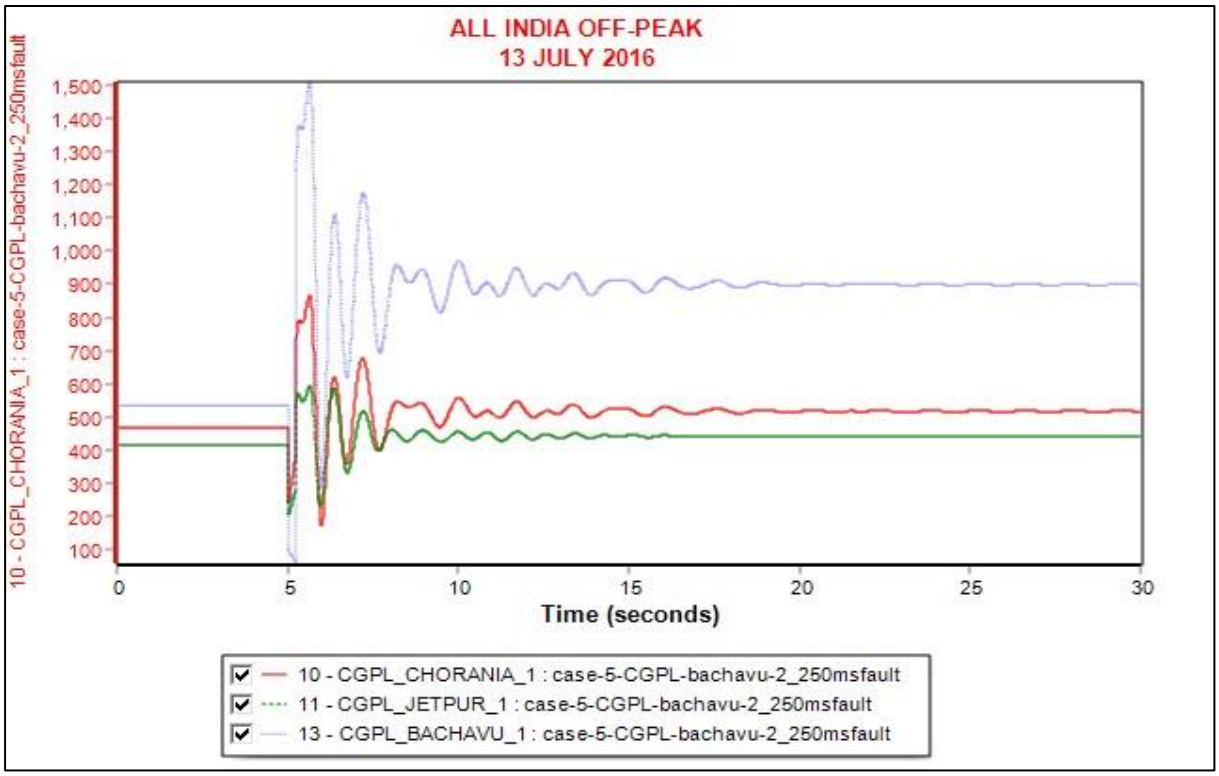


Figure: Power flow on 400 kV lines connected to CGPL Mundra

Case 8: 3 Phase fault on 400kV CGPL-Bhachau 2 cleared in 300 ms by tripping of line

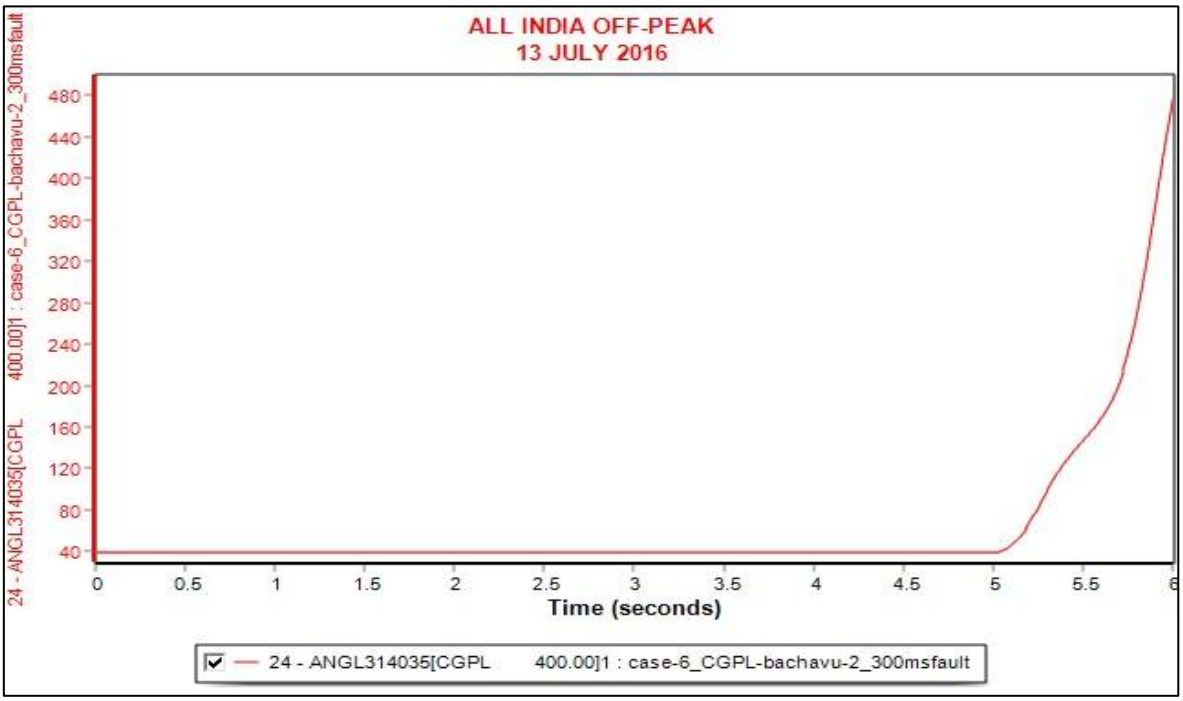


Figure: CGPL Unit 1 Machine Angle

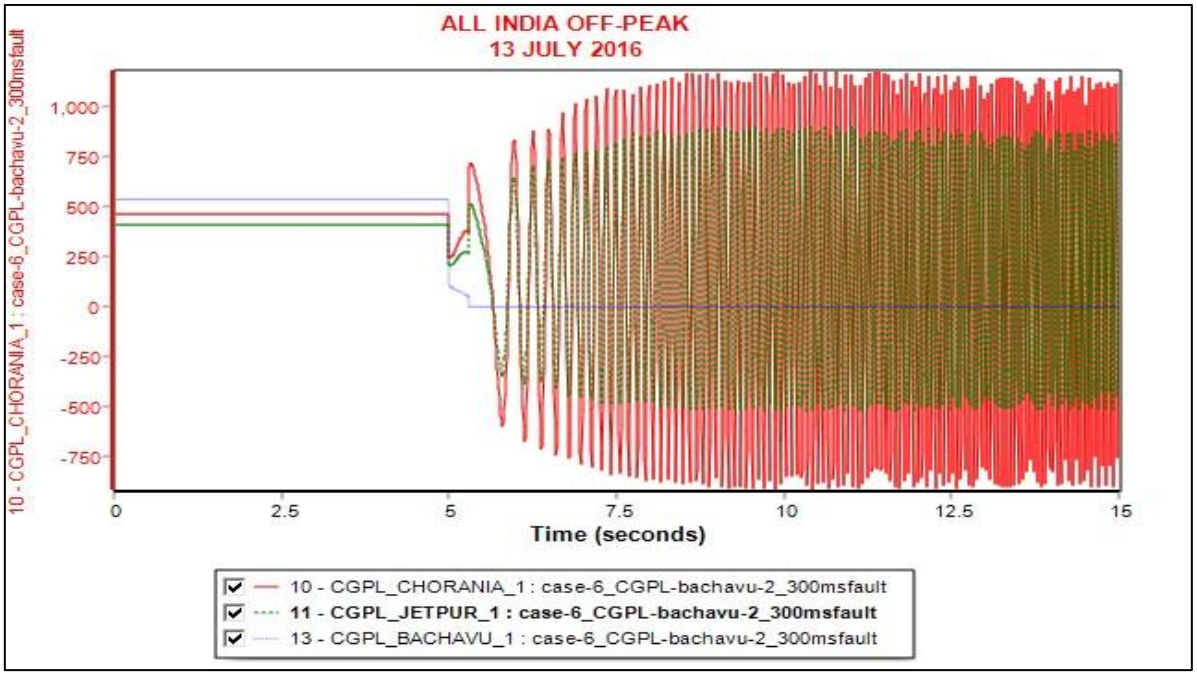


Figure: Power flow on 400 kV lines connected to CGPL Mundra

It can be inferred from plots of Case-5 and Case-6 that the System is stable for fault clearing in 250 ms and unstable for fault clearing in 300 ms.

Case 9 : Base Case + One CGPL Unit tripping at 300 ms after fault at Versana

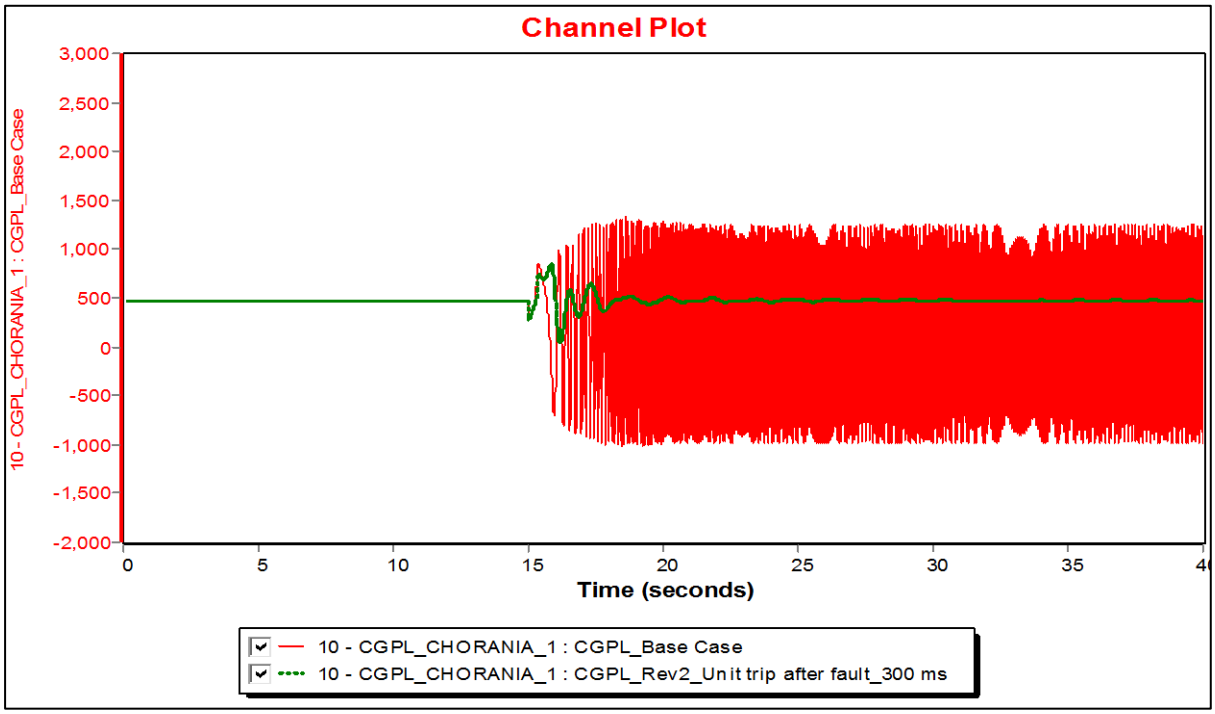


Figure: Power flow on 400 kV CGPL-Choronia

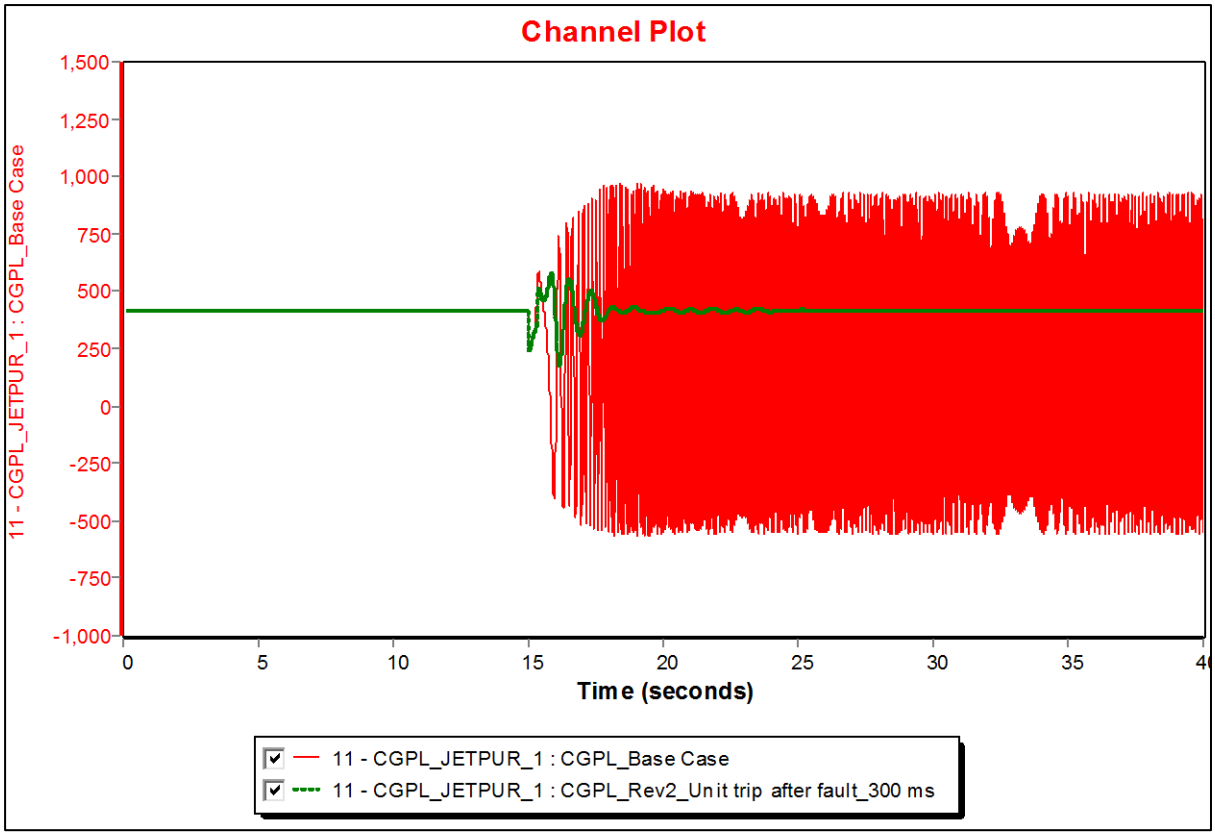


Figure: Power flow on 400 kV CGPL-Jetpur

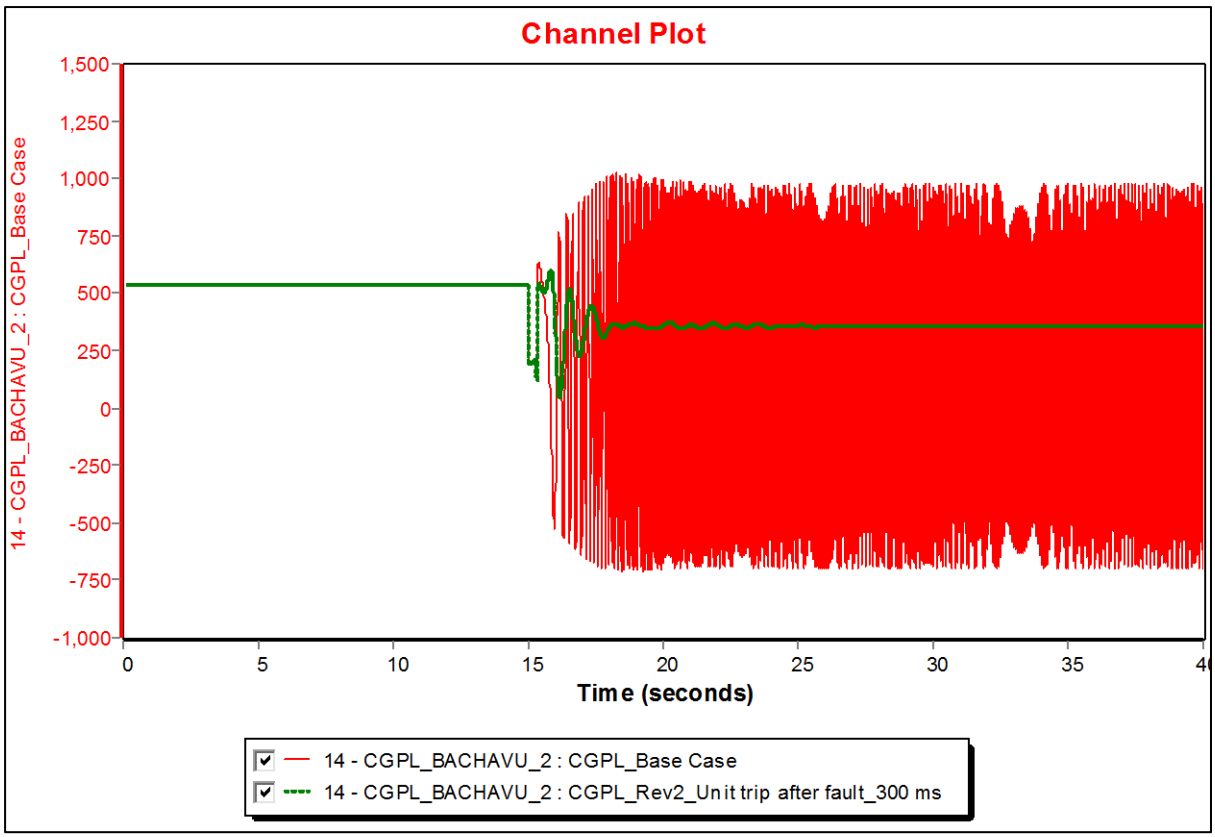


Figure: Power flow on 400 kV CGPL-Bhachau

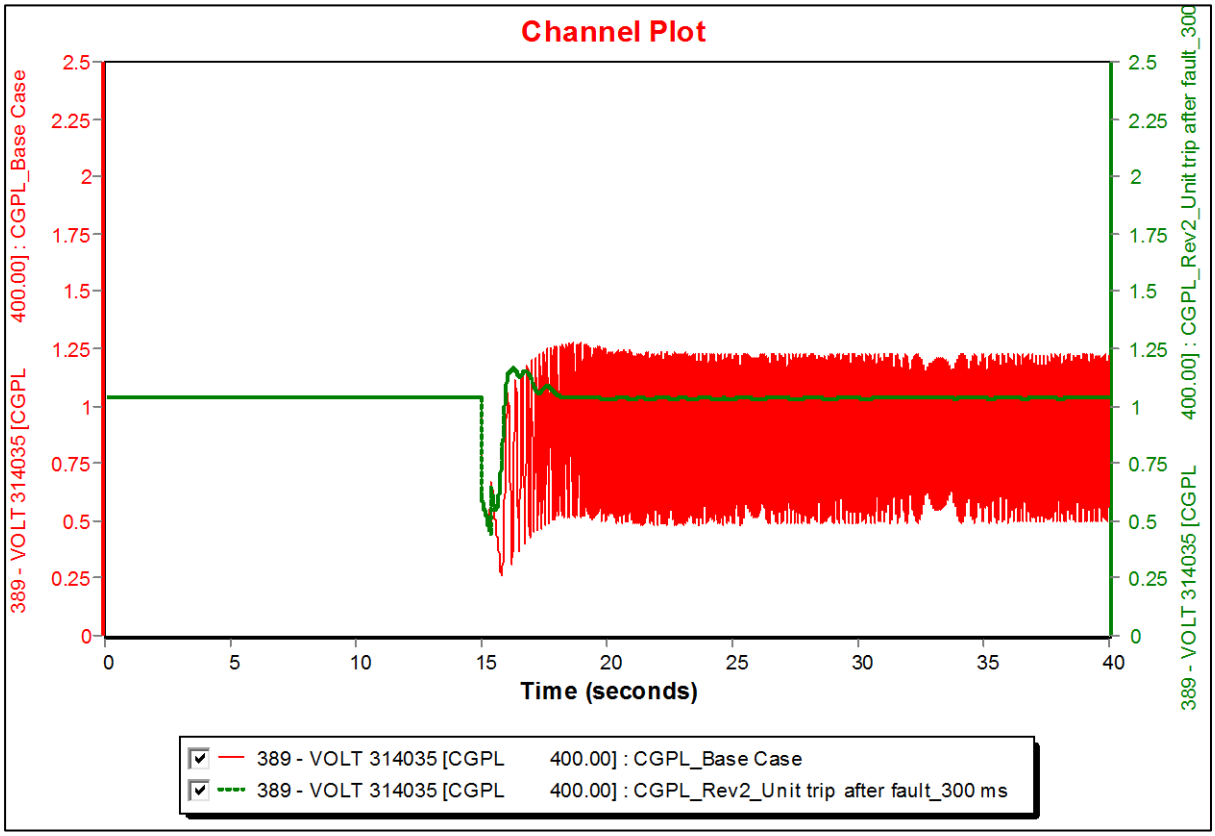


Figure: Voltage at CGPL

Case 10 : Base Case + One CGPL Unit tripping at 350 ms after fault at Versana

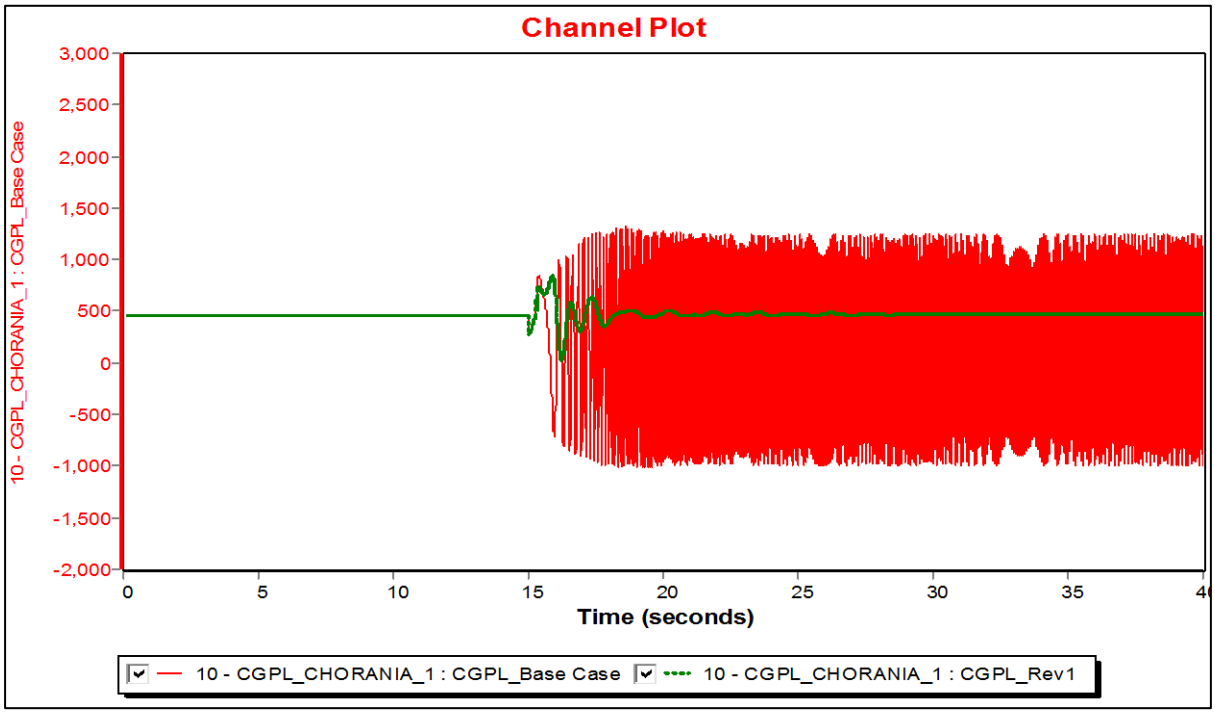


Figure: Power flow on 400 kV CGPL-Choronia

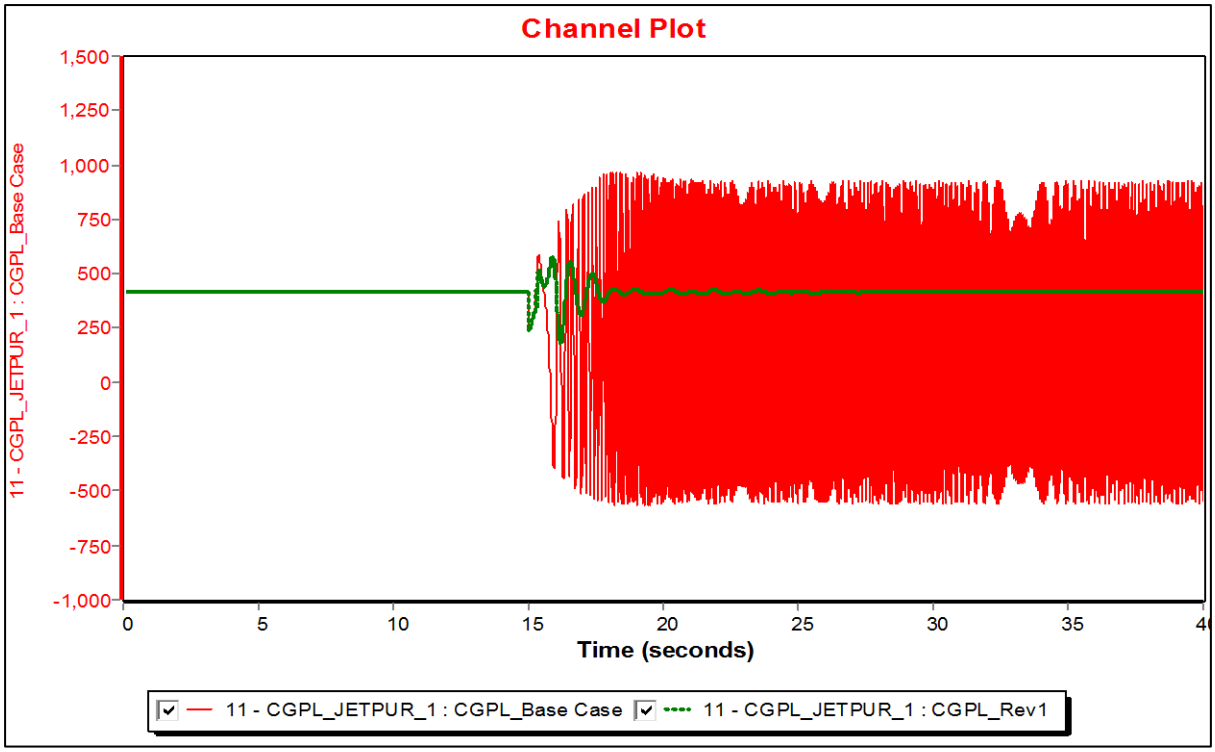


Figure: Power flow on 400 kV CGPL-Jetpur

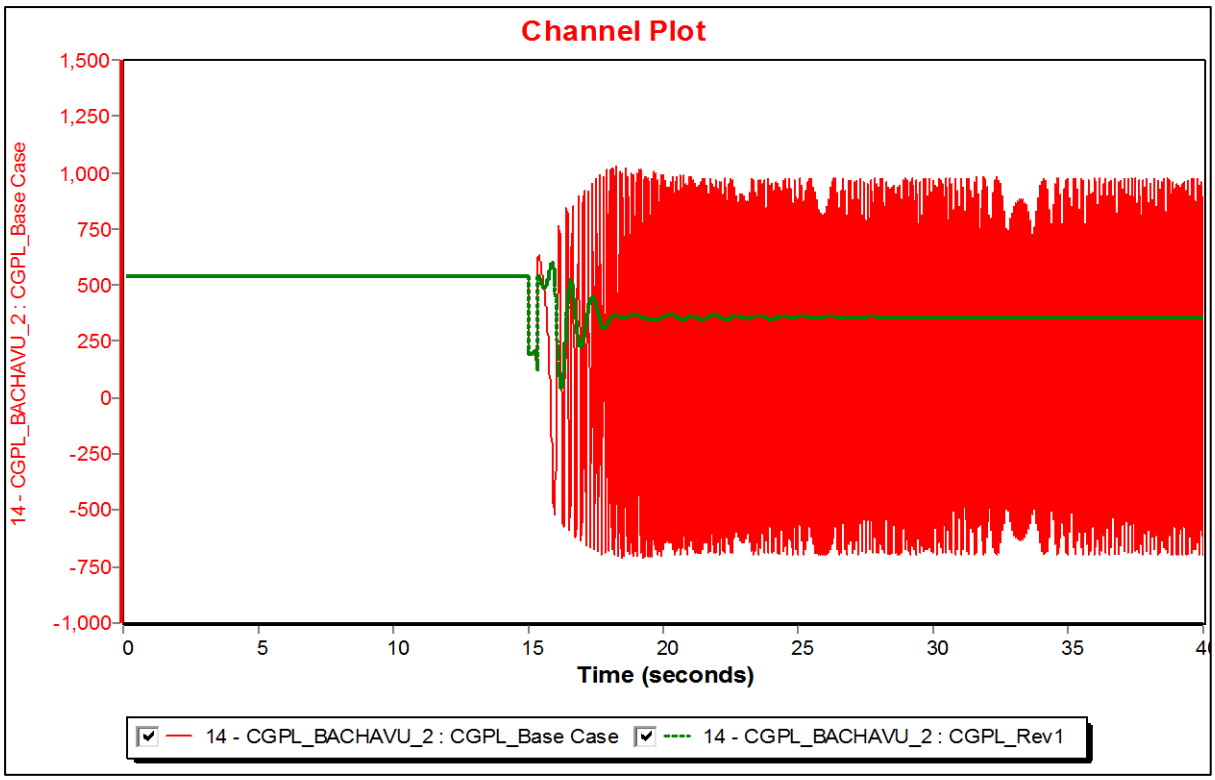


Figure: Power flow on 400 kV CGPL-Bhachau

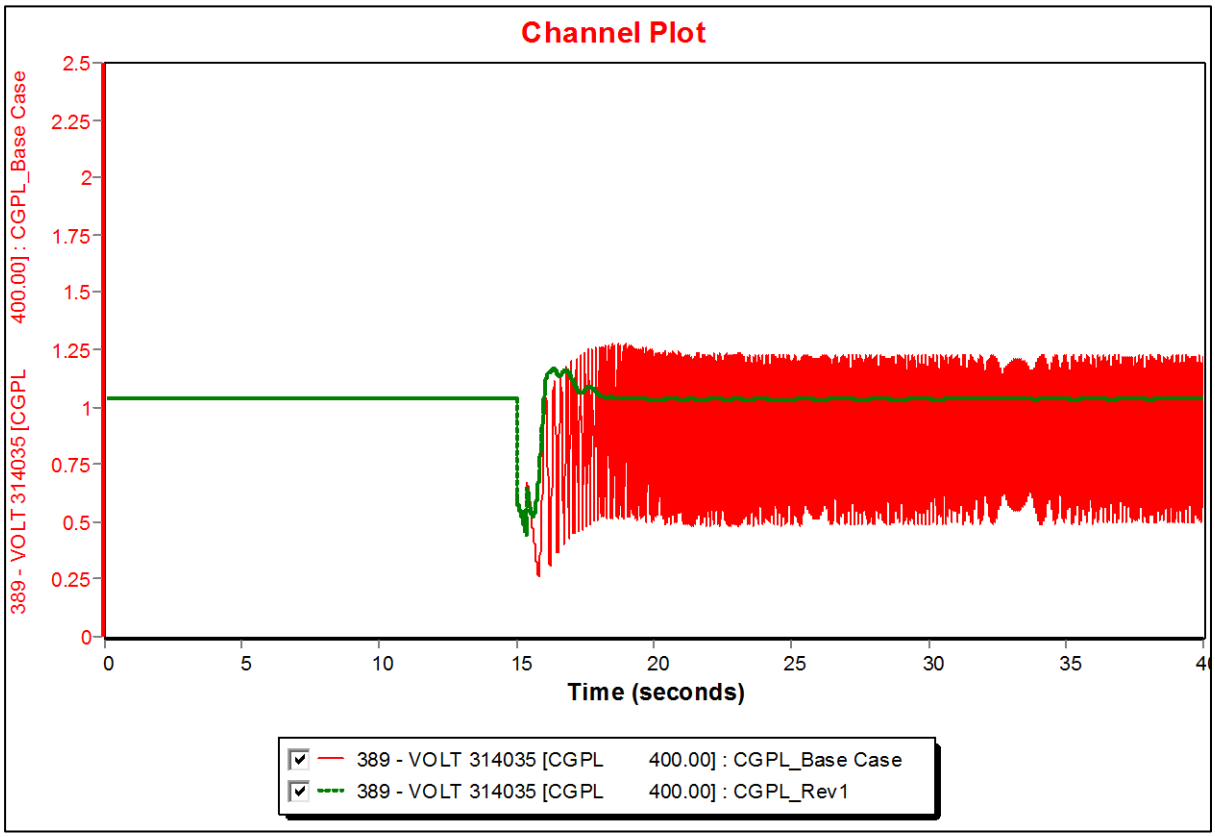


Figure: Voltage at CGPL

Case 11: Base Case + One CGPL Unit Tripping at 400 ms after fault at Versana

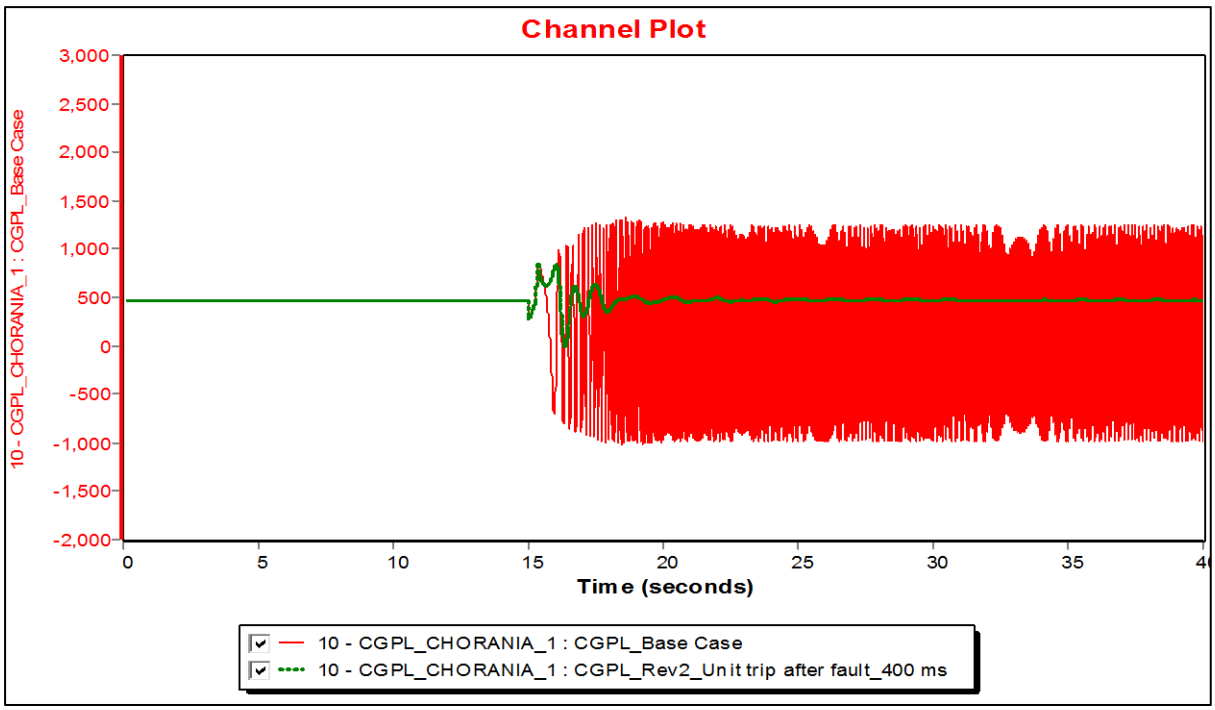


Figure: Power flow on 400 kV CGPL-Choronia

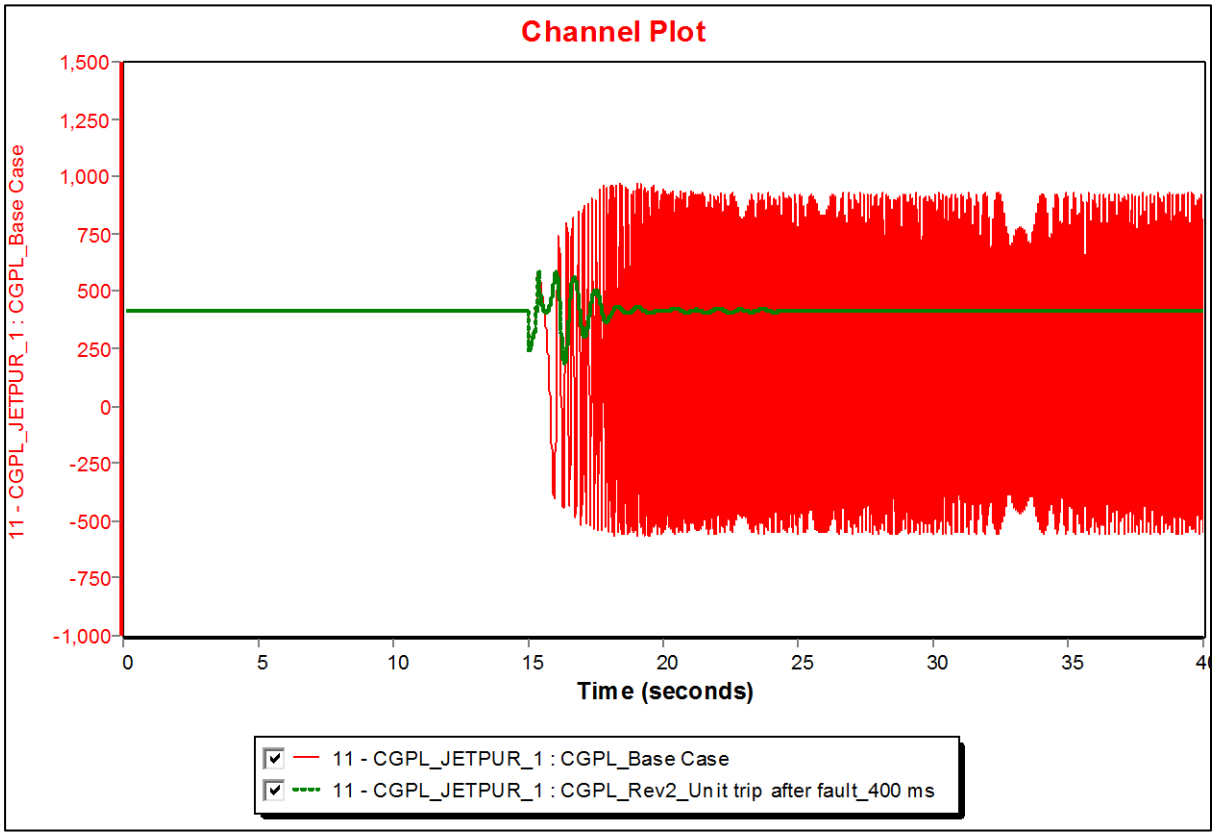


Figure: Power flow on 400 kV CGPL-Jetpur

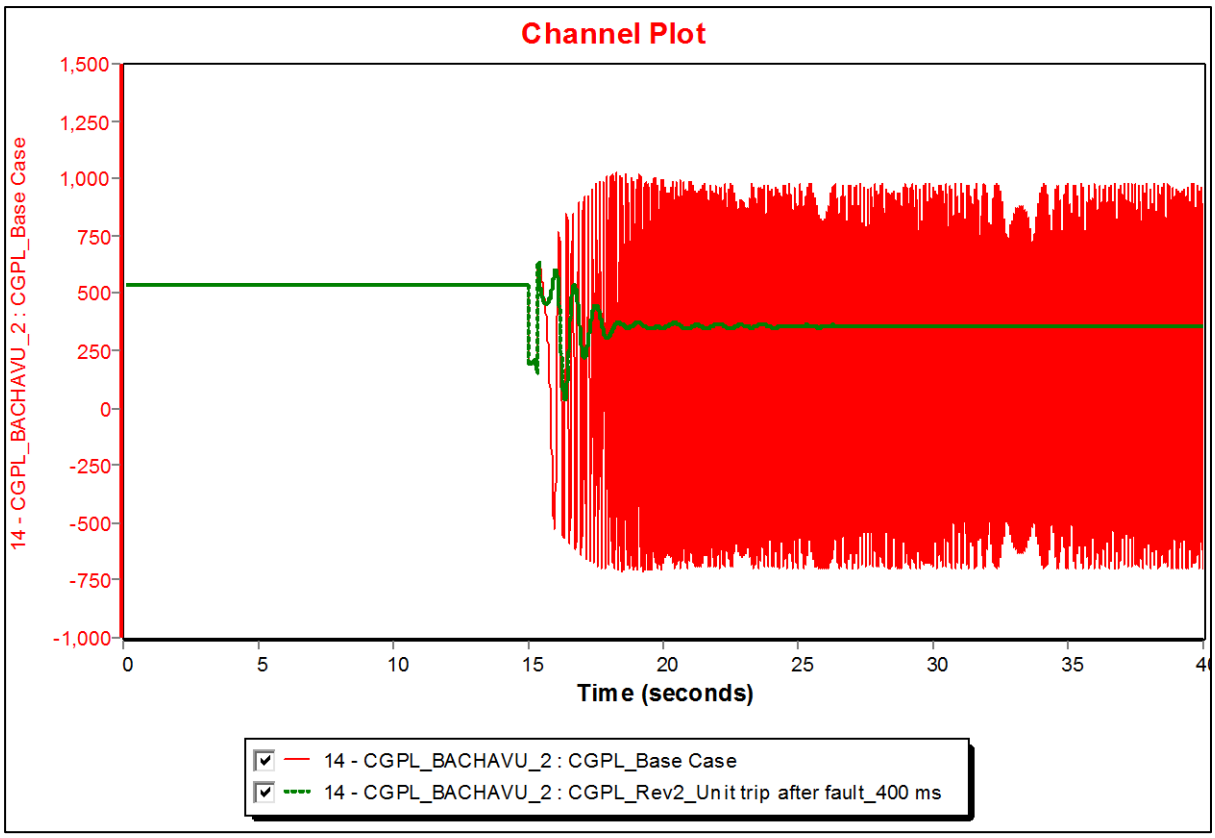


Figure: Power flow on 400 kV CGPL-Bhachau

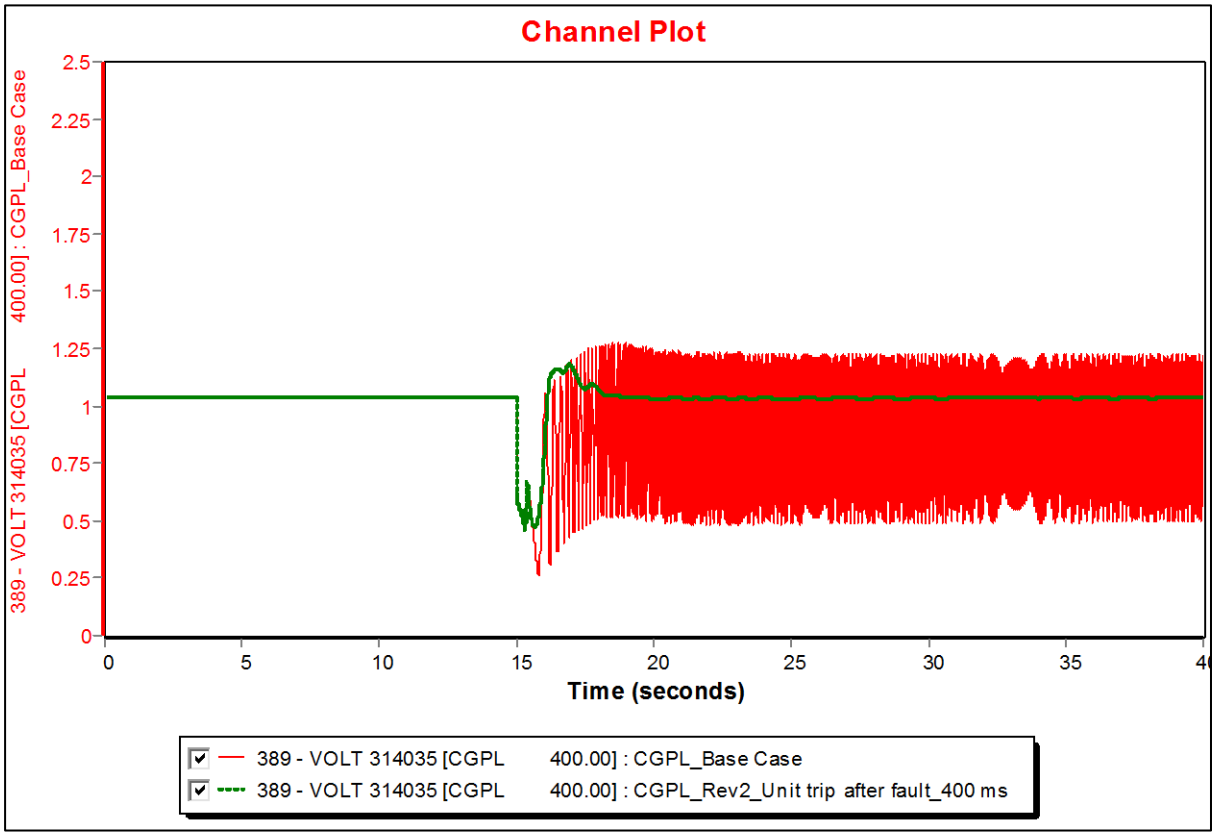


Figure: Voltage at CGPL

Case 12 : Base Case + One CGPL Unit Tripping at 500 ms after fault at Versana

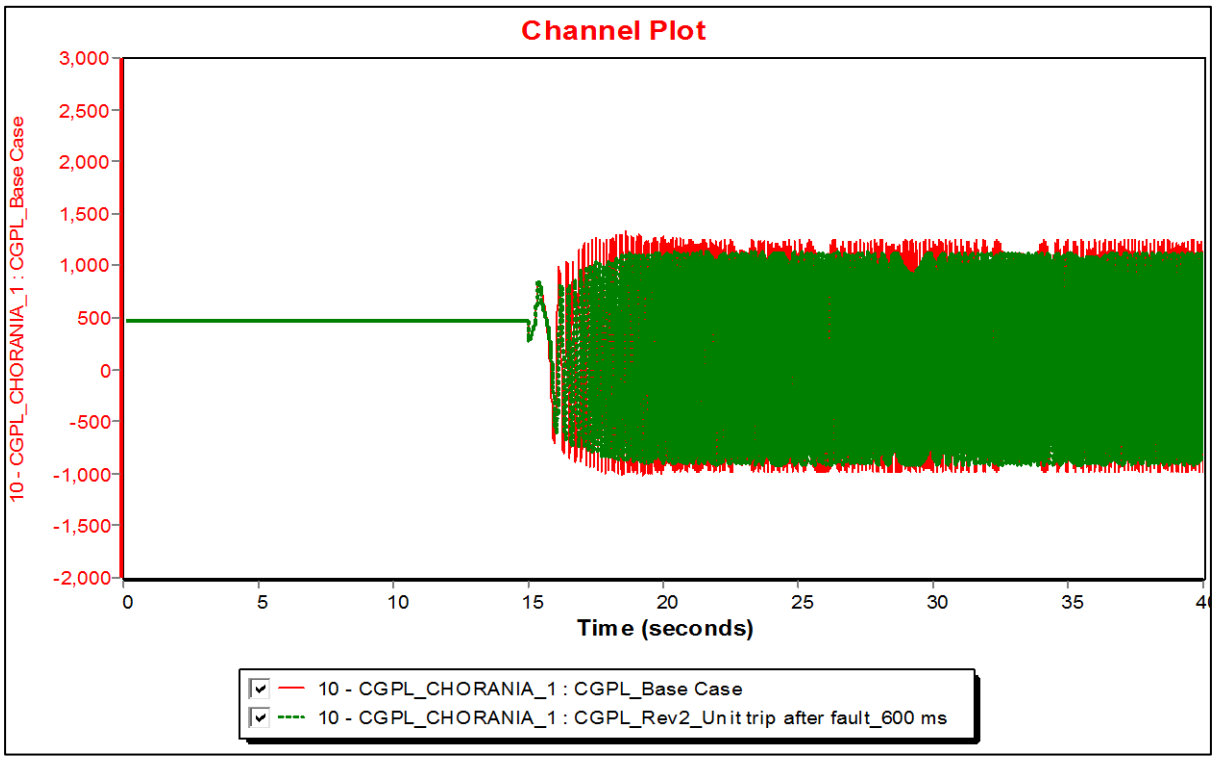


Figure: Power flow on 400 kV CGPL-Choronia

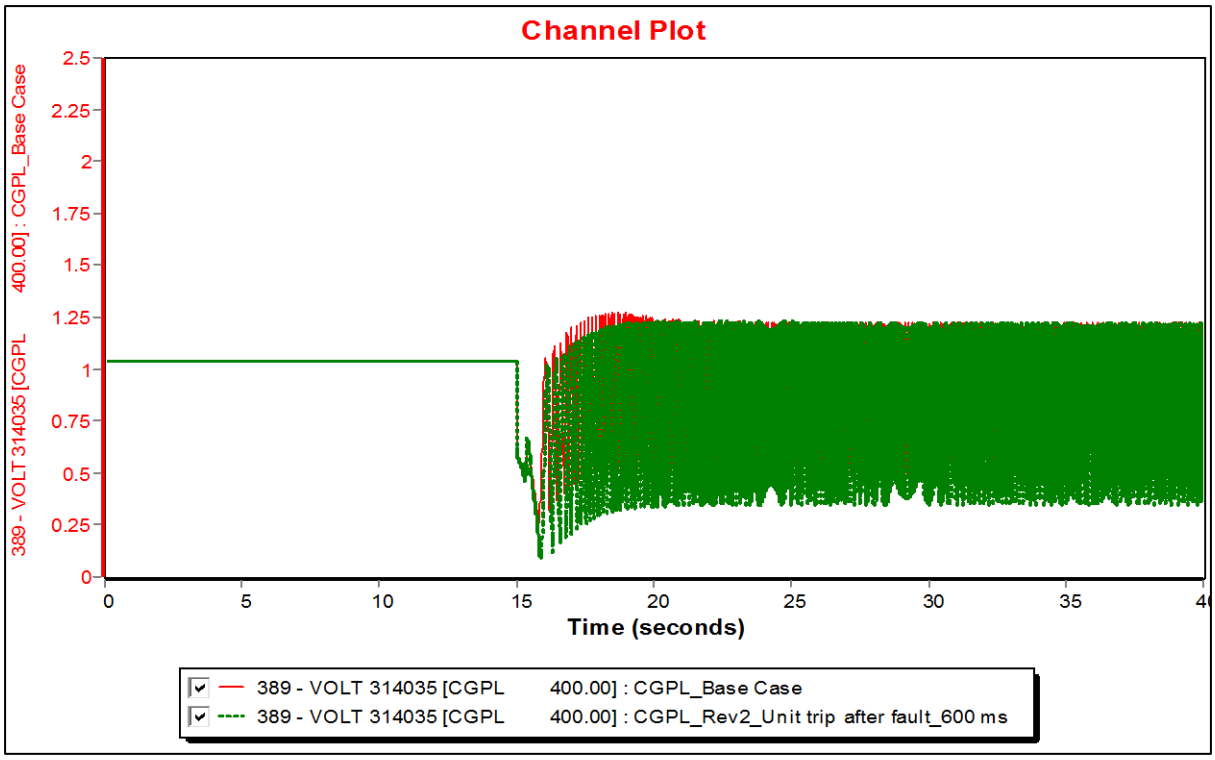


Figure: Voltage at CGPL

Case 13: Impact of Lines in service from Choronia , Jetpur and Ranchodpura

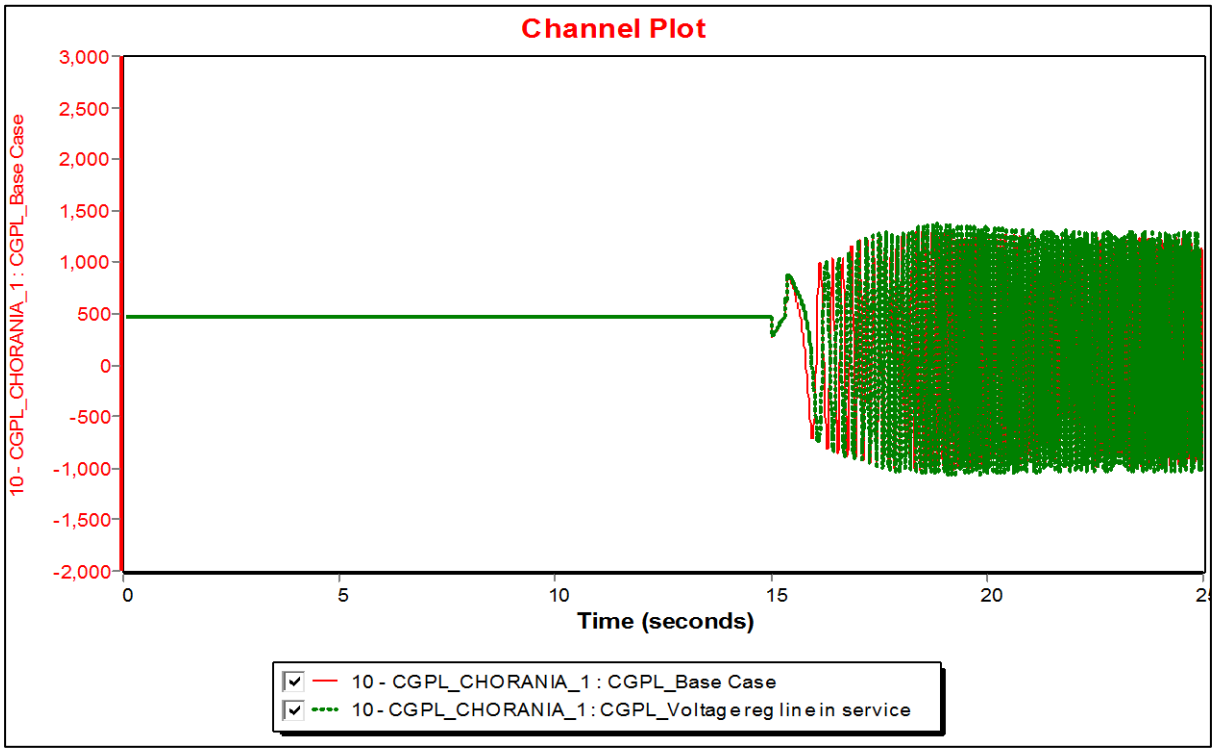


Figure: Power flow on 400 kV CGPL-Choronia

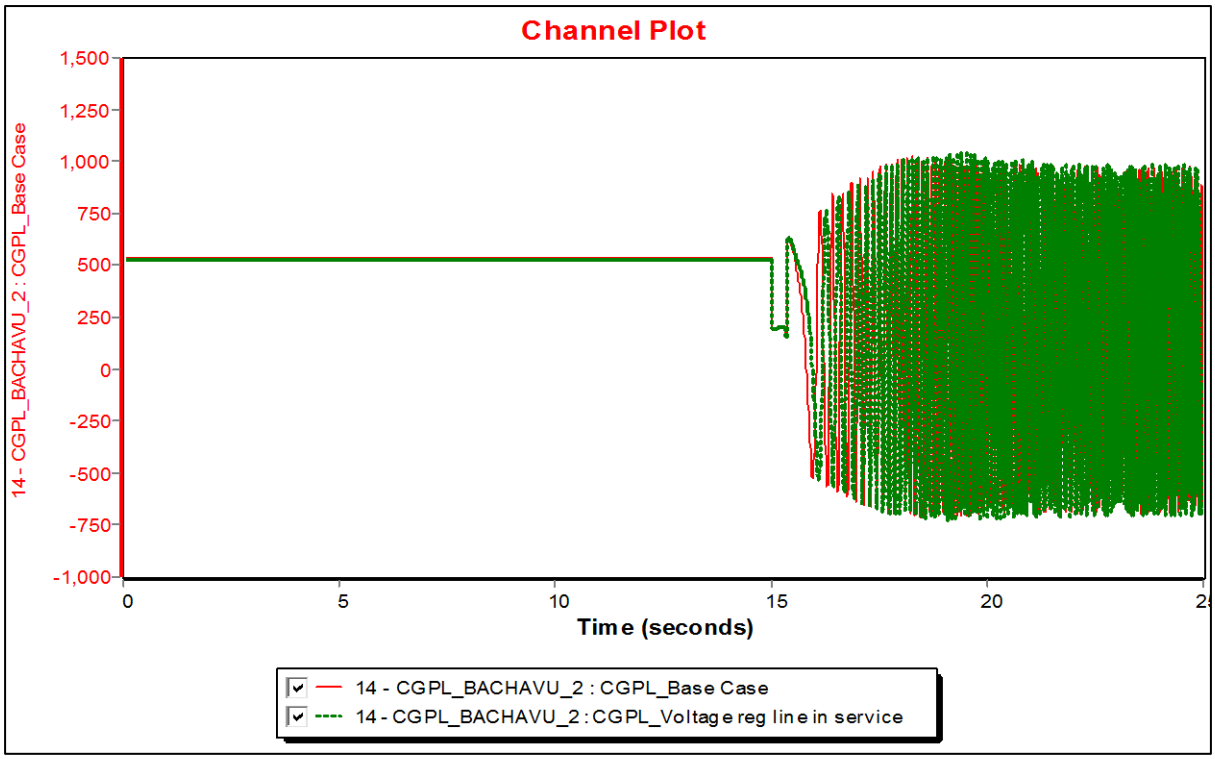


Figure: Power flow on 400 kV CGPL-Bhachau

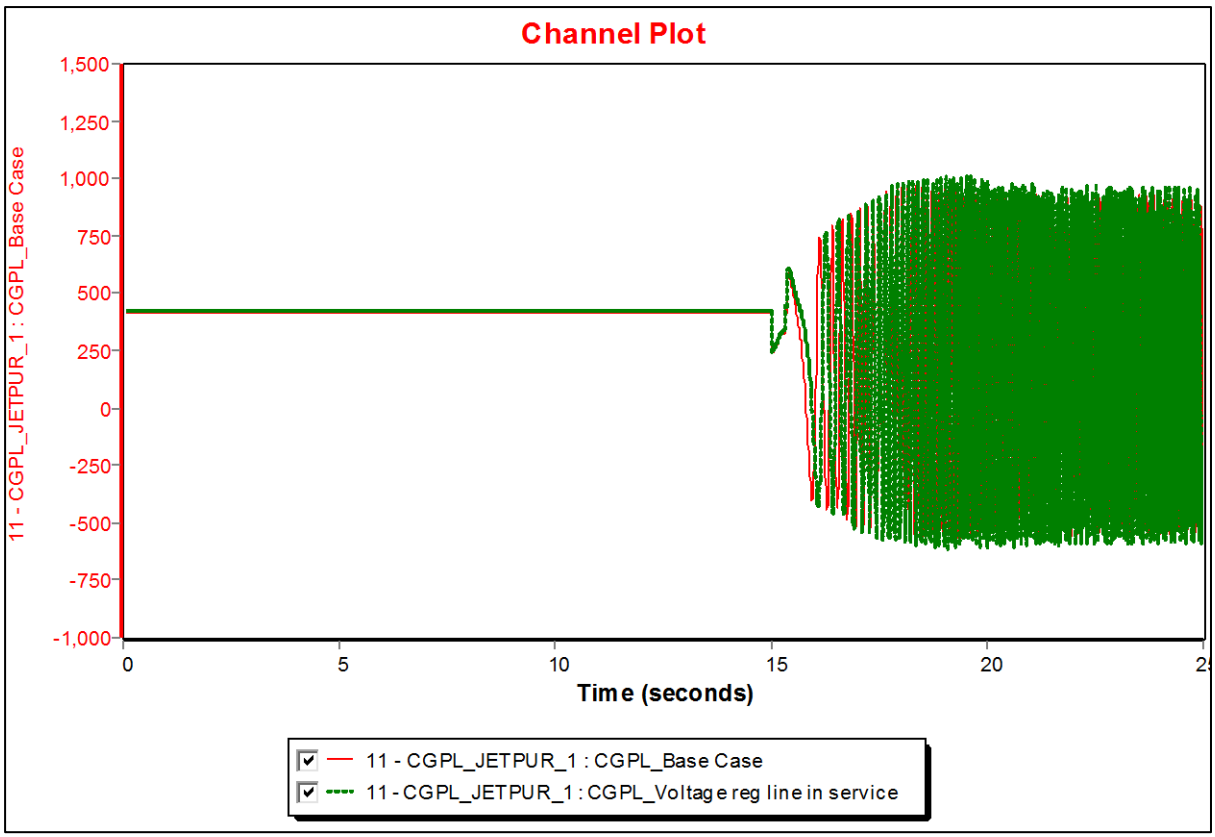


Figure: Power flow on 400 kV CGPL-Jetpur

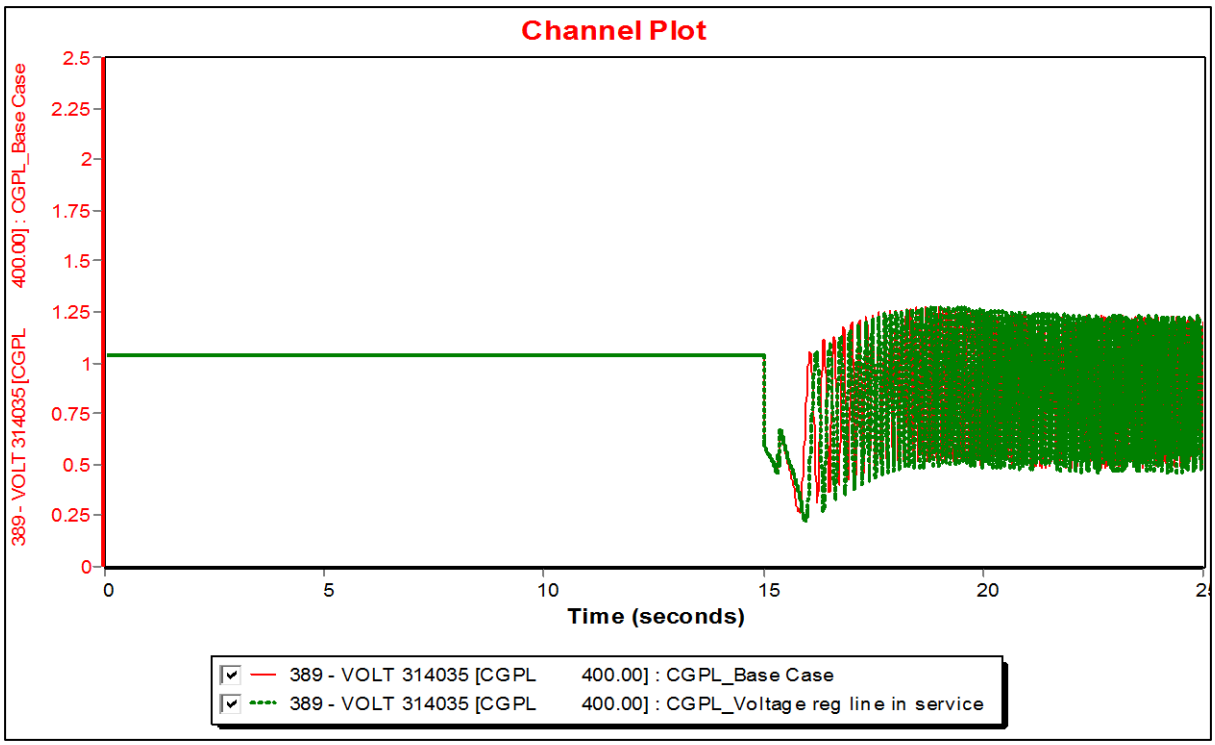


Figure: Voltage at CGPL

Case Study 14: 3 phase fault of 250 ms on each evacuating line from CGPL and to check the power swing observed on other lines and unit.

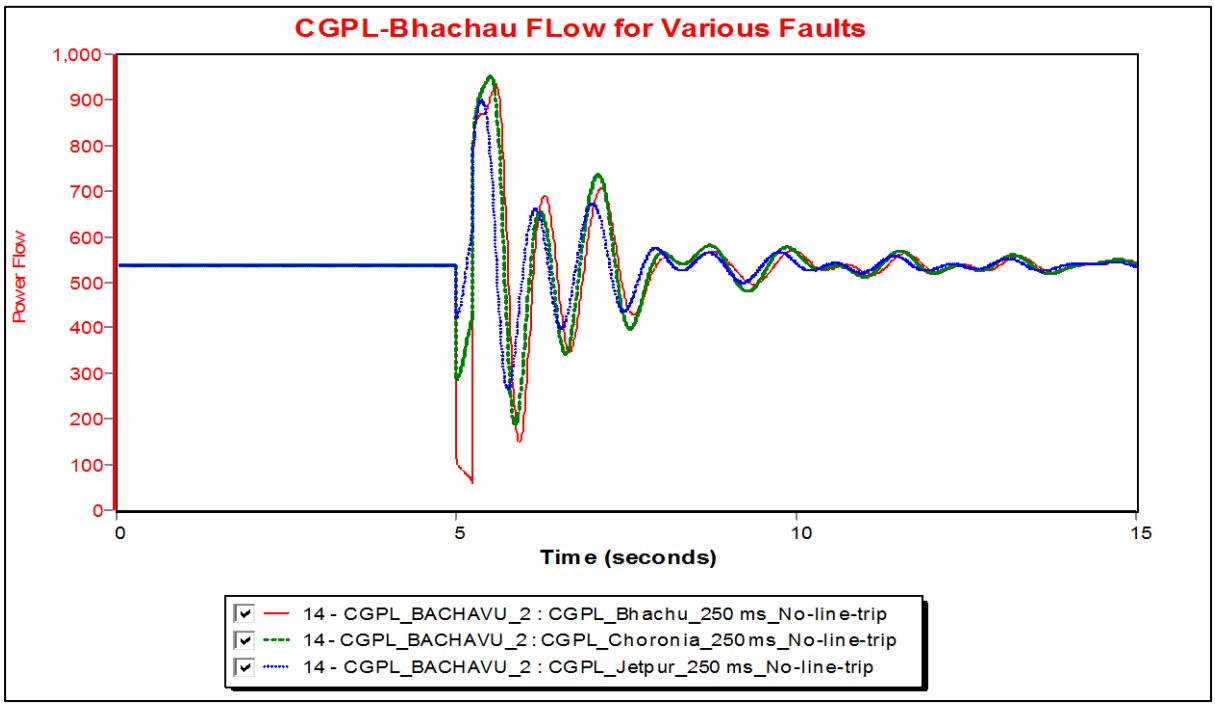


Figure: Power flow on 400 kV CGPL-Bhachau

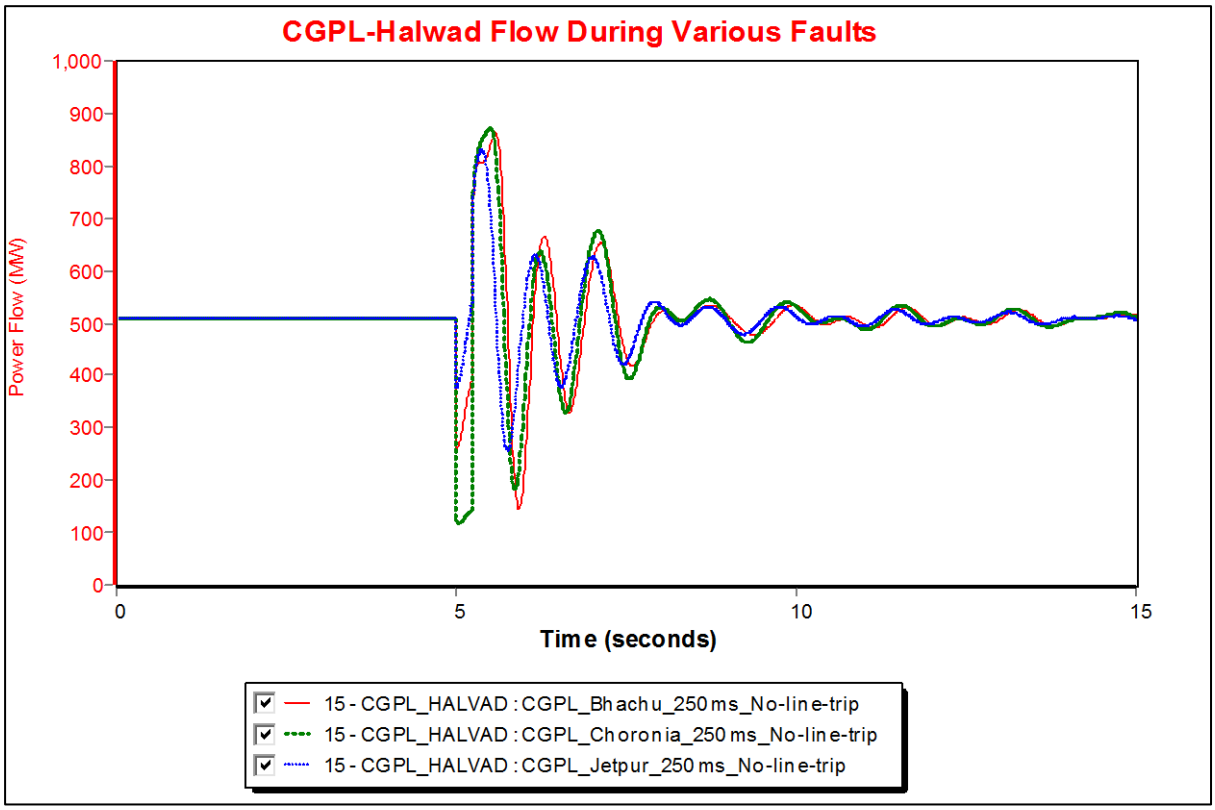


Figure: Power flow on 400 kV CGPL-Halwad

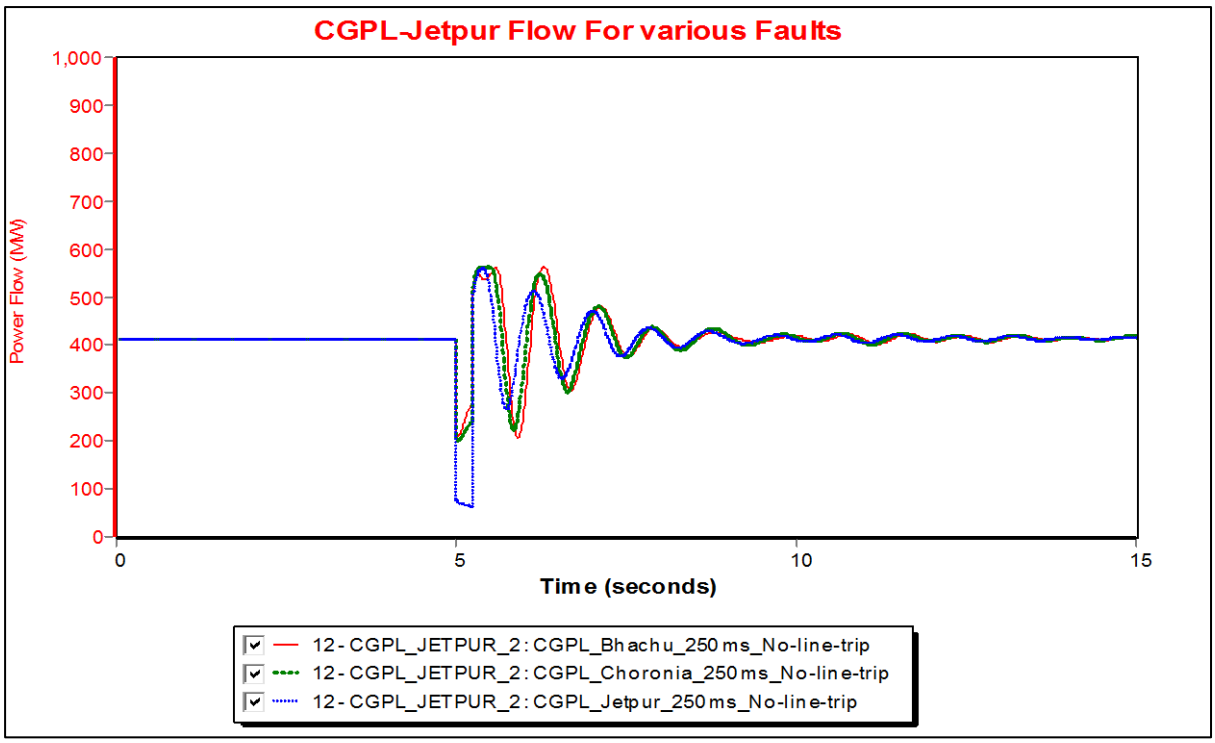


Figure: Power flow on 400 kV CGPL-Jetpur

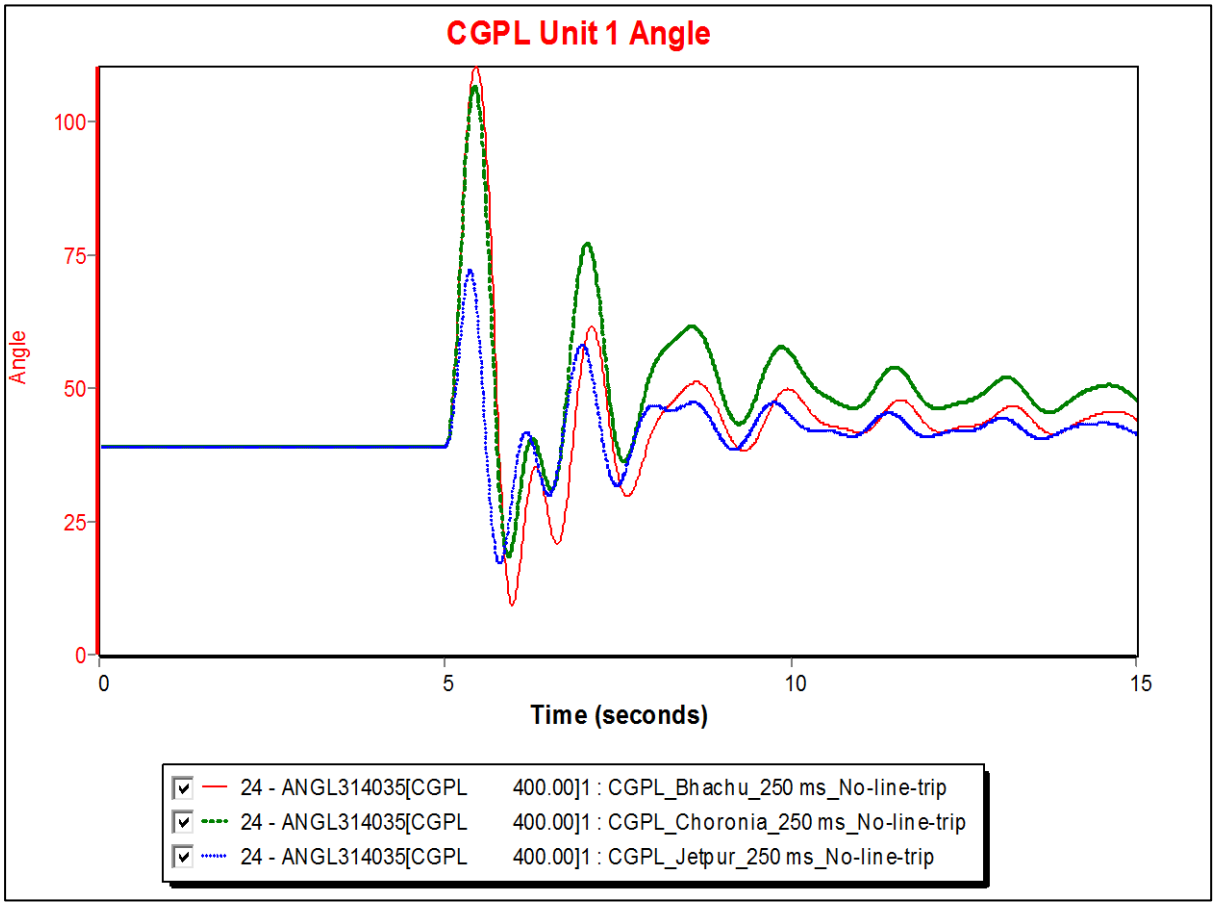


Figure: CGPL Unit 1 angle

Case Study 15: 3 phase fault of 250 ms on each evacuating line from CGPL and thereafter its tripping to check the power swing observed on other lines and unit

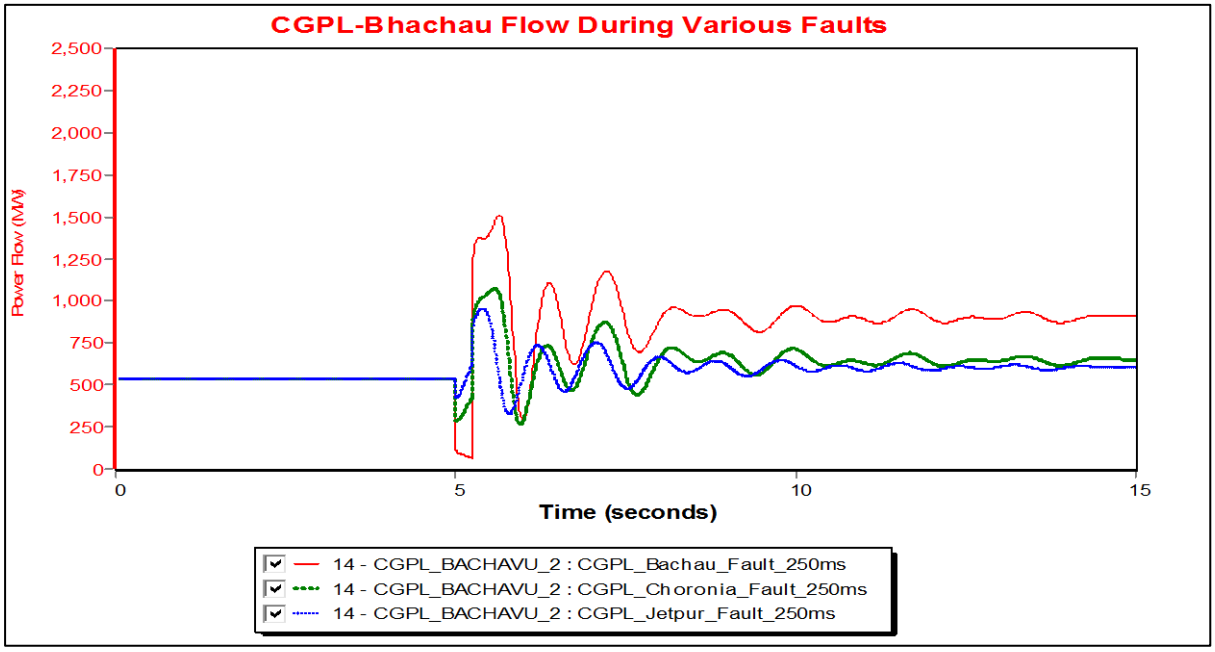


Figure: Power flow on 400 kV CGPL-Bhachau

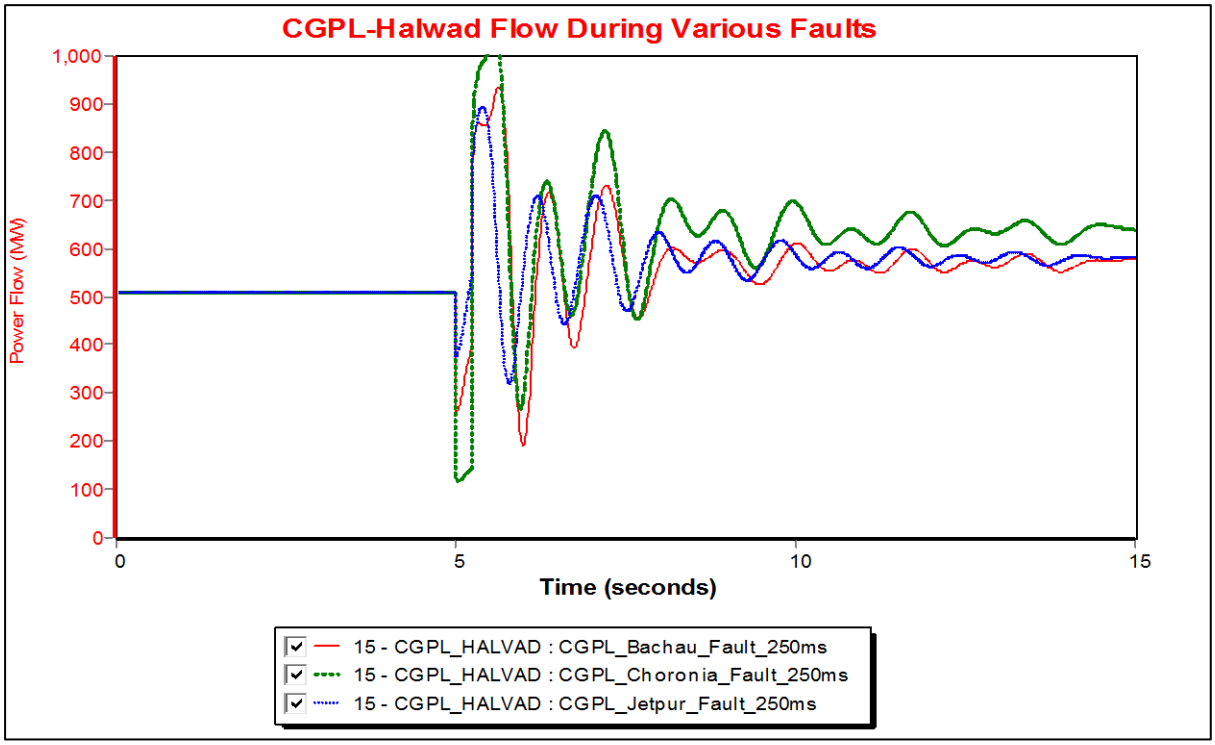


Figure: Power flow on 400 kV CGPL-Halwad

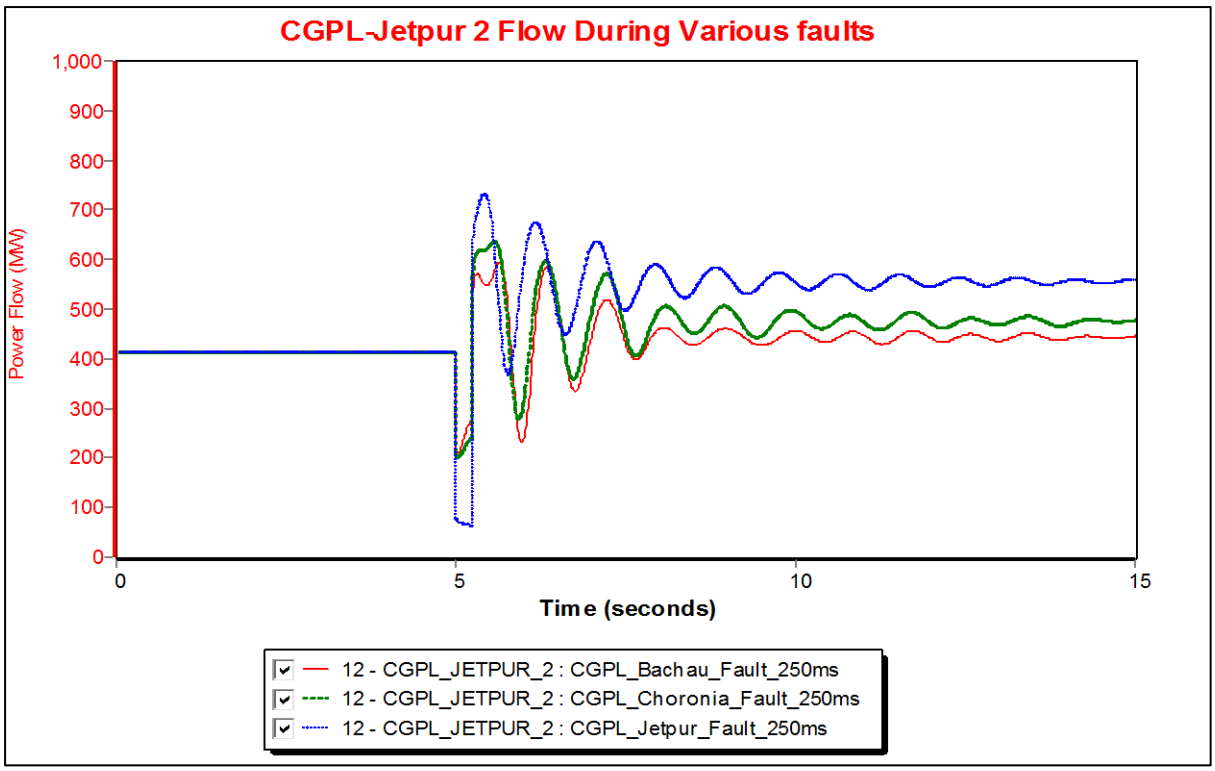


Figure: Power flow on 400 kV CGPL-Jetpur

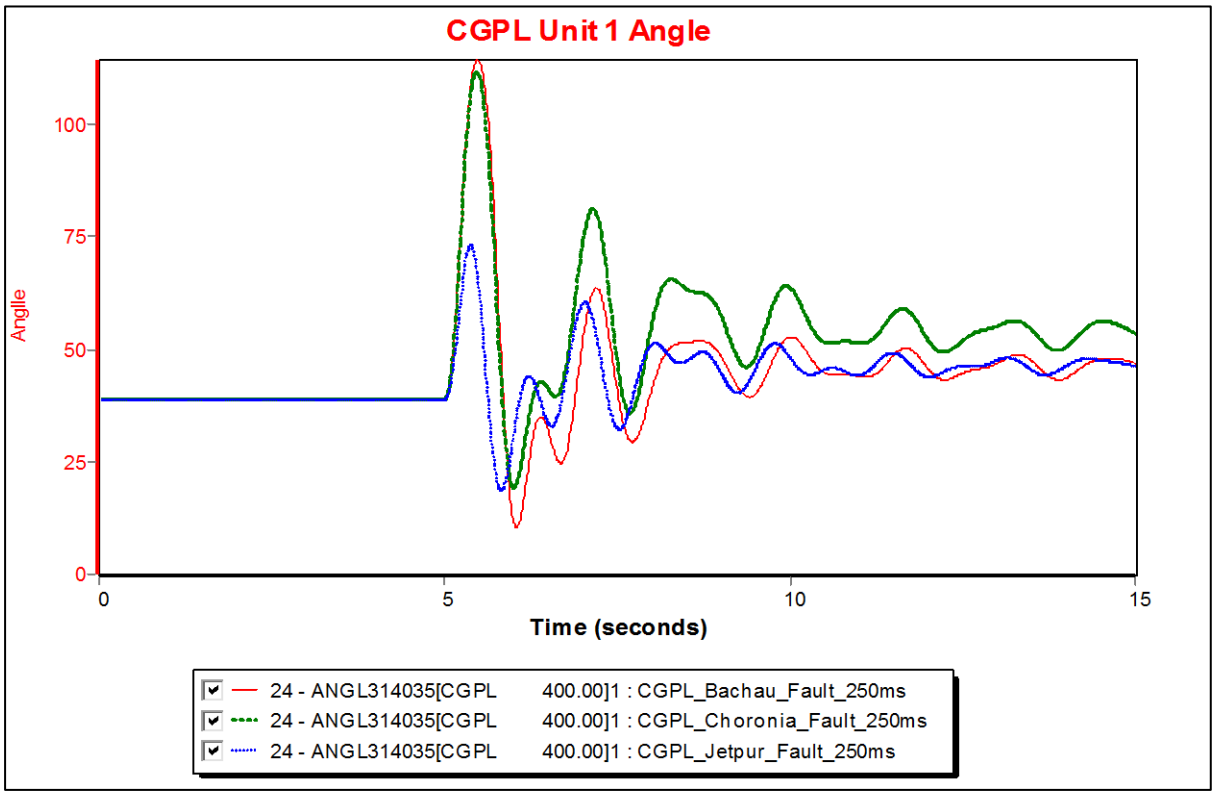


Figure: CGPL Unit 1 angle

Study report for Submission to the Expert Group on CGPL with Future Network and Full Generation

In order to study the impact of future network modification of network near CGPL complex along with full generation of CGPL, the base case was setup with 400 kV CGPL-Mansar (Halwad) and CGPL-Choronia LILO at Bhachau substation along with Full generation at CGPL and APL complex.

After that an extensive study of N-1, N-1-1 and N-2 has been studied for the CGPL complex. Along with this, various N-1 case with different durations of faults has also been studied. So, a total of 45 case studies has been done and the summary of the case studies along with plots are given in the end of this report. The major observation from these case studies are found to be:

1. System is stable for N-1, N-1-1 and N-2 combination of line tripping without any fault.
2. System is also stable for N-1 cases for 100 ms duration 3 phase fault.
3. System is not stable for a N-1 case with a three phase fault of more than 150 ms duration at CGPL/Bhachau substation.
4. System is stable for N-1 and N-1-1 of 400 kV Bhachau-Versana D/C however swings are large. This may be due to the reason that these lines tripping increases the electrical distances between CGPL and APL generating complex to a large extent.

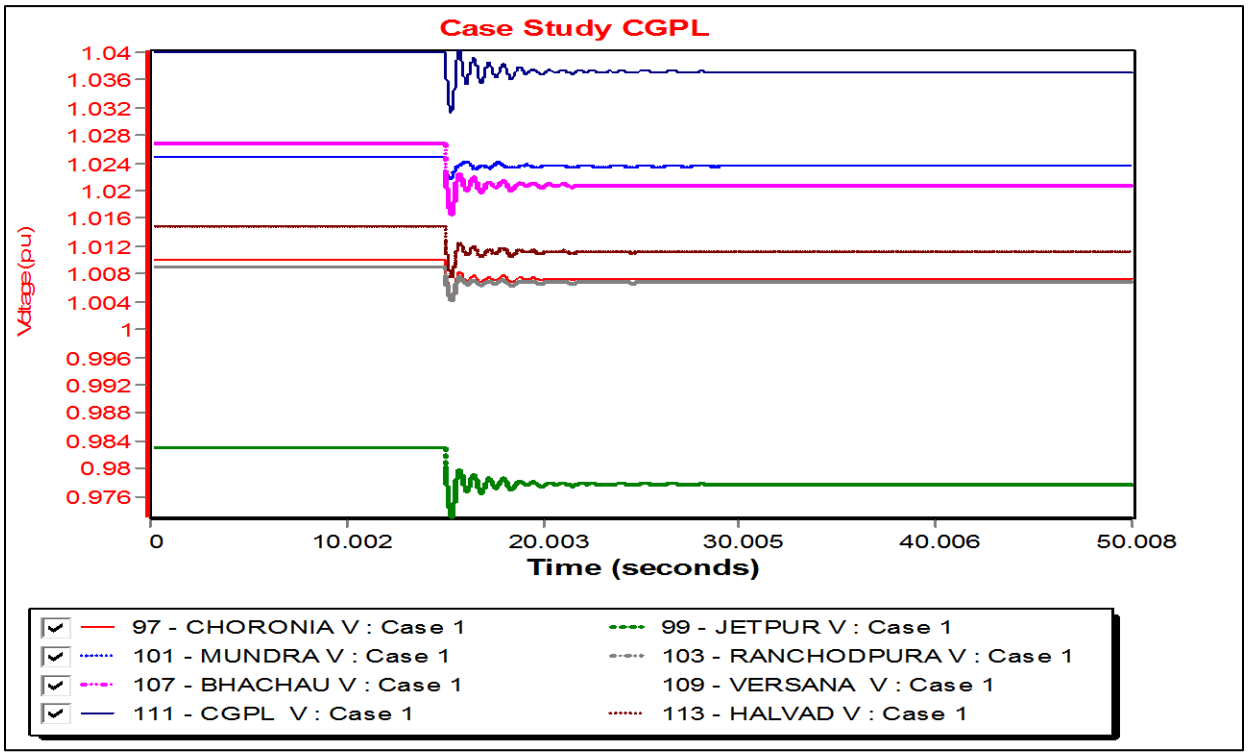
Table 1 : Summary of case studies

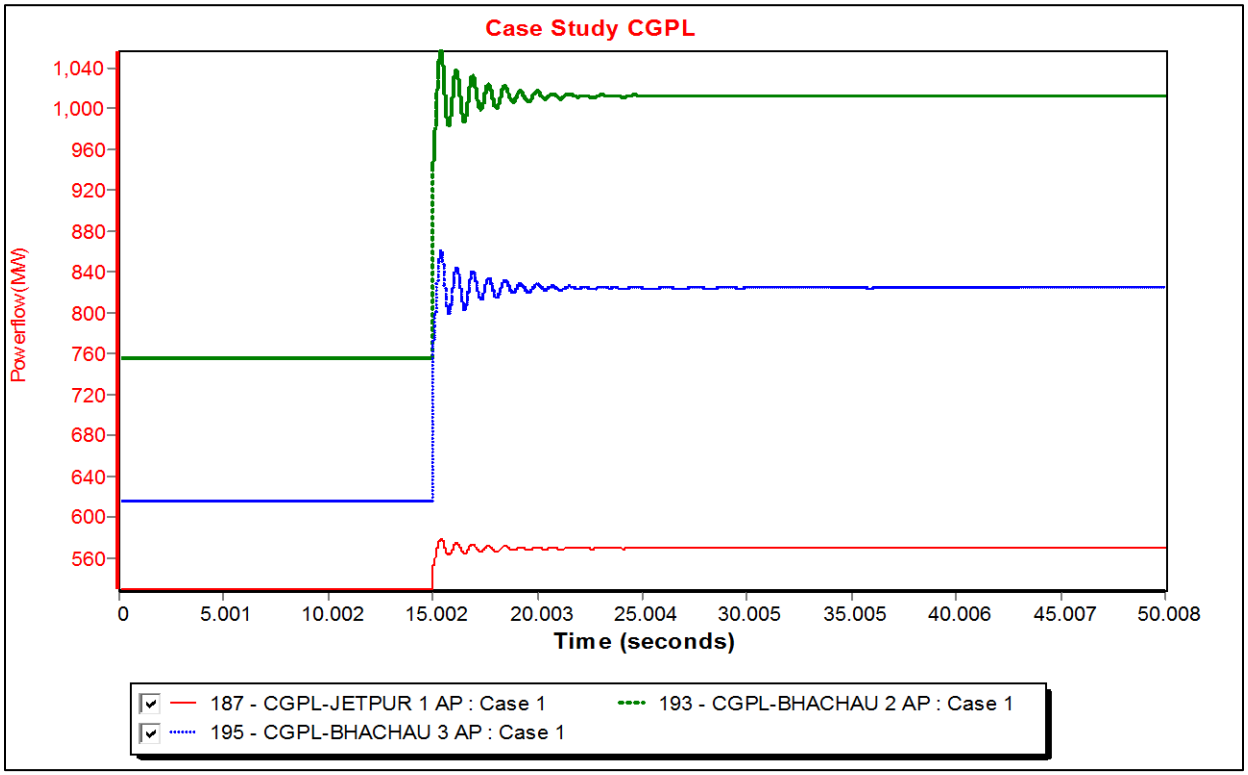
Case Study	Name	Result
Case 1	N-1 of CGPL-Bhachau 1	Stable
Case 2	N-1 of CGPL-Bhachau 3	Stable
Case 3	N-1 of CGPL-Jetpur 1	Stable
Case 4	N-1 of Bhachau-Ranchodpura 1	Stable
Case 5	Case 1 + N-1-1 of CGPL Bhachau 2 (After 5 second)	Stable
Case 6	Case 1 + N-2 of CGPL-Bhachau 2	Stable
Case 7	Case 1 + N-1-1 of CGPL-Jetpur 1 (After 5 second)	Stable
Case 8	Case 1 + N-2 of CGPL-Jetpur 1	Stable
Case 9	Case 3 + N-1-1 of CGPL-Jetpur 2 (After 5 second)	Stable
Case 10	Case 3 + N-2 of CGPL-Jetpur 2	Stable
Case 11	N-1 of Bhachau-Ranchodpura 1 + N-1 -1 of Bhachau-Ranchodpura 2 (After 5 second)	Stable
Case 12	N-1 of Bhachau-Ranchodpura 1 + N-1 -1 of Bhachau-Versana 1 (After 5 second)	Stable
Case 13	N-1 of Bhachau-Ranchodpura 1 + N-1 -1 of Bhachau-Choronia (After 5 second)	Stable
Case 14	N-1 of Bhachau-Choronia 1 + N-1 -1 of Bhachau-Halwad (After 5 second)	Stable
Case 15	N-1 of Bhachau-Versana 1 + N-1 -1 of Bhachau-Versana 2 (After 5 second)	Stable
Case 16	N-1 of Bhachau-Ranchodpura 1 + N-2 of Bhachau-Ranchodpura 2	Stable
Case 17	N-1 of Bhachau-Versana 1 + N-2 of Bhachau-Versana 2	Stable
Case 18	N-1 of Bhachau-Choronia 1 + N-2 of Bhachau-Halwad	Stable
Fault 1	N-1 of CGPL-Bhachau 1 with 100 ms Fault at CGPL	Stable
Fault 2	N-1 of CGPL-Bhachau 1 with 100 ms Fault at Bhachau	Stable
Fault 3	N-1 of CGPL-Jetpur 1 with 100 ms Fault at CGPL	Stable
Fault 4	N-1 of CGPL-Bhachau 1 with 150 ms Fault at CGPL	Stable
Fault 5	N-1 of CGPL-Bhachau 1 with 200 ms Fault at CGPL	Unstable
Fault 6	N-1 of CGPL-Jetpur 1 with 150 ms Fault at CGPL	Stable
Fault 7	N-1 of CGPL-Jetpur 1 with 200 ms Fault at CGPL	Unstable
Fault 8	N-1 of CGPL-Bhachau 1 with 200 ms Fault at Bhachau	Unstable
Fault 9	N-1 of CGPL-Bhachau 1 with 150 ms Fault at Bhachau	Stable
Fault 10	N-1 of CGPL-Jetpur 1 with 150 ms Fault at Jetpur	Stable
Fault 11	N-1 of CGPL-Jetpur 1 with 200 ms Fault at Jetpur	Stable
Fault 12	N-1 of CGPL-Jetpur 1 with 250 ms Fault at Jetpur	Stable
Fault 13	N-1 of CGPL-Jetpur 1 with 300 ms Fault at Jetpur	Stable
Fault 14	N-1 of CGPL-Jetpur 1 with 400 ms Fault at Jetpur	Stable
Fault 15	N-1 of CGPL-Jetpur 1 with 500 ms Fault at Jetpur	Stable
Fault 16	N-1 of CGPL-Jetpur 1 with 600 ms Fault at Jetpur	Stable

Fault 17	N-1 of CGPL-Jetpur 1 with 800 ms Fault at Jetpur	Stable
Fault 18	N-1 of CGPL-Jetpur 1 with 1000 ms Fault at Jetpur	Stable
Fault 19	N-1 of CGPL-Jetpur 1 with 1500 ms Fault at Jetpur	Unstable
Fault 20	N-1 of Bhachau-Ranchodpura 1 with 100 ms Fault at Bhachau end	Stable
Fault 21	N-1 of Bhachau-Ranchodpura 1 with 200 ms Fault at Bhachau end	Unstable
Fault 22	N-1 of Bhachau-Halvad with 100 ms Fault at Bhachau end	Stable
Fault 23	N-1 of Bhachau-Halvad with 200 ms Fault at Bhachau end	Unstable
Fault 24	N-1 of Bhachau-Choronia with 100 ms Fault at Bhachau end	Stable
Fault 25	N-1 of Bhachau-Choronia with 200 ms Fault at Bhachau end	Unstable
Fault 26	N-1 of Bhachau-Versana 1 with 100 ms Fault at Bhachau end	Stable
Fault 27	N-1 of Bhachau-Versana 1 with 200 ms Fault at Bhachau end	Unstable

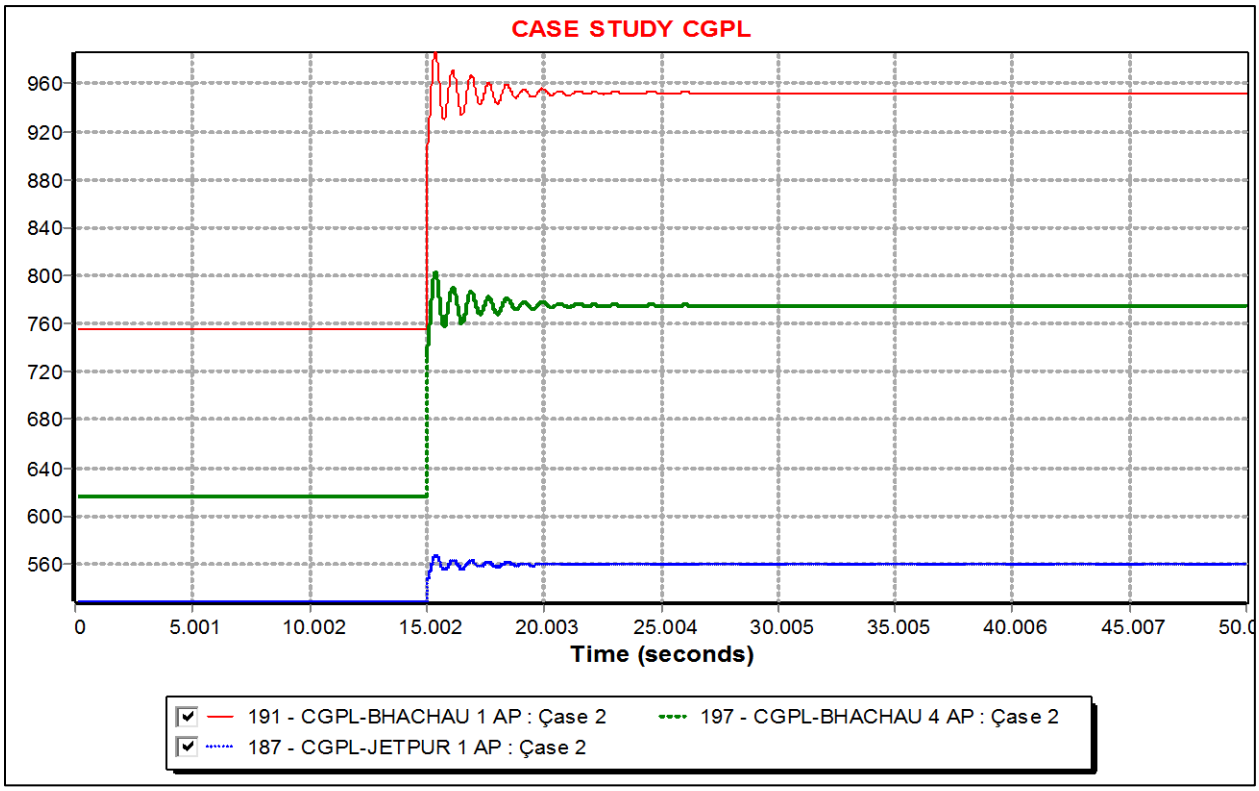
Simulation plots

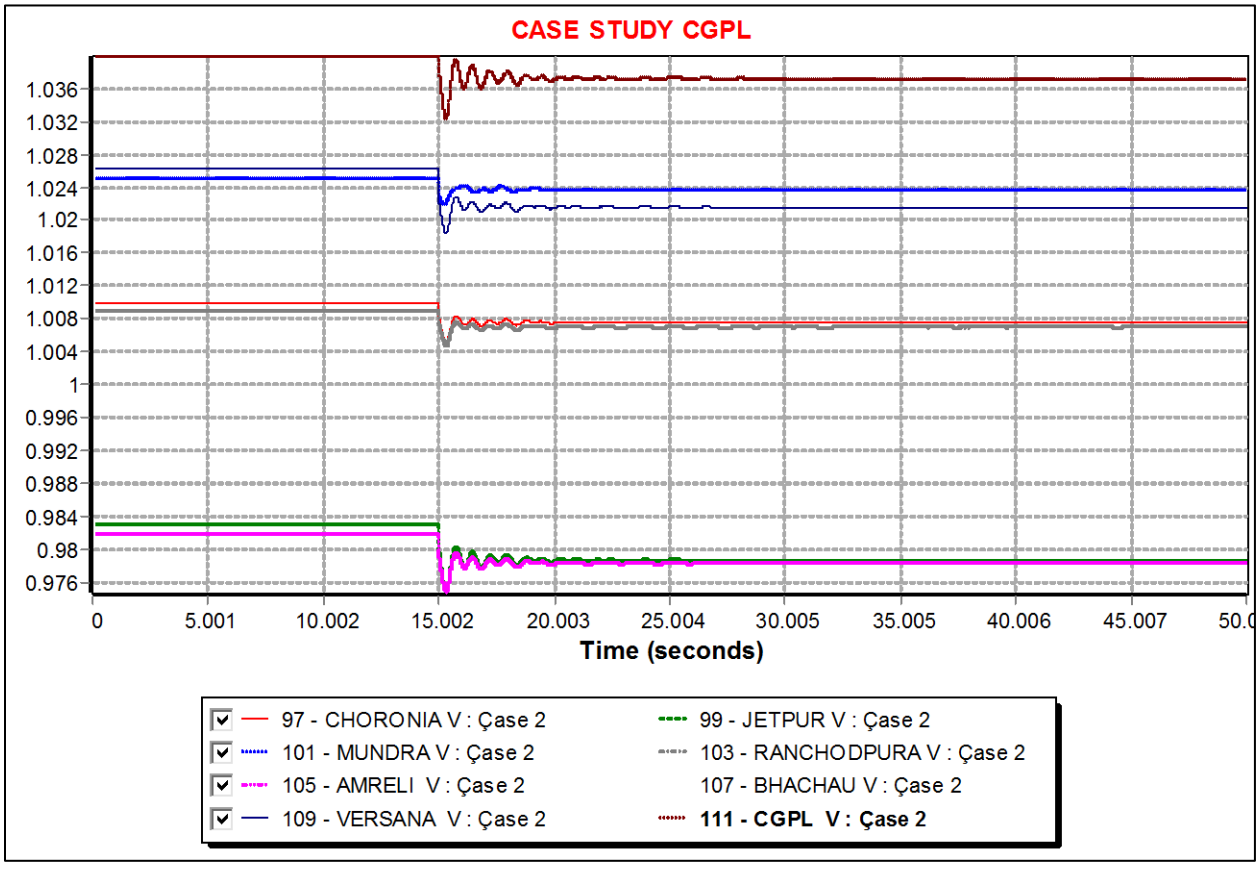
Case 1:



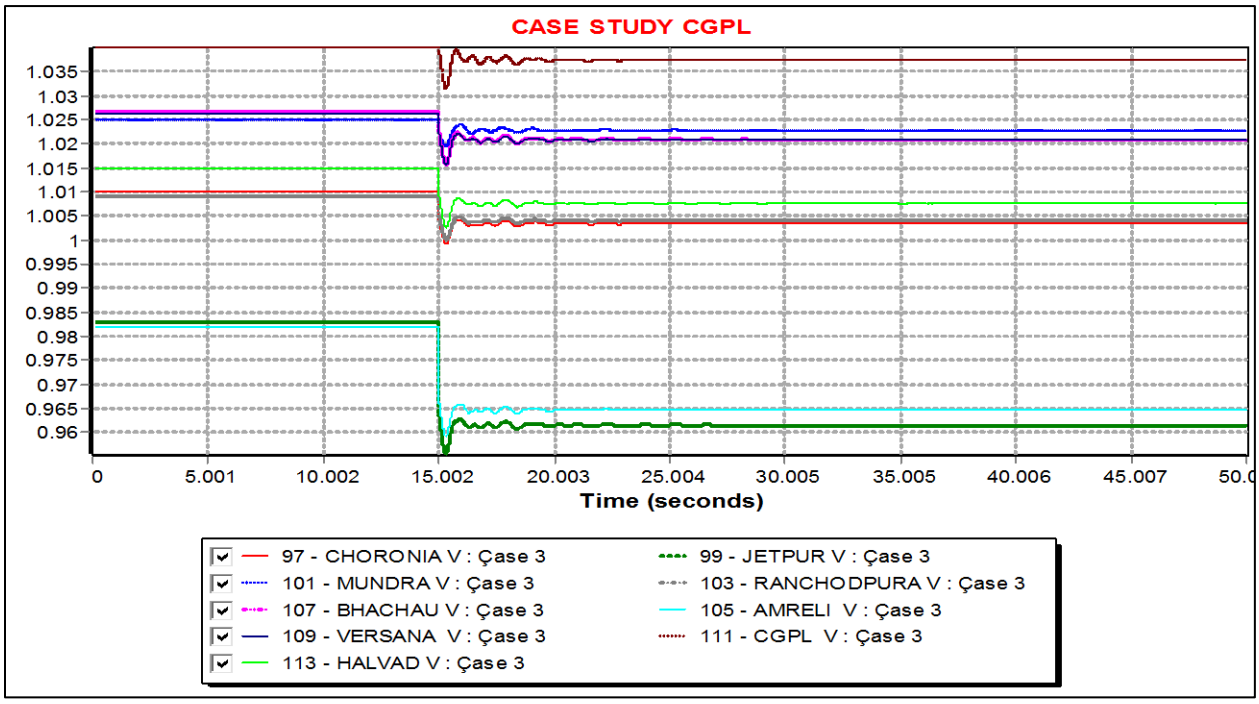


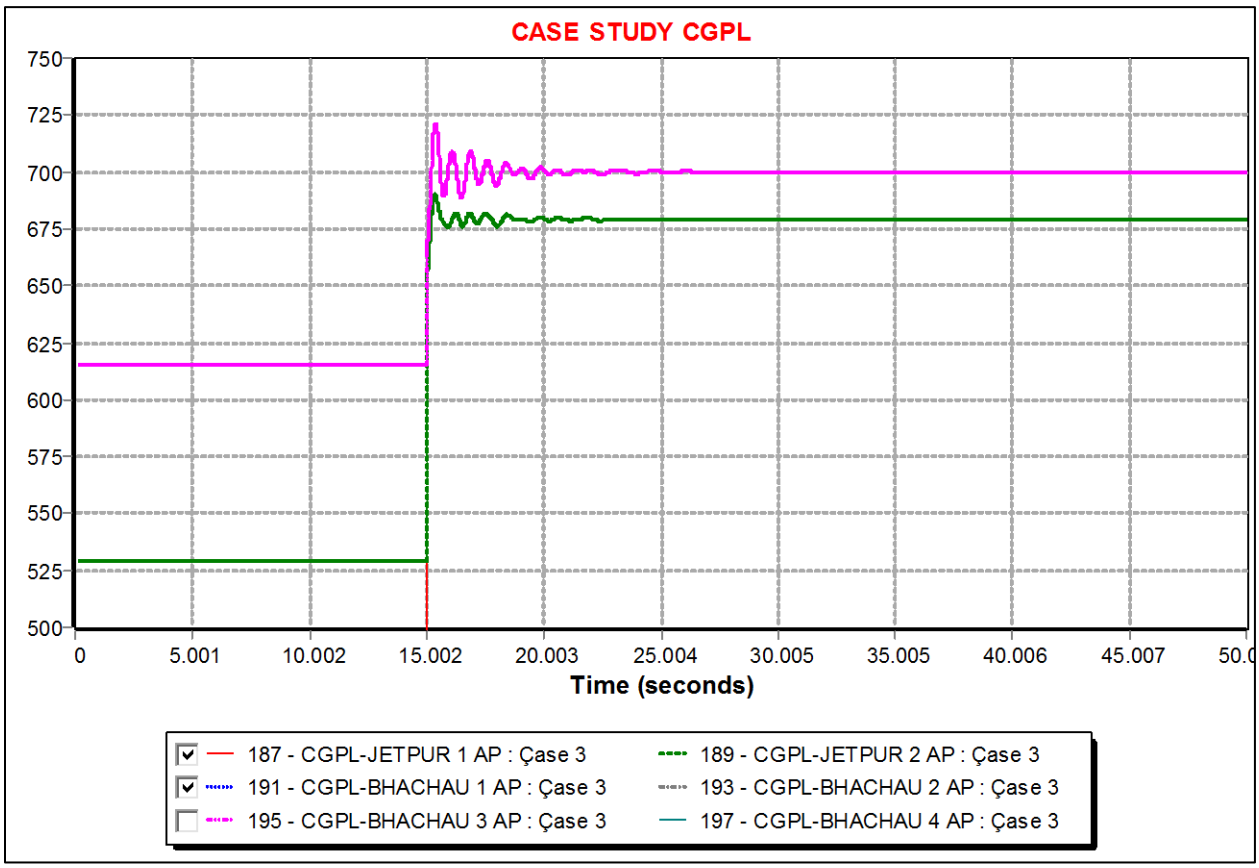
Case 2

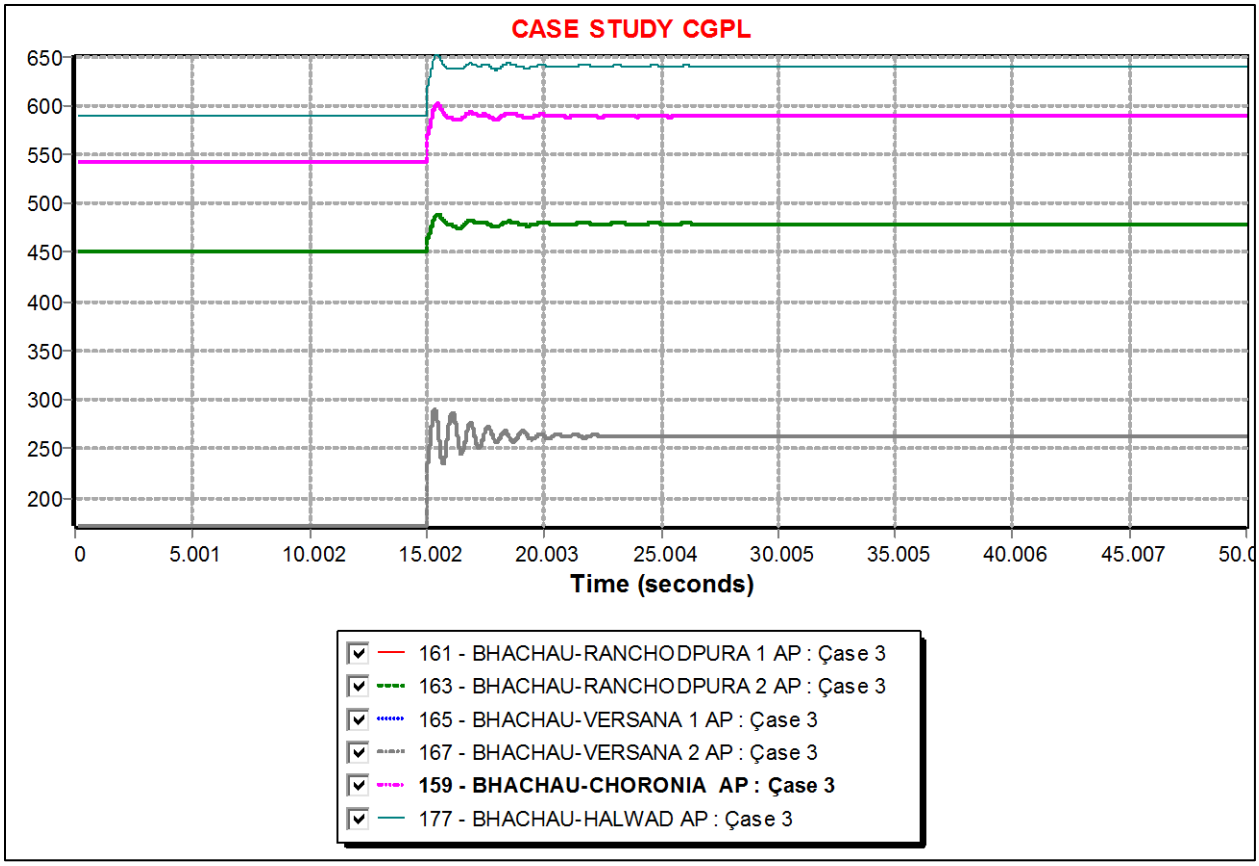

CASE STUDY CGPL
960
920
880
840
800
760
720
680
640
600
560
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
191 - CGPL-BHACHAU 1 AP : Case 2
187 - CGPL-JETPUR 1 AP : Case 2
197 - CGPL-BHACHAU 4 AP : Case 2


CASE STUDY CGPL
1.036
1.032
1.028
1.024
1.02
1.016
1.012
1.008
1.004
1
0.996
0.992
0.988
0.984
0.98
0.976
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 2
101 - MUNDRA V : Case 2
105 - AMRELI V : Case 2
109 - VERSANA V : Case 2
99 - JETPUR V : Case 2
103 - RANCHODPURA V : Case 2
107 - BHACHAU V : Case 2
111 - CGPL V : Case 2

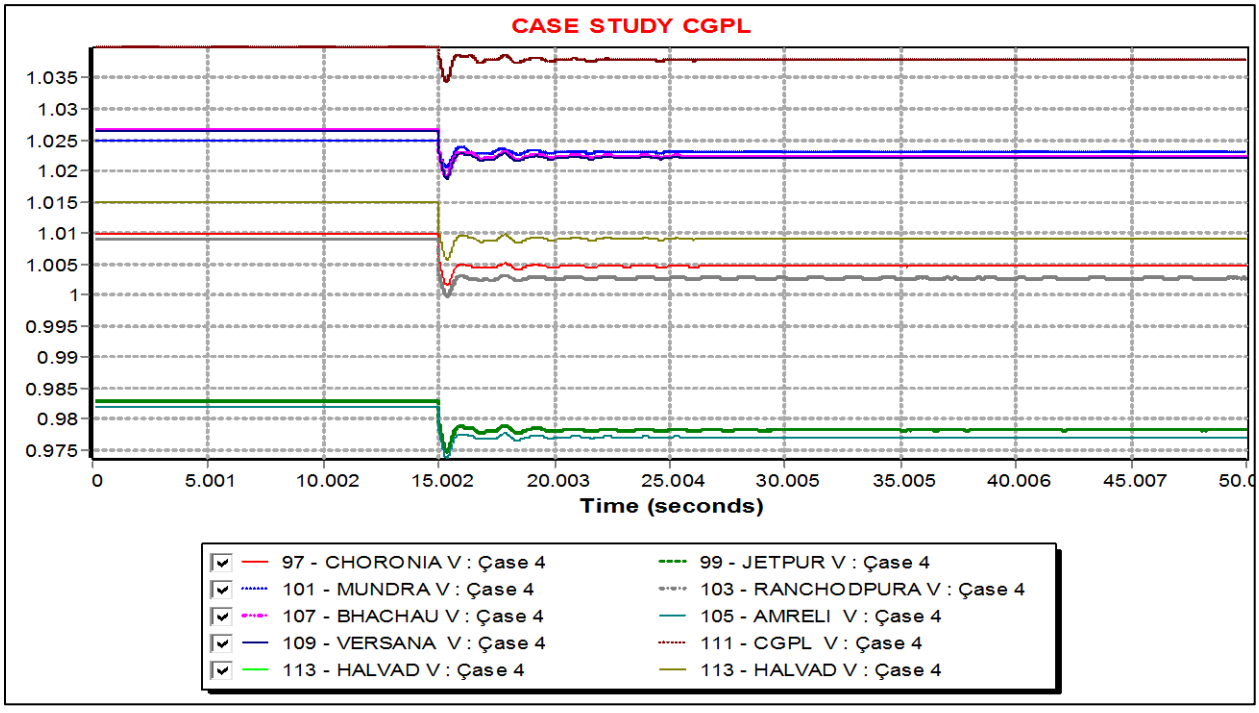
Case 3:

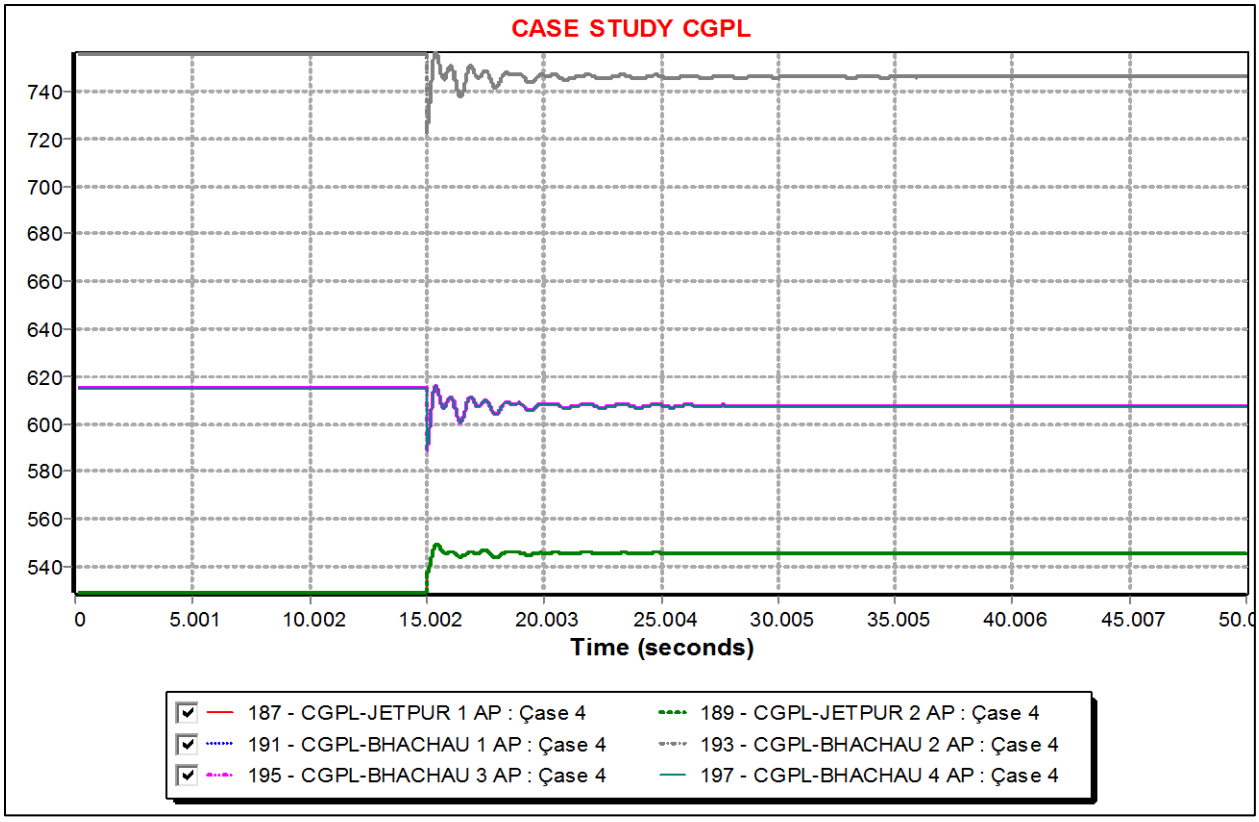

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 3
101 - MUNDRA V : Çase 3
107 - BHACHAU V : Çase 3
109 - VERSANA V : Çase 3
113 - HALVAD V : Çase 3
99 - JETPUR V : Çase 3
103 - RANCHODPURA V : Çase 3
105 - AMRELI V : Çase 3
111 - CGPL V : Çase 3

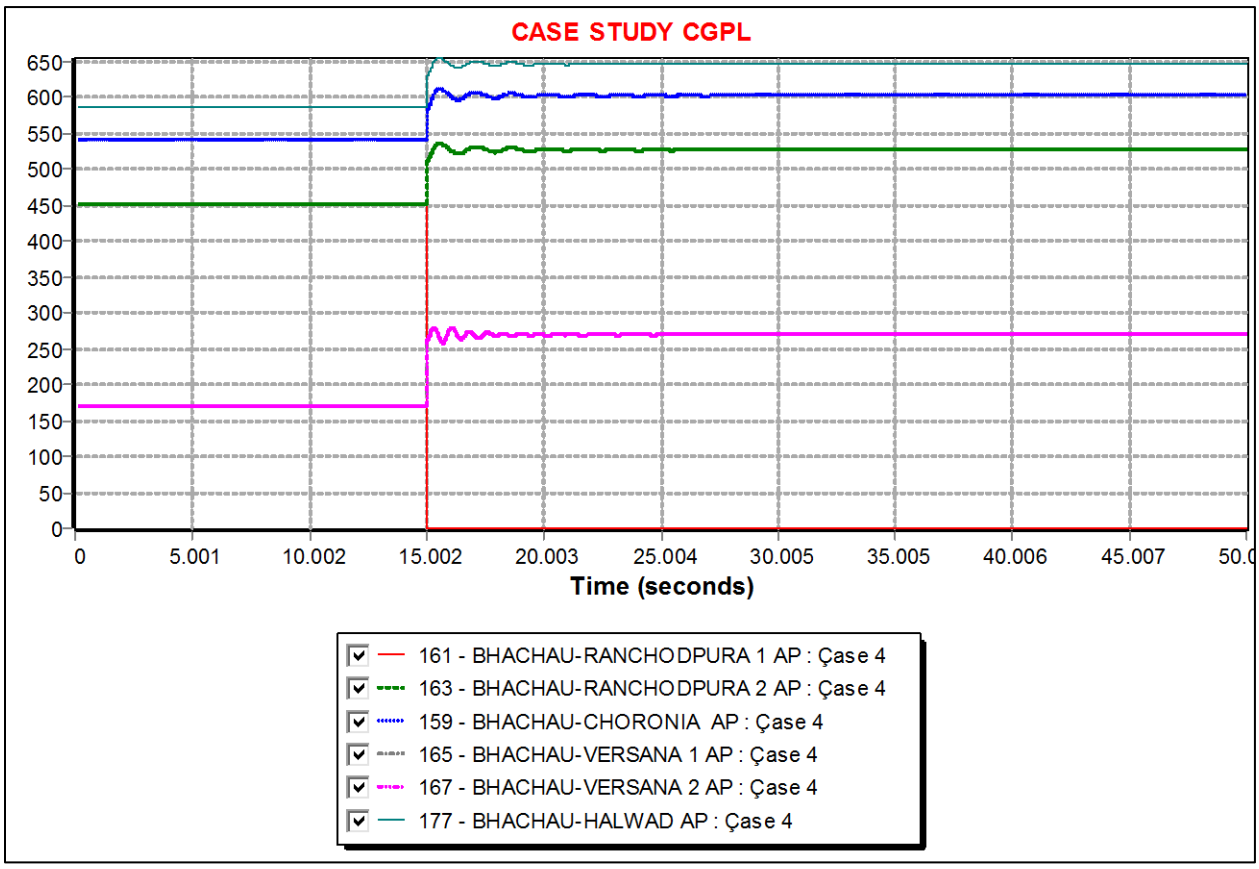

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
525
500
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 3
191 - CGPL-BHACHAU 1 AP : Çase 3
195 - CGPL-BHACHAU 3 AP : Çase 3
189 - CGPL-JETPUR 2 AP : Çase 3
193 - CGPL-BHACHAU 2 AP : Çase 3
197 - CGPL-BHACHAU 4 AP : Çase 3


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 3
163 - BHACHAU-RANCHODPURA 2 AP : Çase 3
165 - BHACHAU-VERSANA 1 AP : Çase 3
167 - BHACHAU-VERSANA 2 AP : Çase 3
159 - BHACHAU-CHORONIA AP : Çase 3
177 - BHACHAU-HALWAD AP : Çase 3

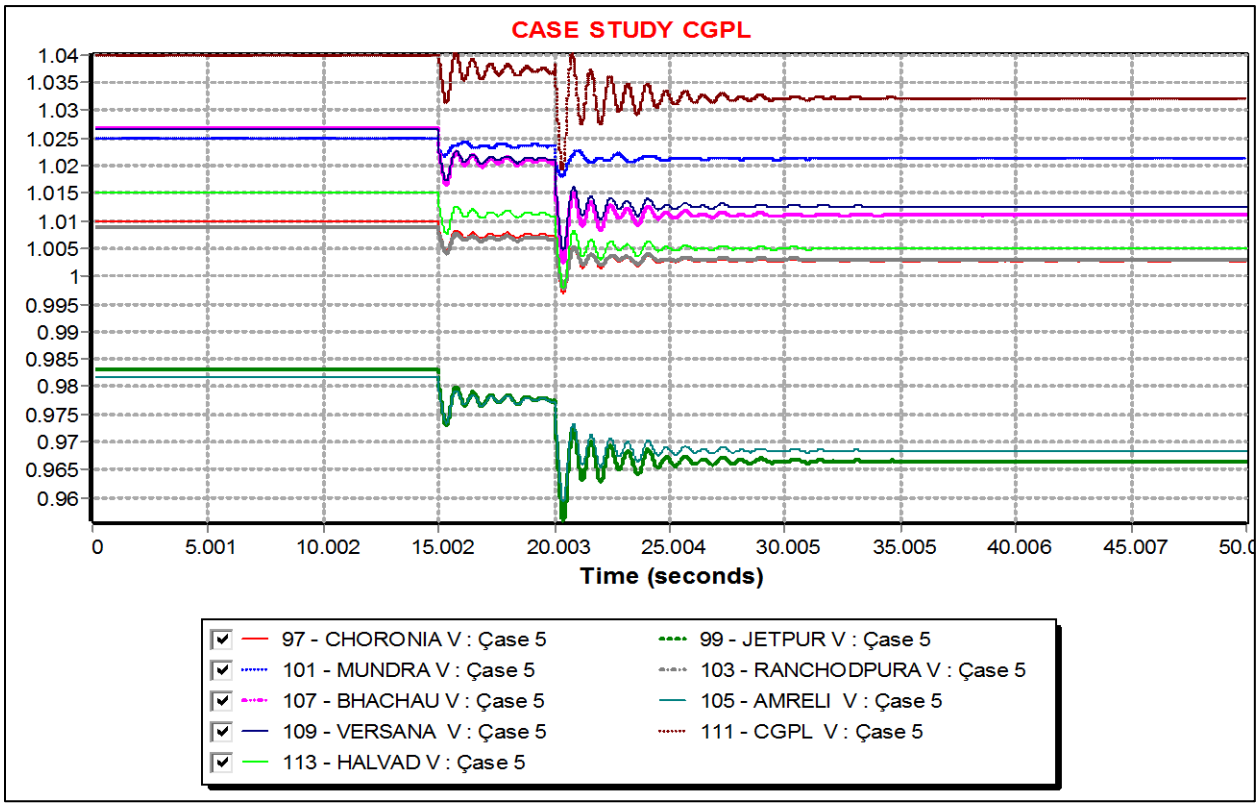
Case 4:

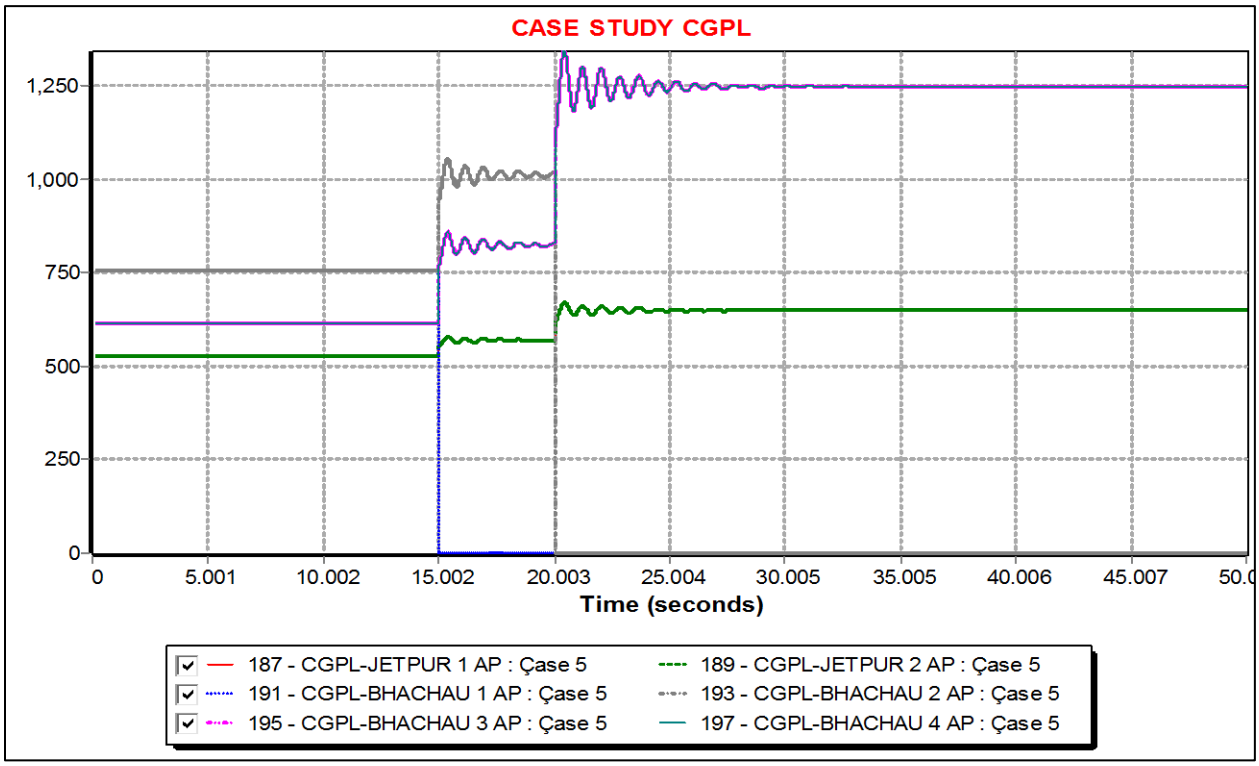

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 4
101 - MUNDRA V : Çase 4
107 - BHACHAU V : Çase 4
109 - VERSANA V : Çase 4
113 - HALVAD V : Çase 4
99 - JETPUR V : Çase 4
103 - RANCHODPURA V : Çase 4
105 - AMRELI V : Çase 4
111 - CGPL V : Çase 4
113 - HALVAD V : Çase 4

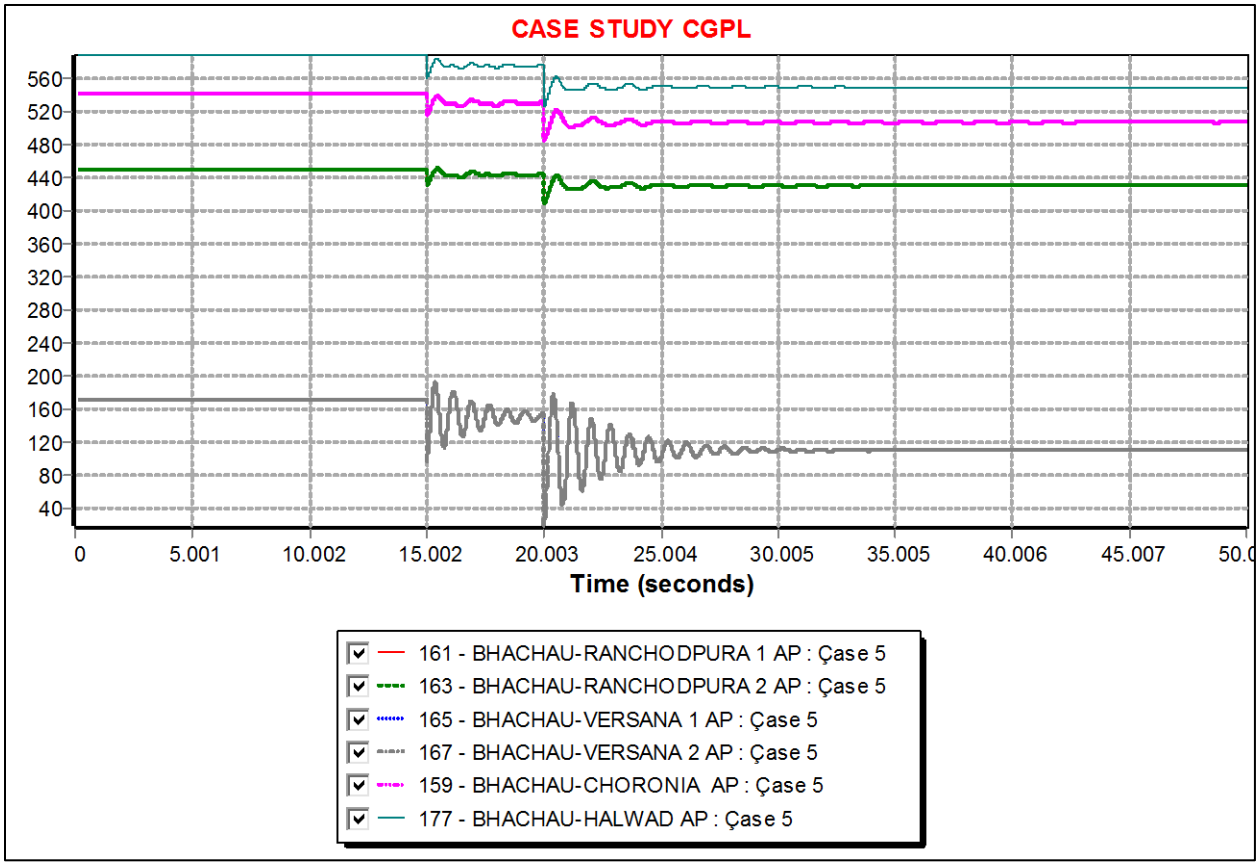

CASE STUDY CGPL
740
720
700
680
660
640
620
600
580
560
540
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 4
189 - CGPL-JETPUR 2 AP : Case 4
191 - CGPL-BHACHAU 1 AP : Case 4
193 - CGPL-BHACHAU 2 AP : Case 4
195 - CGPL-BHACHAU 3 AP : Case 4
197 - CGPL-BHACHAU 4 AP : Case 4


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 4
163 - BHACHAU-RANCHODPURA 2 AP : Case 4
159 - BHACHAU-CHORONIA AP : Case 4
165 - BHACHAU-VERSANA 1 AP : Case 4
167 - BHACHAU-VERSANA 2 AP : Case 4
177 - BHACHAU-HALWAD AP : Case 4

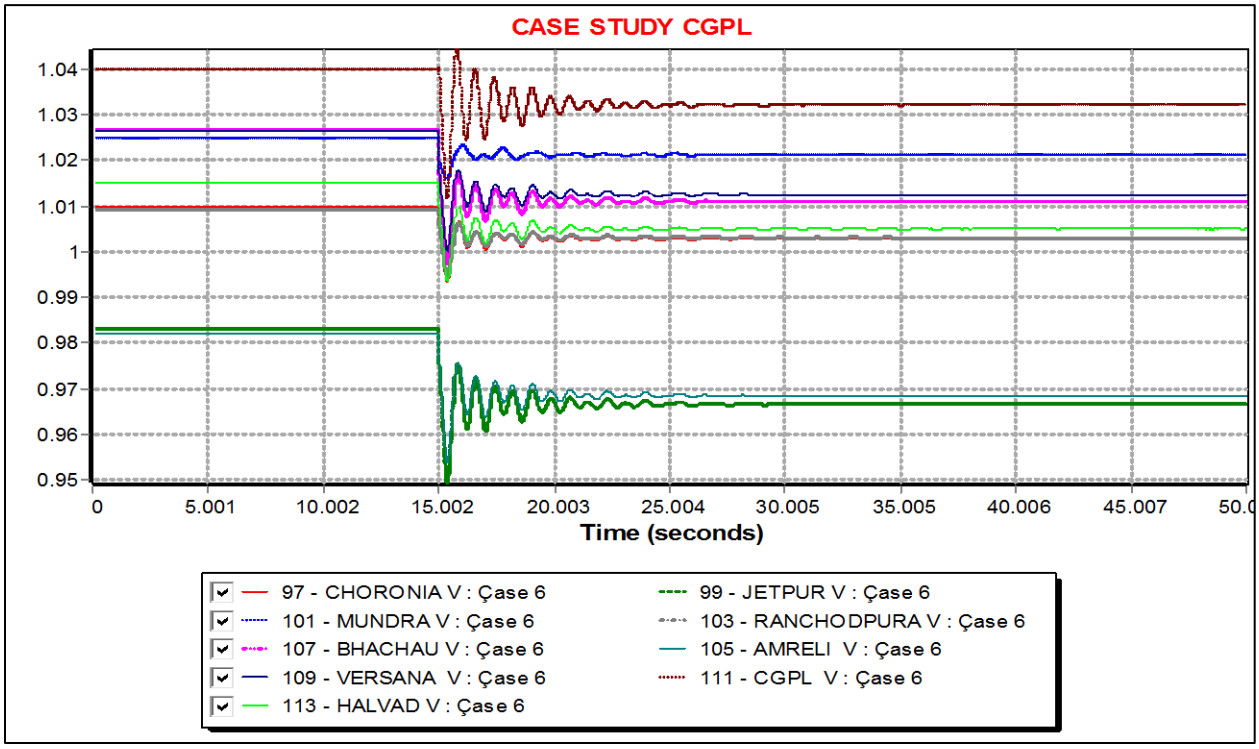
Case 5:

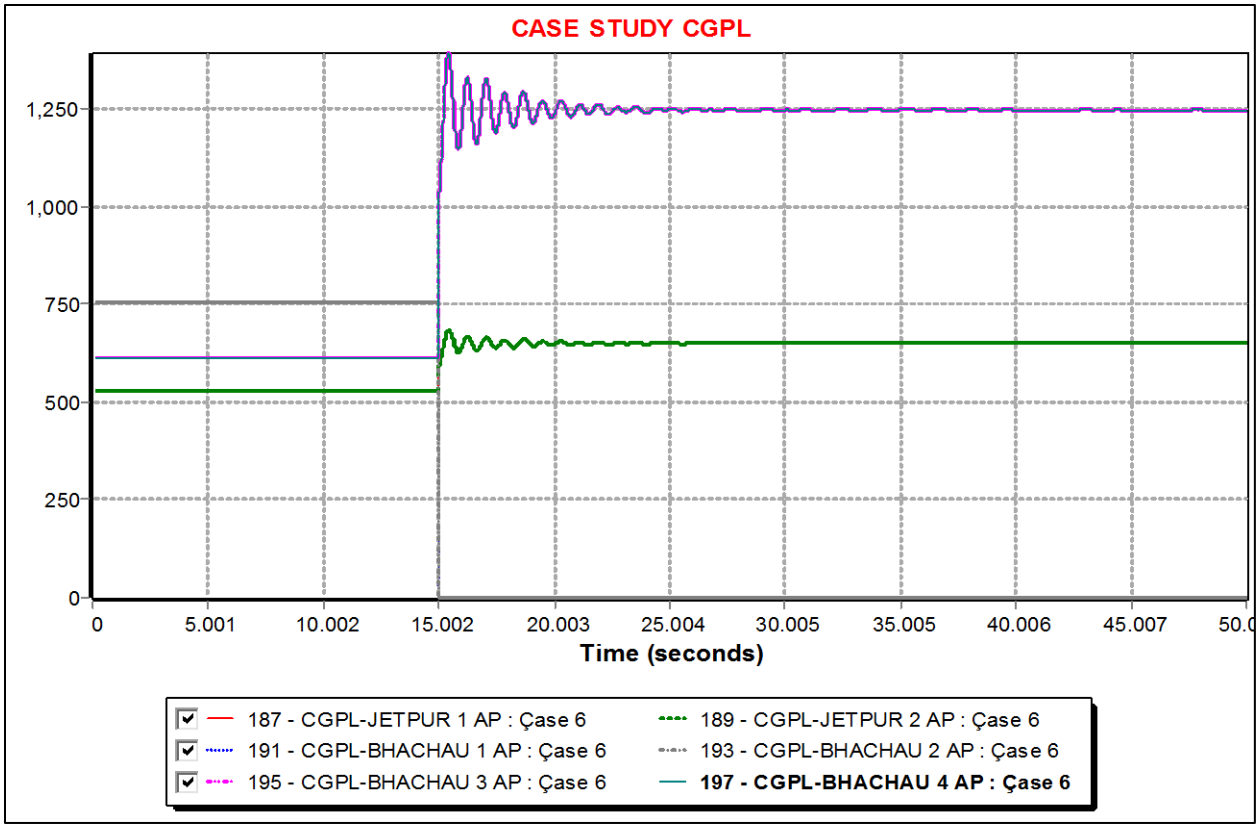

CASE STUDY CGPL
1.04
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 5
101 - MUNDRA V : Çase 5
107 - BHACHAU V : Çase 5
109 - VERSANA V : Çase 5
113 - HALVAD V : Çase 5
99 - JETPUR V : Çase 5
103 - RANCHODPURA V : Çase 5
105 - AMRELI V : Çase 5
111 - CGPL V : Çase 5

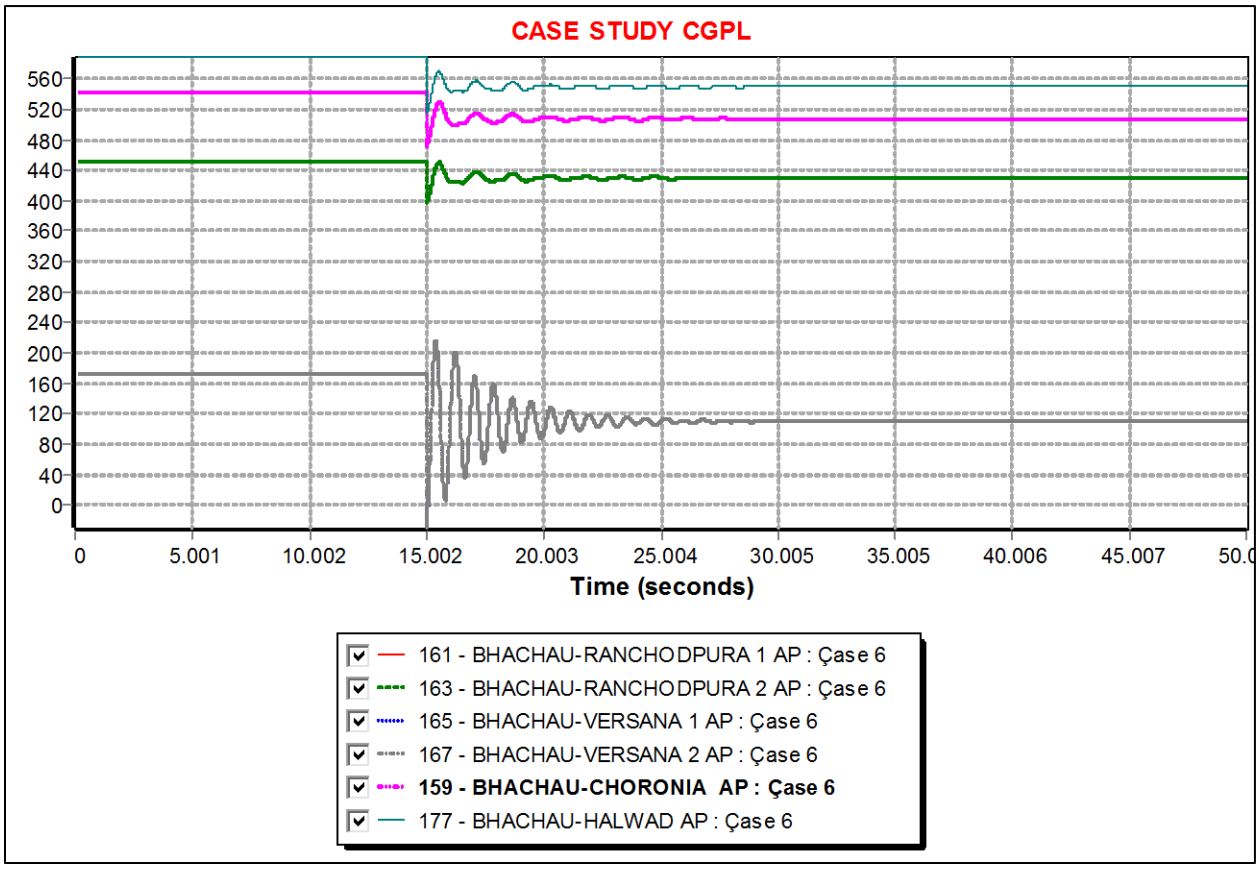

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 5
191 - CGPL-BHACHAU 1 AP : Çase 5
195 - CGPL-BHACHAU 3 AP : Çase 5
189 - CGPL-JETPUR 2 AP : Çase 5
193 - CGPL-BHACHAU 2 AP : Çase 5
197 - CGPL-BHACHAU 4 AP : Çase 5


CASE STUDY CGPL
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 5
163 - BHACHAU-RANCHODPURA 2 AP : Case 5
165 - BHACHAU-VERSANA 1 AP : Case 5
167 - BHACHAU-VERSANA 2 AP : Case 5
159 - BHACHAU-CHORONIA AP : Case 5
177 - BHACHAU-HALWAD AP : Case 5

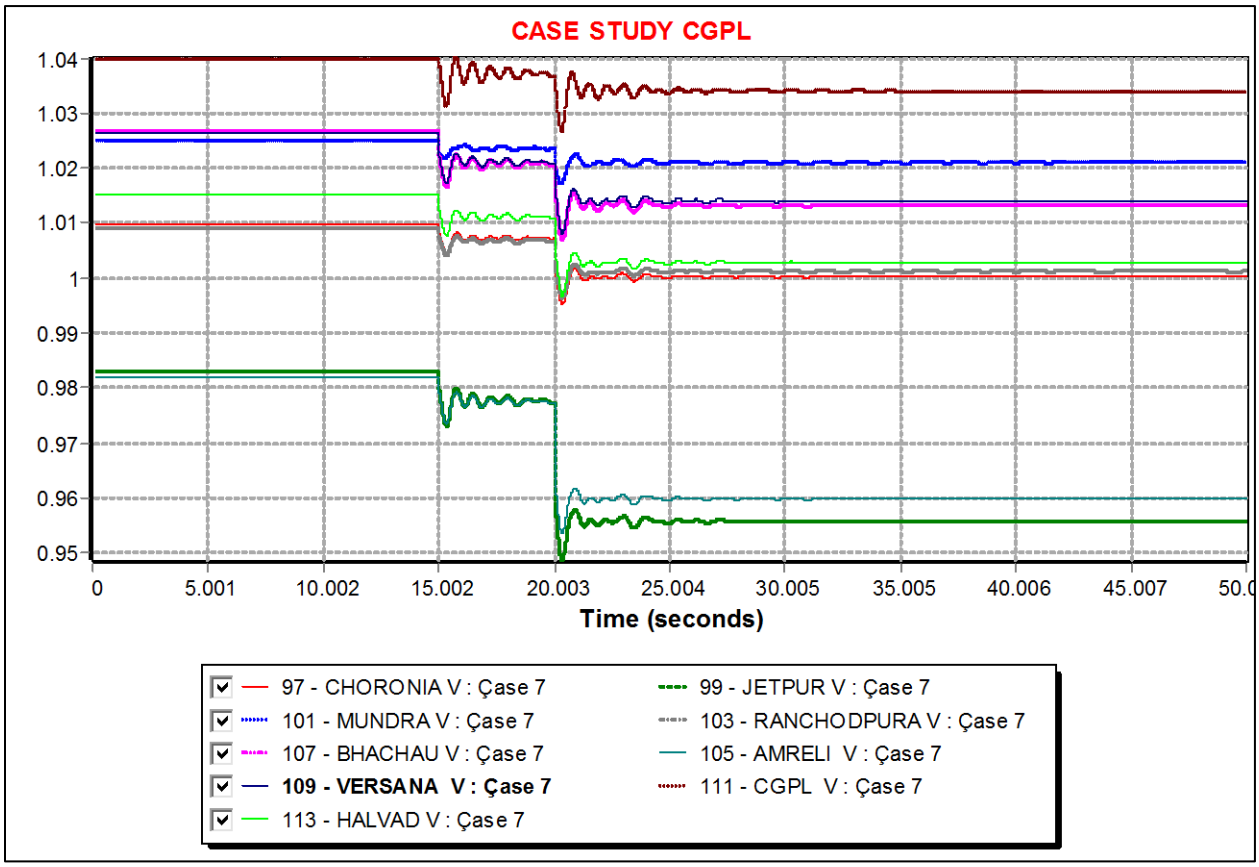
Case 6 :

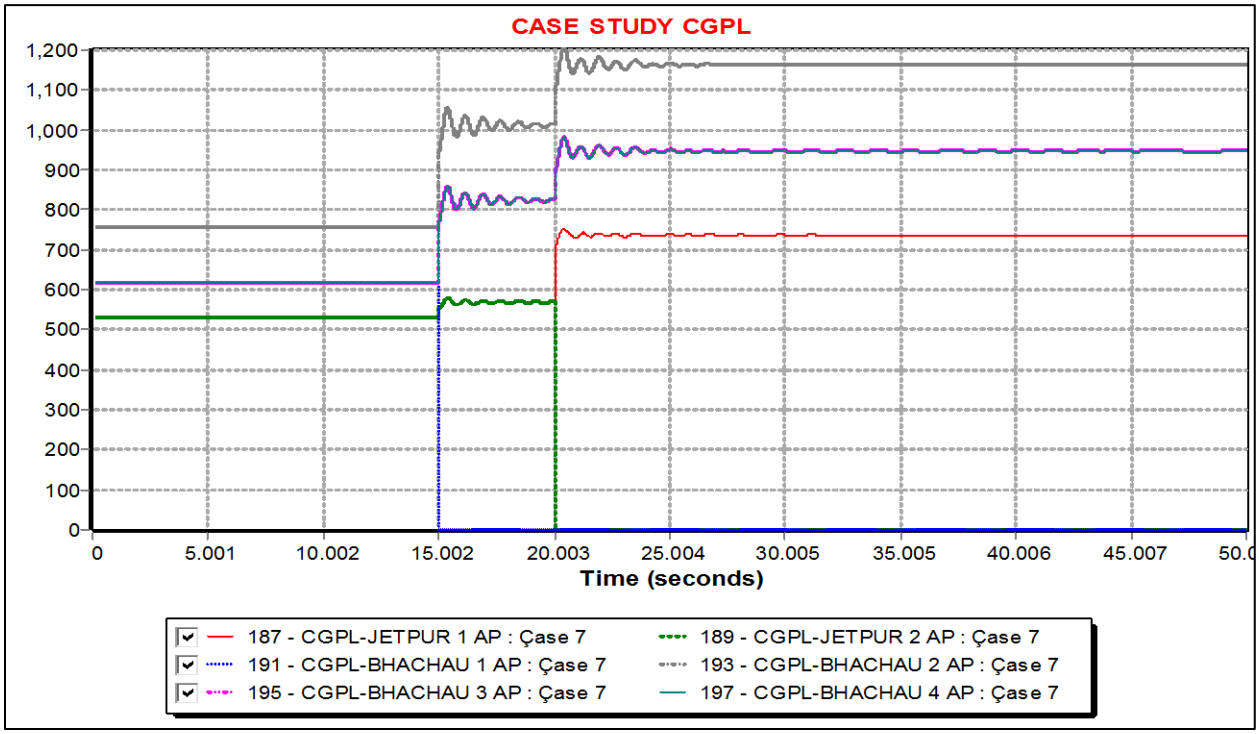

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 6
101 - MUNDRA V : Case 6
107 - BHACHAU V : Case 6
109 - VERSANA V : Case 6
113 - HALVAD V : Case 6
99 - JETPUR V : Case 6
103 - RANCHODPURA V : Case 6
105 - AMRELI V : Case 6
111 - CGPL V : Case 6

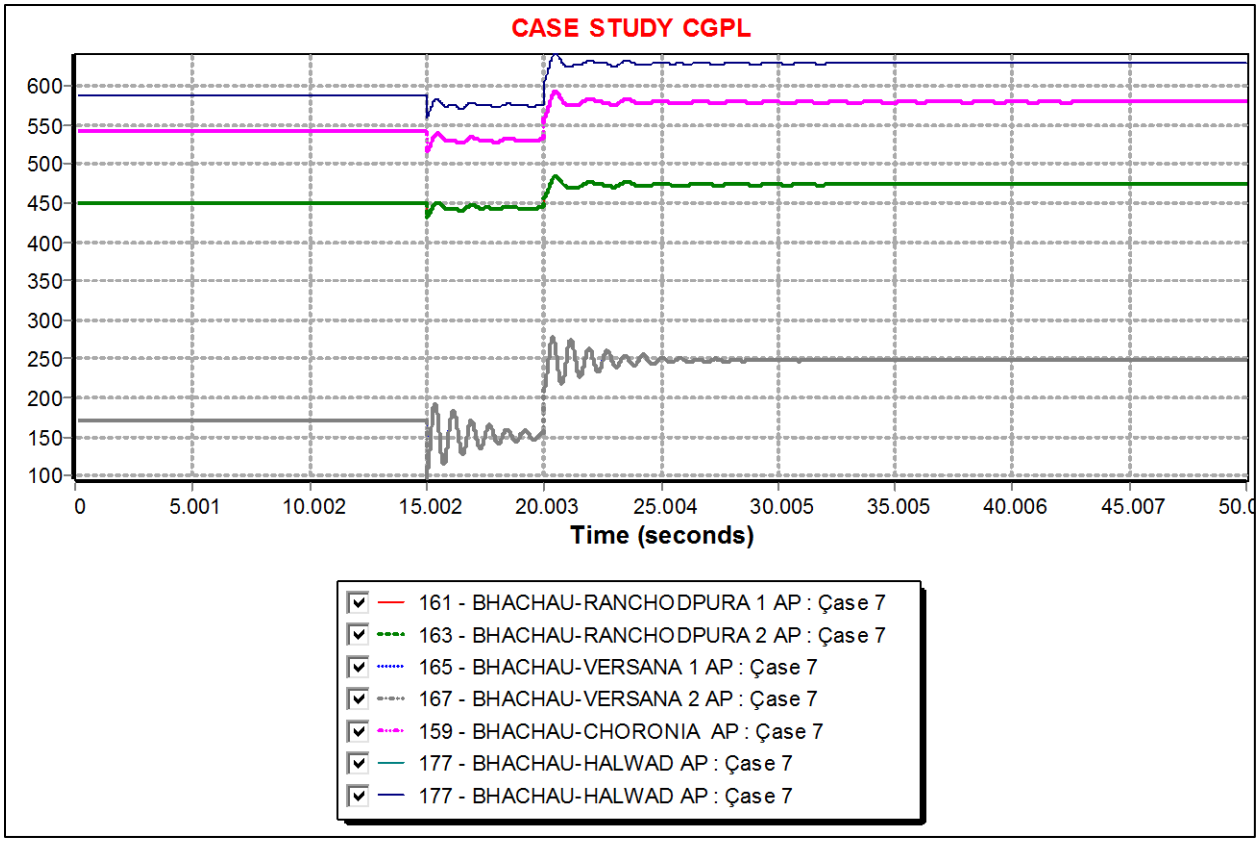

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 6
189 - CGPL-JETPUR 2 AP : Case 6
191 - CGPL-BHACHAU 1 AP : Case 6
193 - CGPL-BHACHAU 2 AP : Case 6
195 - CGPL-BHACHAU 3 AP : Case 6
197 - CGPL-BHACHAU 4 AP : Case 6


CASE STUDY CGPL
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 6
163 - BHACHAU-RANCHODPURA 2 AP : Case 6
165 - BHACHAU-VERSANA 1 AP : Case 6
167 - BHACHAU-VERSANA 2 AP : Case 6
159 - BHACHAU-CHORONIA AP : Case 6
177 - BHACHAU-HALWAD AP : Case 6

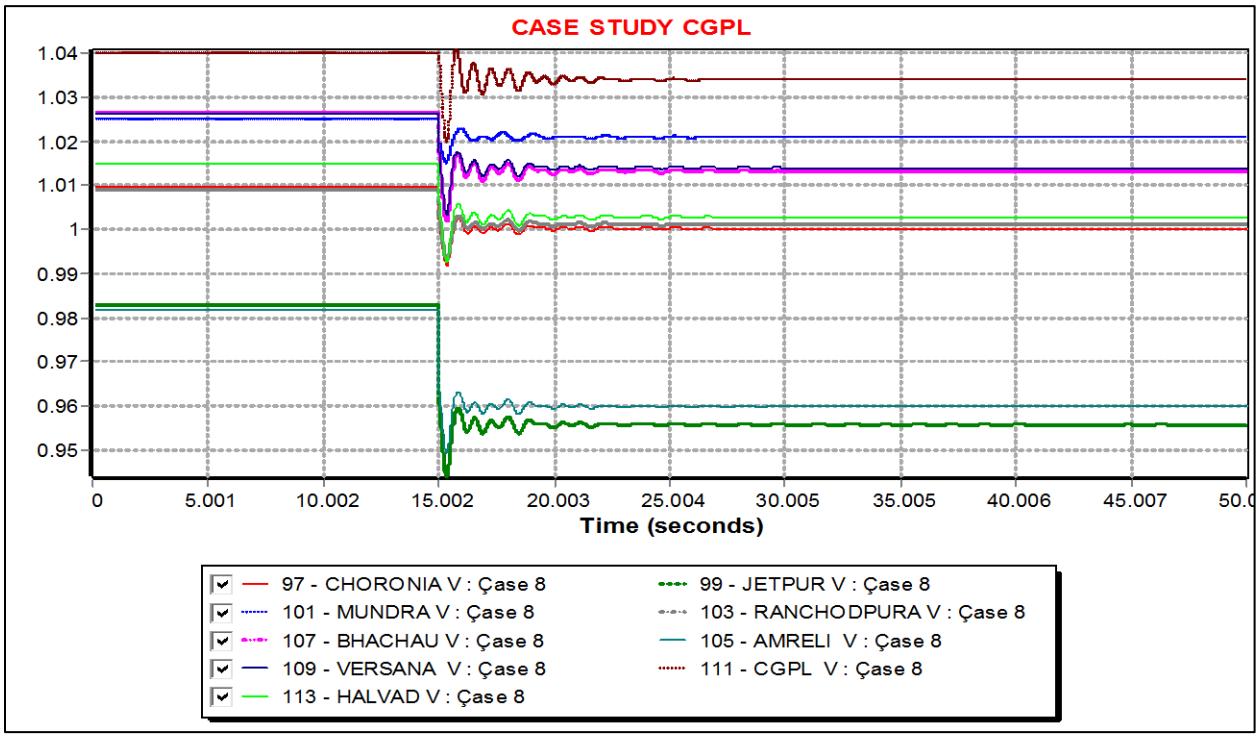
Case 7:

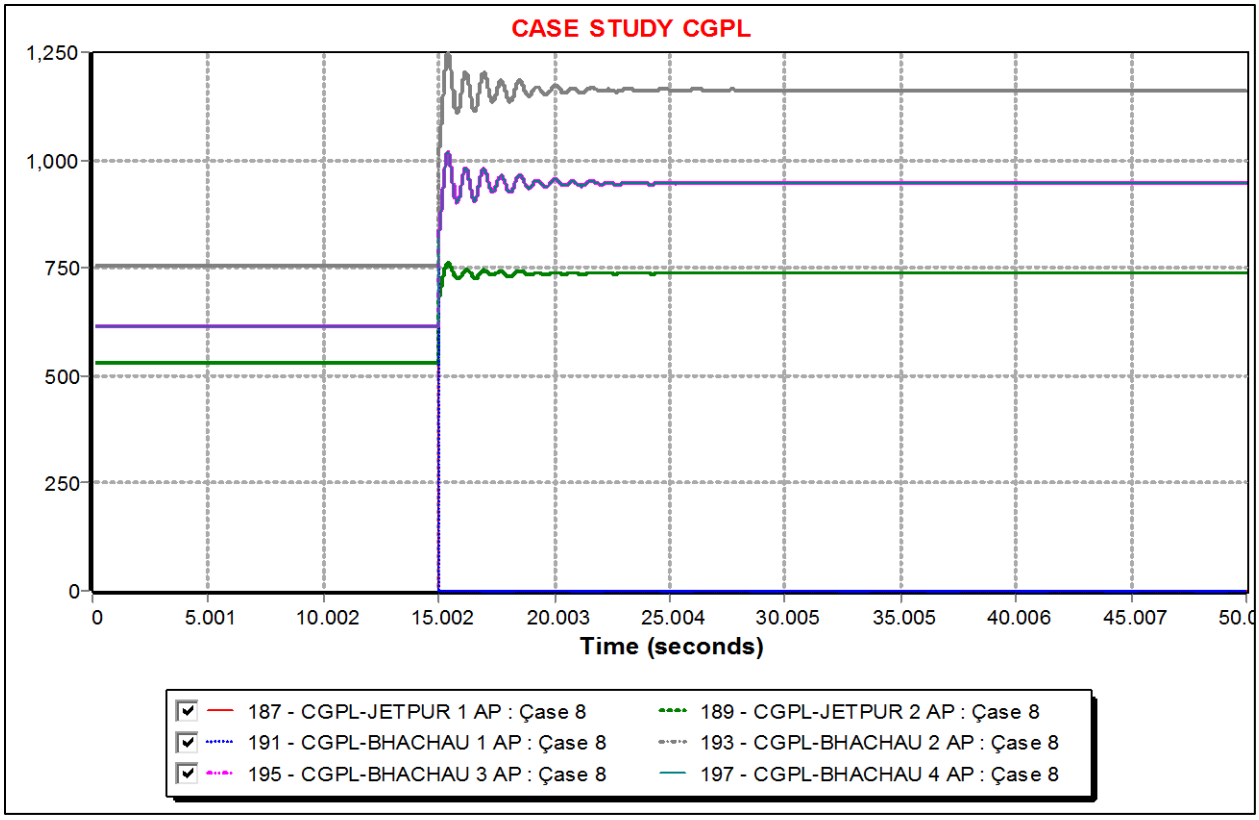

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 7
99 - JETPUR V : Case 7
101 - MUNDRA V : Case 7
103 - RANCHODPURA V : Case 7
107 - BHACHAU V : Case 7
105 - AMRELI V : Case 7
109 - VERSANA V : Case 7
111 - CGPL V : Case 7
113 - HALVAD V : Case 7

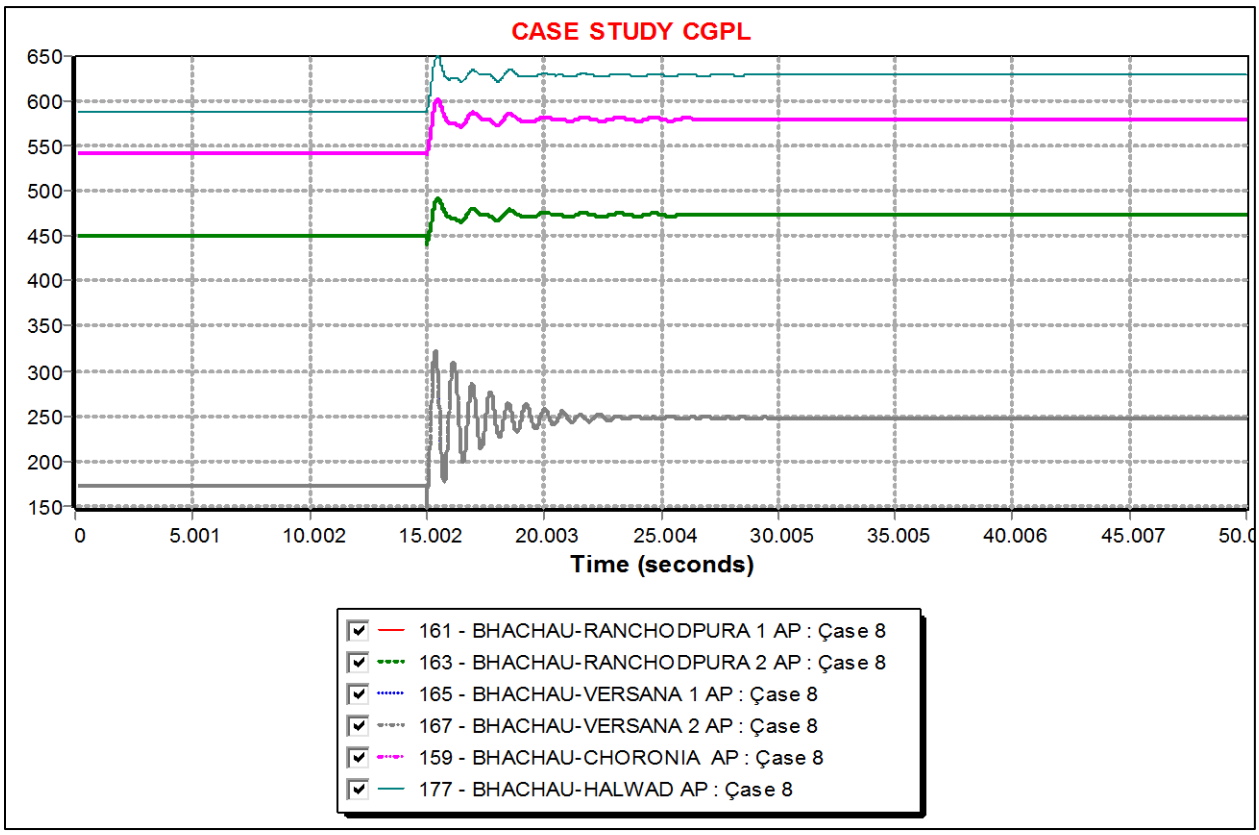

CASE STUDY CGPL
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 7
189 - CGPL-JETPUR 2 AP : Case 7
191 - CGPL-BHACHAU 1 AP : Case 7
193 - CGPL-BHACHAU 2 AP : Case 7
195 - CGPL-BHACHAU 3 AP : Case 7
197 - CGPL-BHACHAU 4 AP : Case 7


CASE STUDY CGPL
600
550
500
450
400
350
300
250
200
150
100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 7
163 - BHACHAU-RANCHODPURA 2 AP : Case 7
165 - BHACHAU-VERSANA 1 AP : Case 7
167 - BHACHAU-VERSANA 2 AP : Case 7
159 - BHACHAU-CHORONIA AP : Case 7
177 - BHACHAU-HALWAD AP : Case 7
177 - BHACHAU-HALWAD AP : Case 7

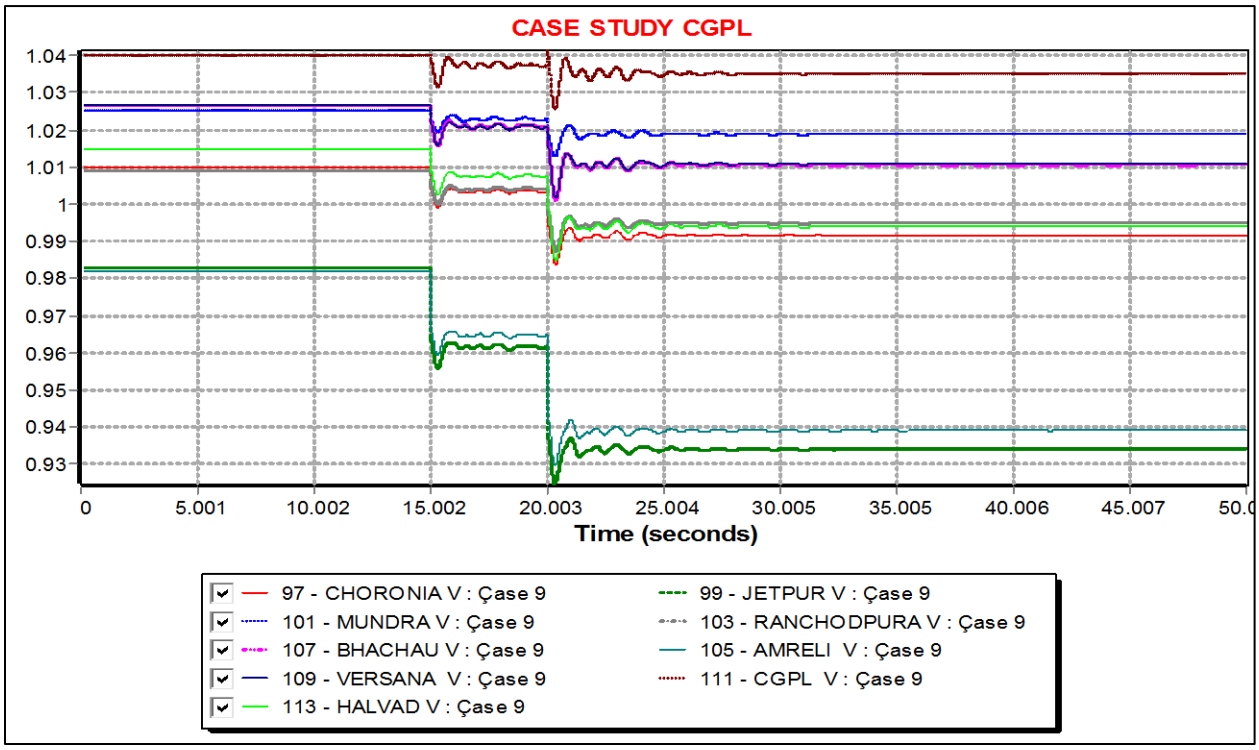
Case 8 :

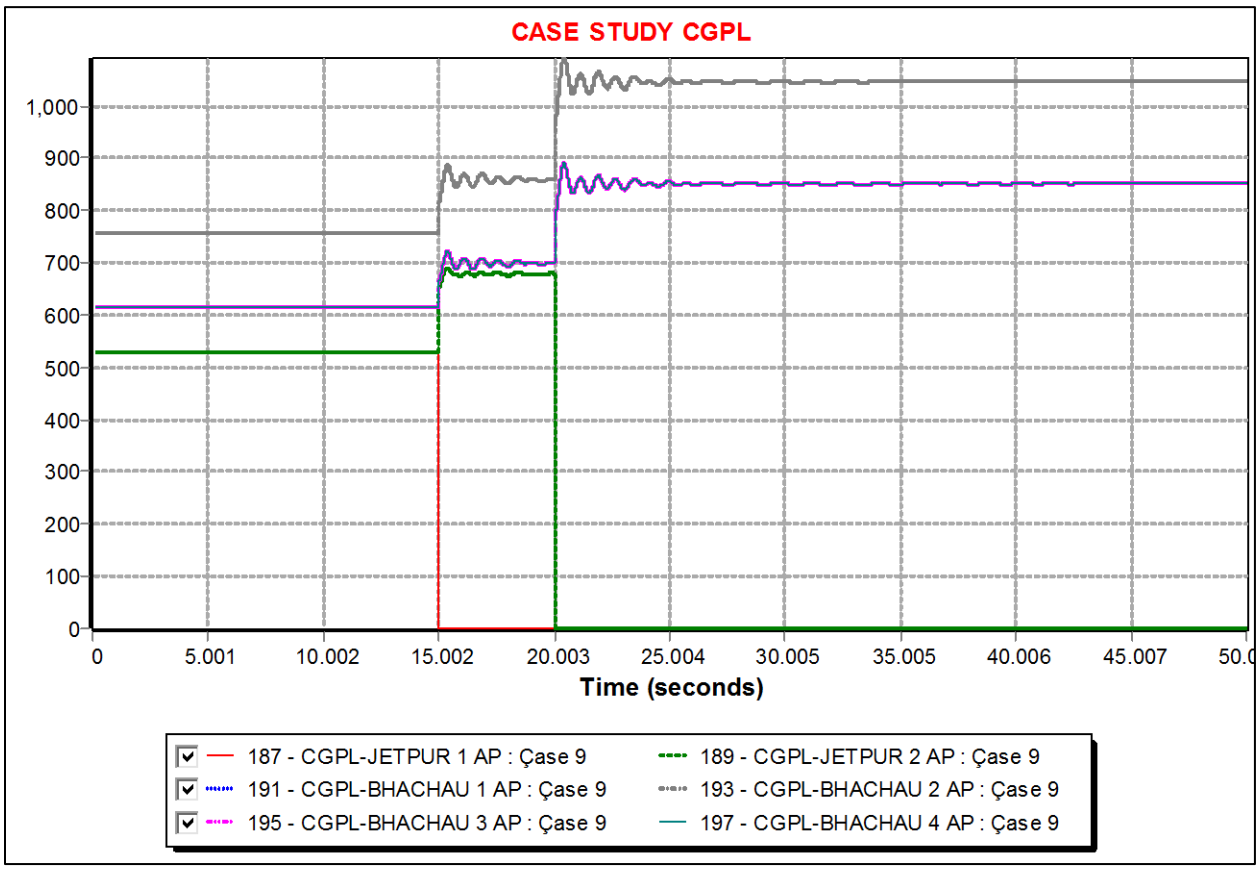

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 8
101 - MUNDRA V : Case 8
107 - BHACHAU V : Case 8
109 - VERSANA V : Case 8
113 - HALVAD V : Case 8
99 - JETPUR V : Case 8
103 - RANCHODPURA V : Case 8
105 - AMRELI V : Case 8
111 - CGPL V : Case 8

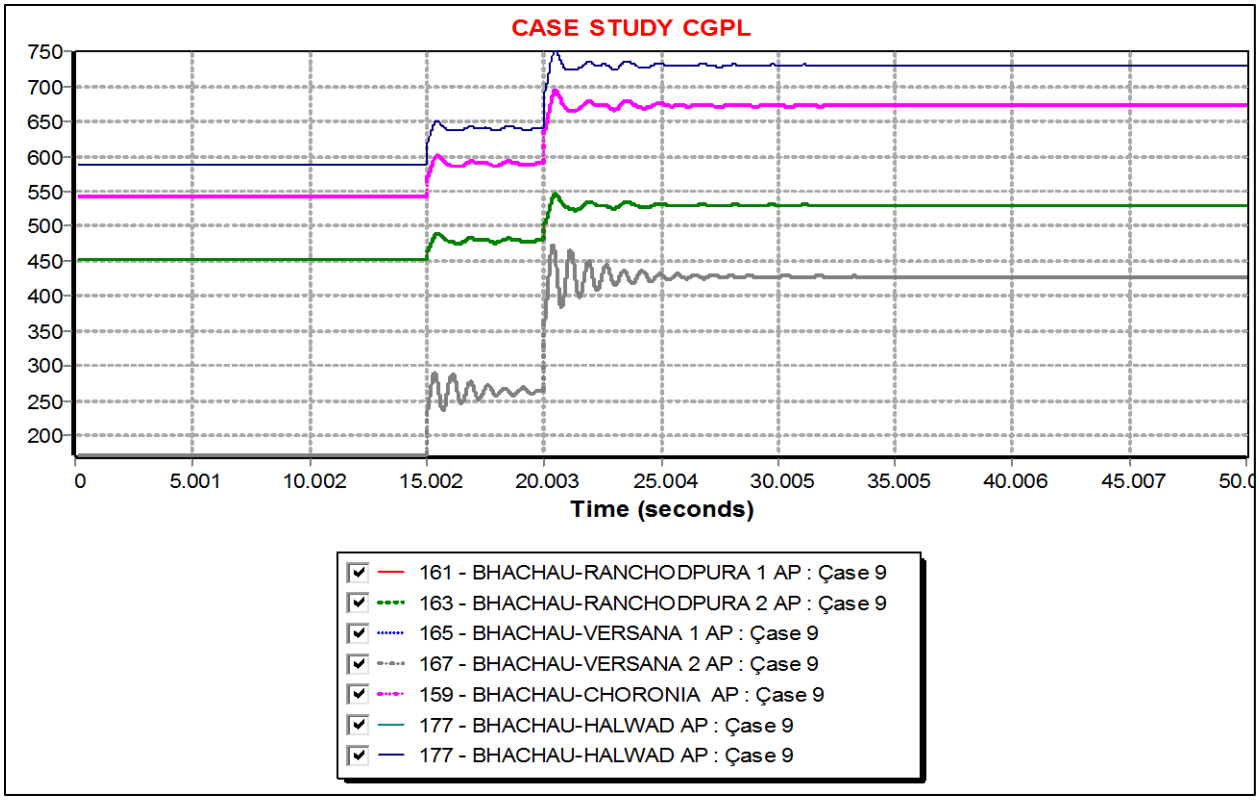

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 8
189 - CGPL-JETPUR 2 AP : Case 8
191 - CGPL-BHACHAU 1 AP : Case 8
193 - CGPL-BHACHAU 2 AP : Case 8
195 - CGPL-BHACHAU 3 AP : Case 8
197 - CGPL-BHACHAU 4 AP : Case 8


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Case 8
163 - BHACHAU-RANCHODPURA 2 AP : Case 8
165 - BHACHAU-VERSANA 1 AP : Case 8
167 - BHACHAU-VERSANA 2 AP : Case 8
159 - BHACHAU-CHORONIA AP : Case 8
177 - BHACHAU-HALWAD AP : Case 8

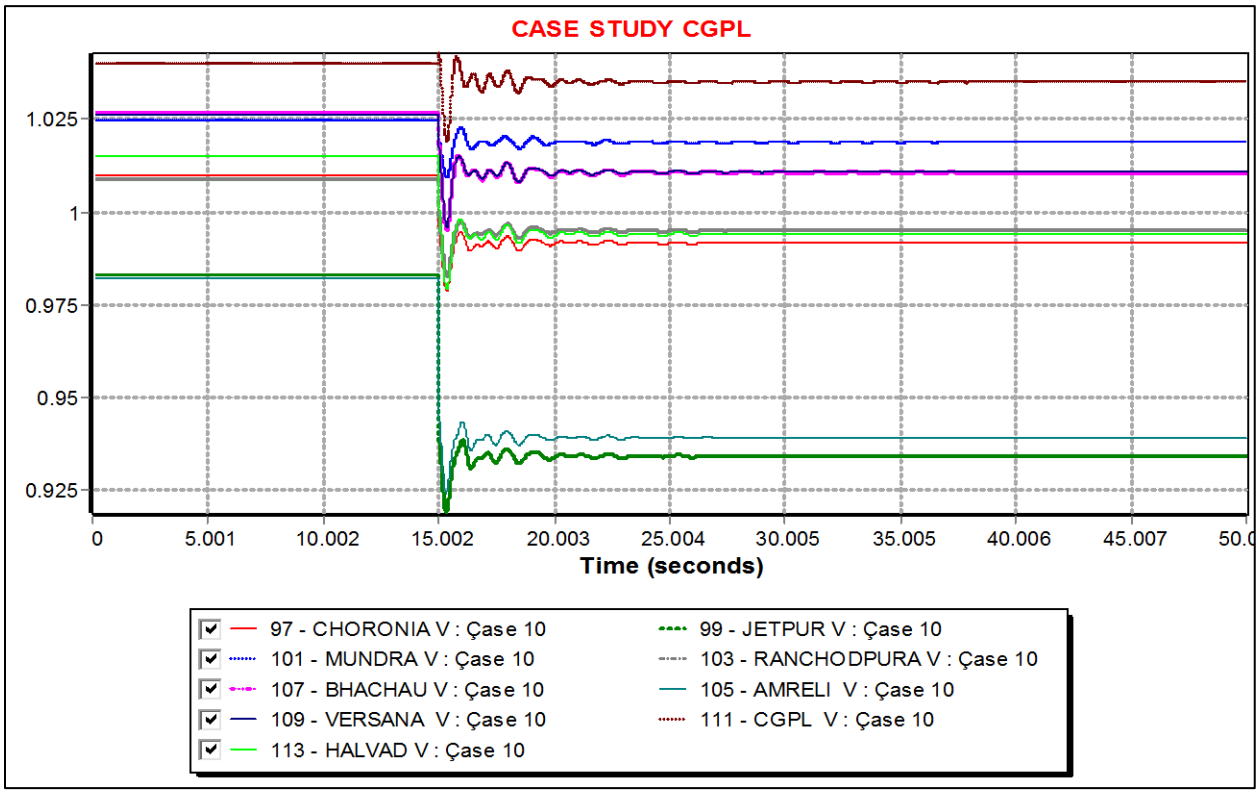
Case 9 :

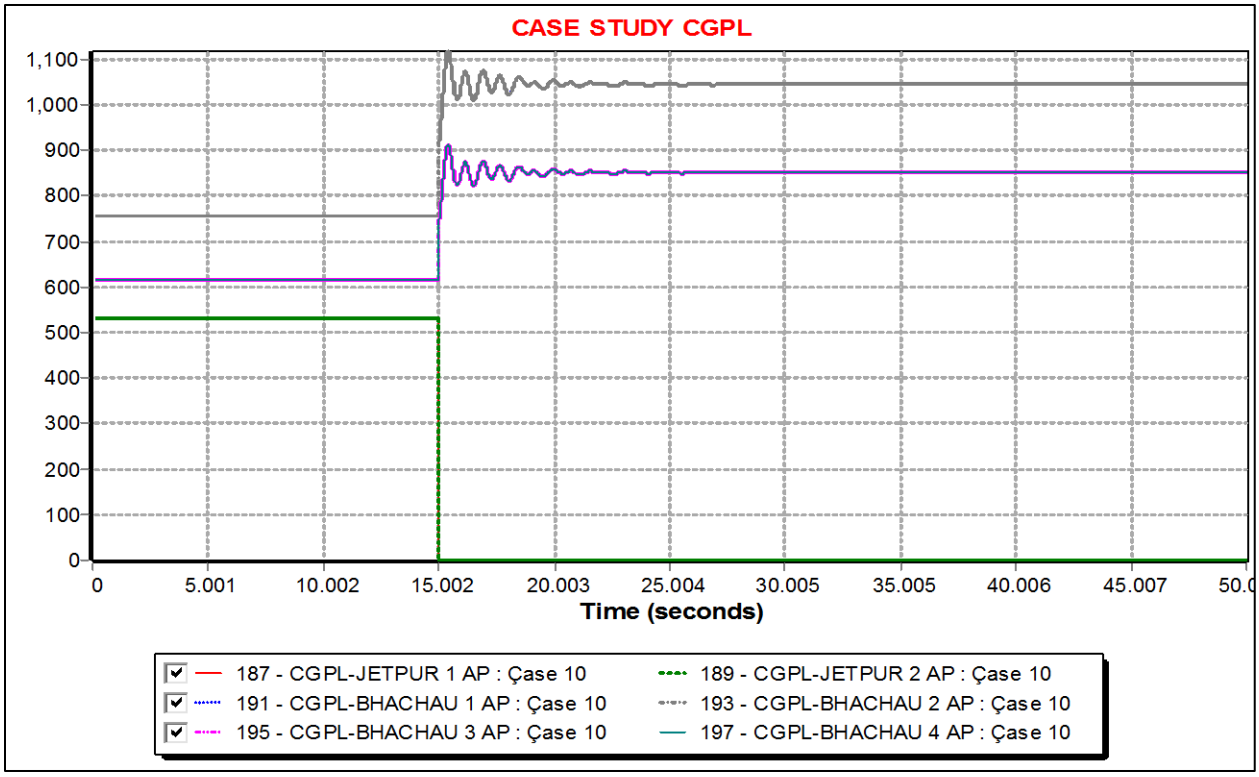

CASE STUDY CGPL
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 9
99 - JETPUR V : Case 9
101 - MUNDRA V : Case 9
103 - RANCHODPURA V : Case 9
107 - BHACHAU V : Case 9
105 - AMRELI V : Case 9
109 - VERSANA V : Case 9
111 - CGPL V : Case 9
113 - HALVAD V : Case 9

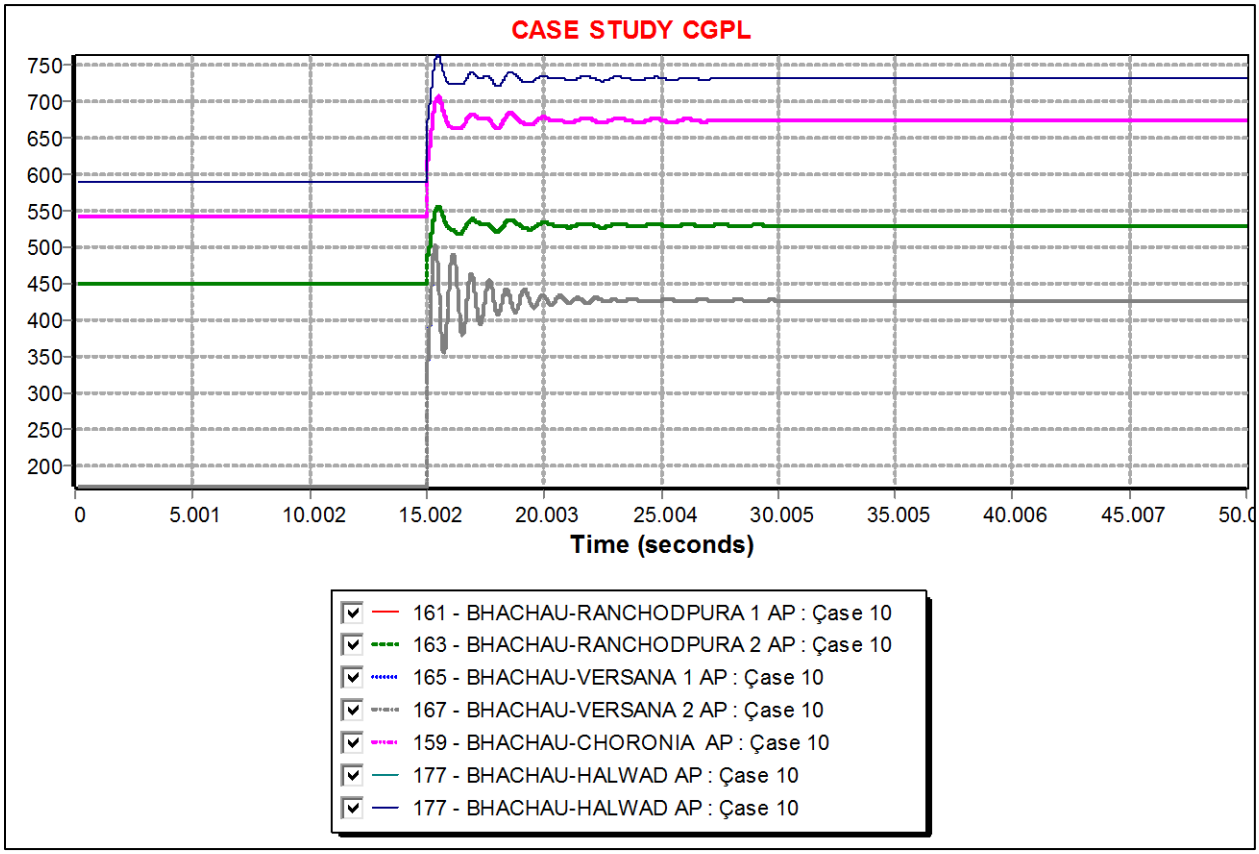

CASE STUDY CGPL
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 9
189 - CGPL-JETPUR 2 AP : Case 9
191 - CGPL-BHACHAU 1 AP : Case 9
193 - CGPL-BHACHAU 2 AP : Case 9
195 - CGPL-BHACHAU 3 AP : Case 9
197 - CGPL-BHACHAU 4 AP : Case 9


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 9
163 - BHACHAU-RANCHODPURA 2 AP : Çase 9
165 - BHACHAU-VERSANA 1 AP : Çase 9
167 - BHACHAU-VERSANA 2 AP : Çase 9
159 - BHACHAU-CHORONIA AP : Çase 9
177 - BHACHAU-HALWAD AP : Çase 9
177 - BHACHAU-HALWAD AP : Çase 9

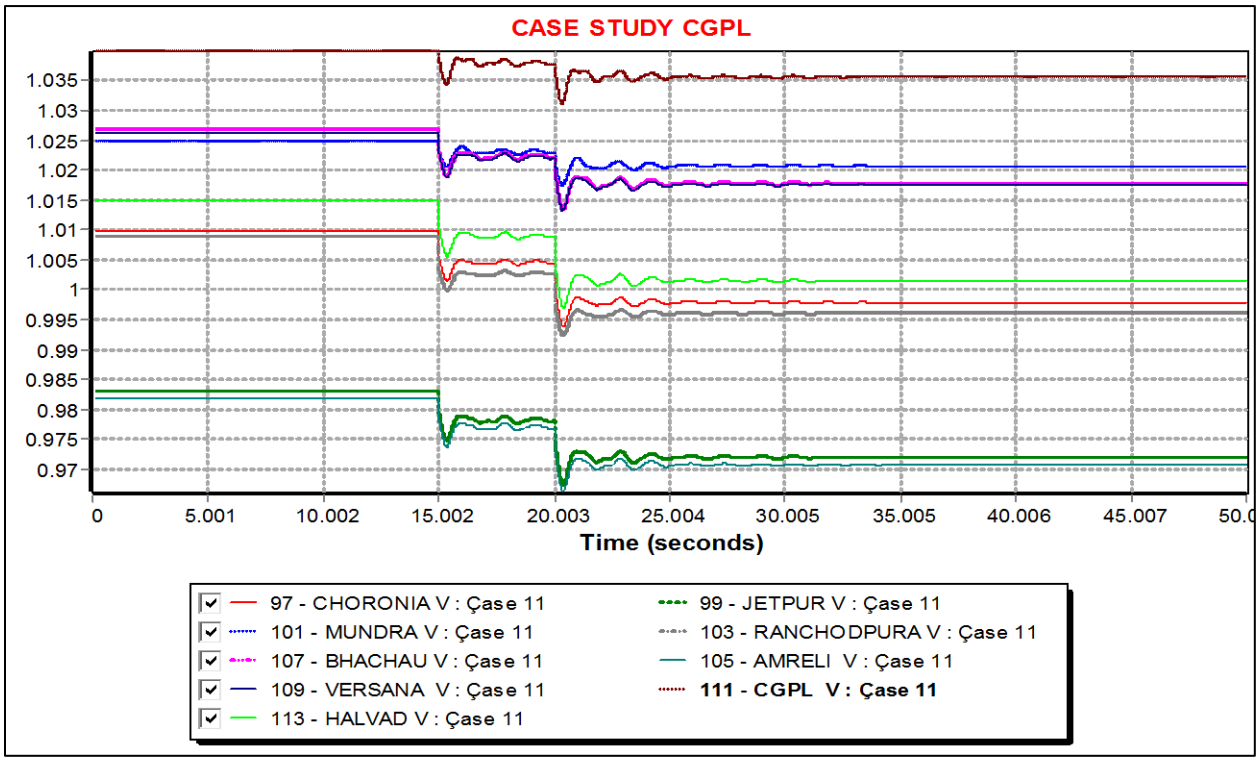
Case 10:

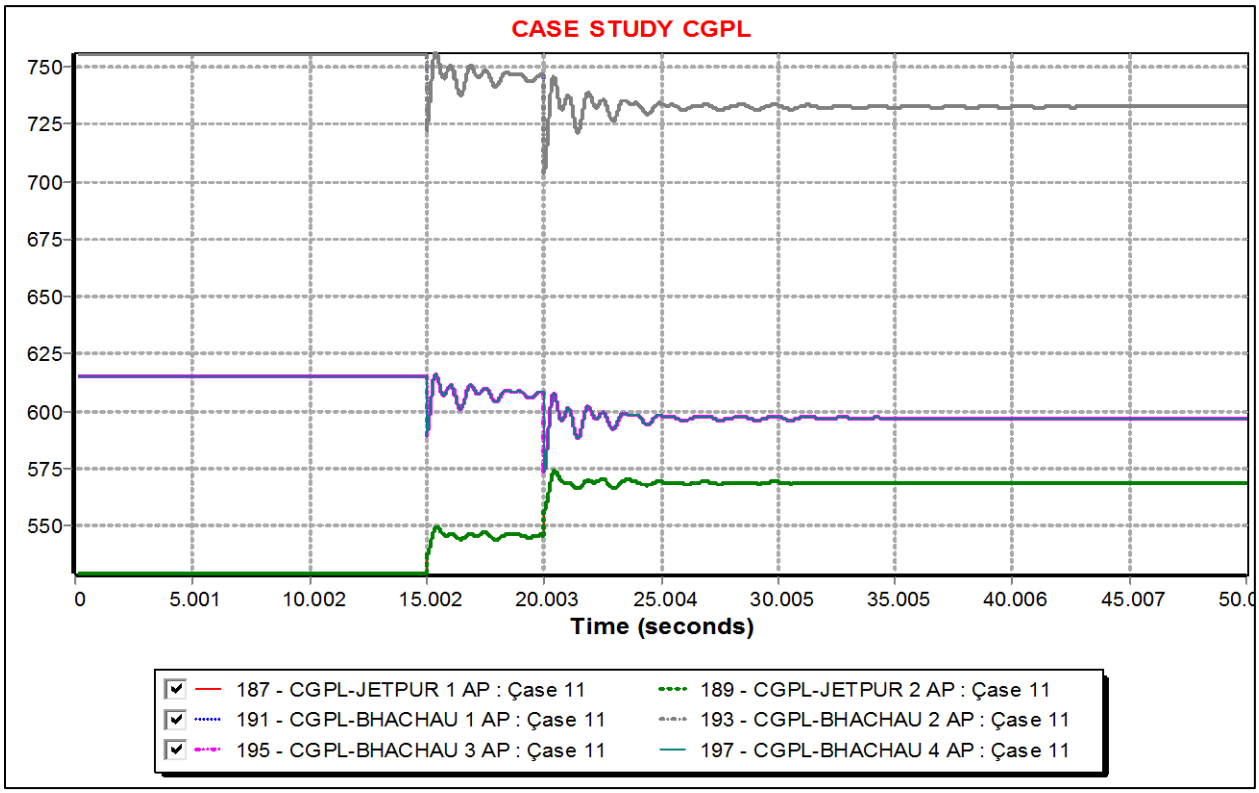

CASE STUDY CGPL
1.025
1
0.975
0.95
0.925
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 10
101 - MUNDRA V : Çase 10
107 - BHACHAU V : Çase 10
109 - VERSANA V : Çase 10
113 - HALVAD V : Çase 10
99 - JETPUR V : Çase 10
103 - RANCHODPURA V : Çase 10
105 - AMRELI V : Çase 10
111 - CGPL V : Çase 10

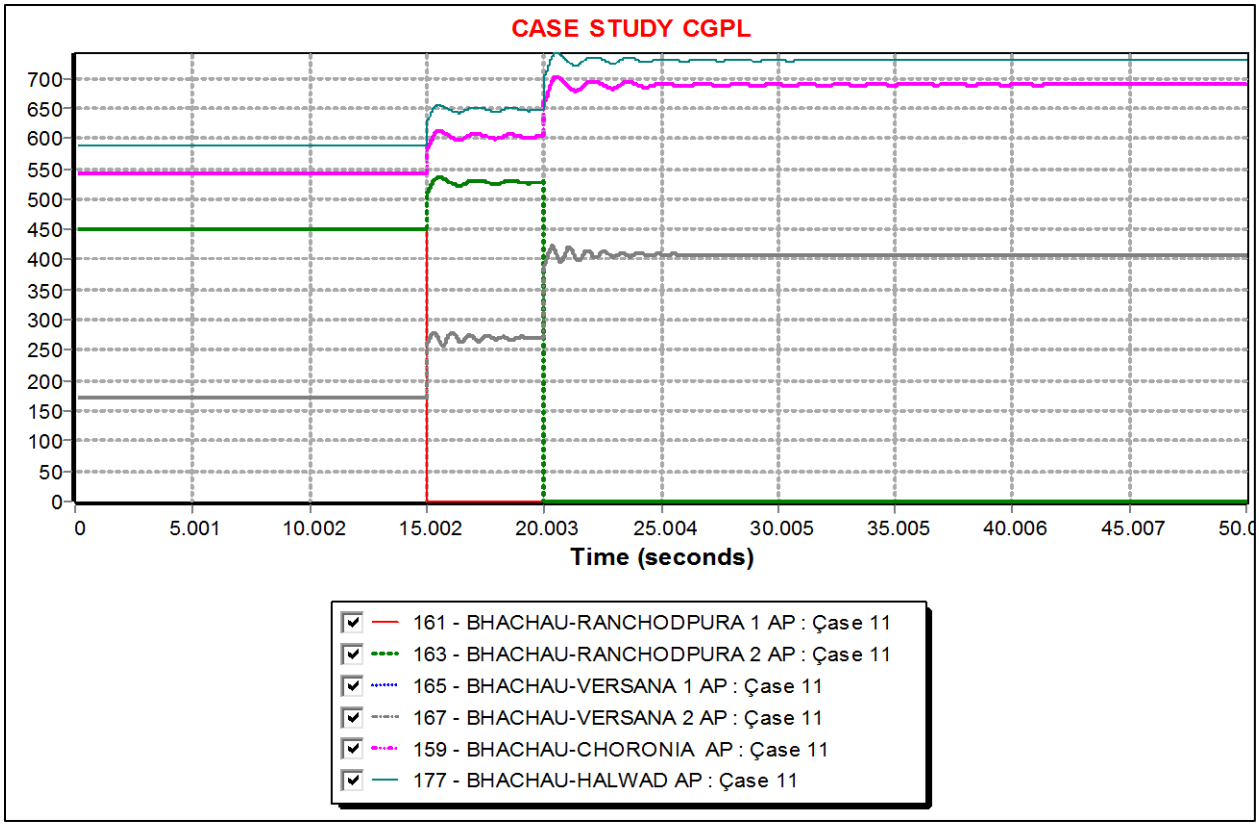

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 10
189 - CGPL-JETPUR 2 AP : Çase 10
191 - CGPL-BHACHAU 1 AP : Çase 10
193 - CGPL-BHACHAU 2 AP : Çase 10
195 - CGPL-BHACHAU 3 AP : Çase 10
197 - CGPL-BHACHAU 4 AP : Çase 10


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 10
163 - BHACHAU-RANCHODPURA 2 AP : Çase 10
165 - BHACHAU-VERSANA 1 AP : Çase 10
167 - BHACHAU-VERSANA 2 AP : Çase 10
159 - BHACHAU-CHORONIA AP : Çase 10
177 - BHACHAU-HALWAD AP : Çase 10
177 - BHACHAU-HALWAD AP : Çase 10

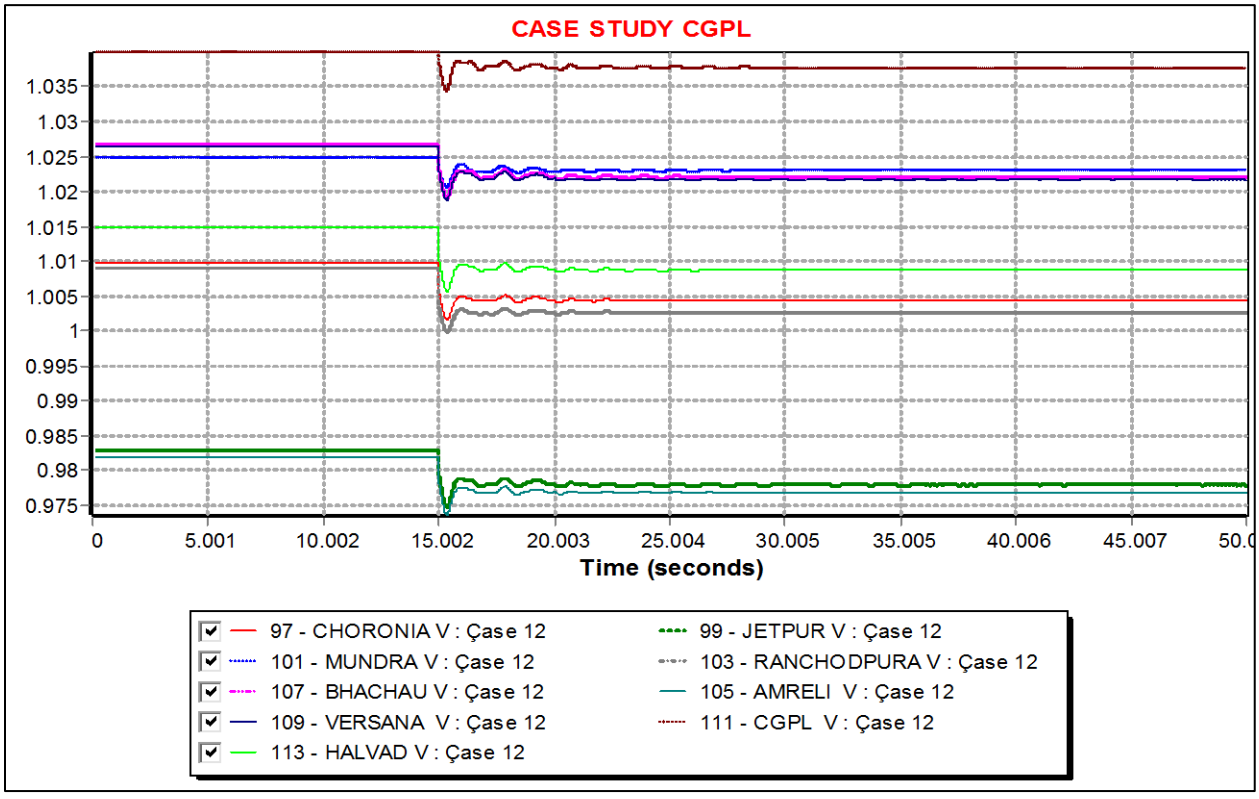
Case 11:

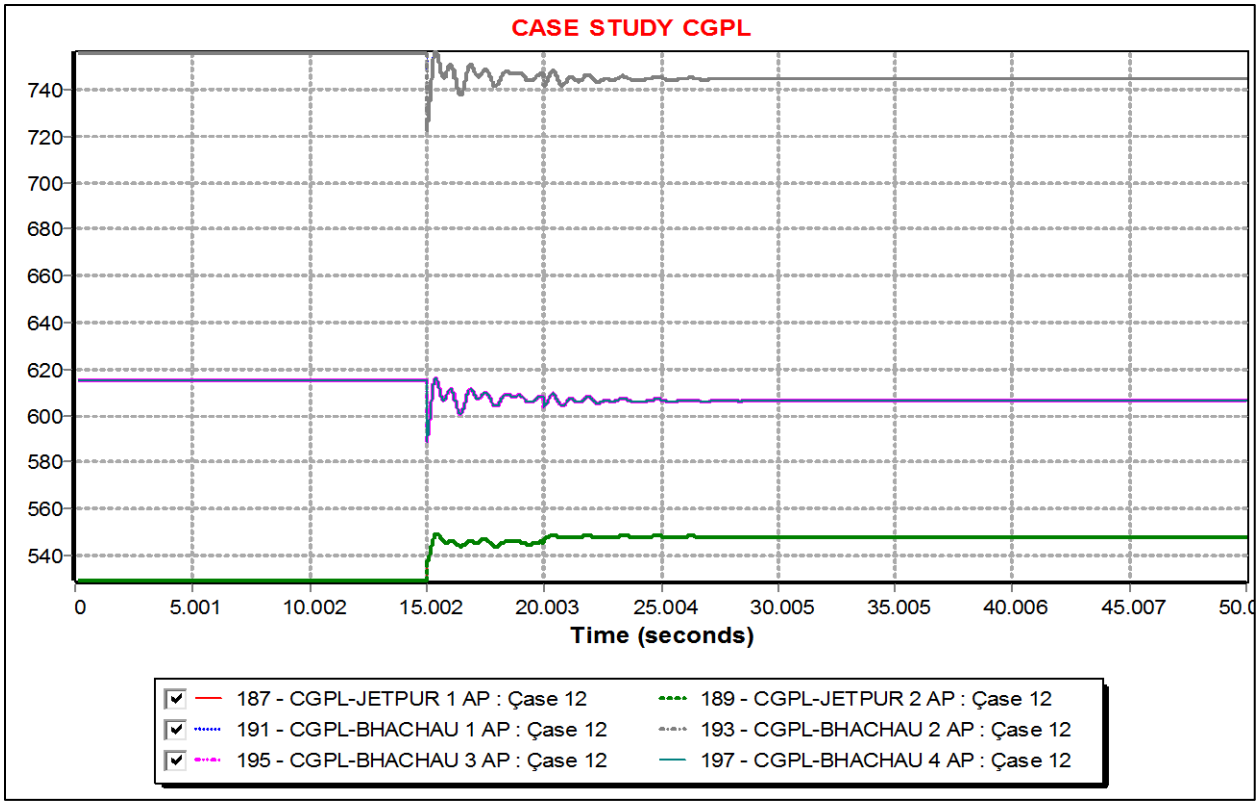

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 11
99 - JETPUR V : Çase 11
101 - MUNDRA V : Çase 11
103 - RANCHODPURA V : Çase 11
107 - BHACHAU V : Çase 11
105 - AMRELI V : Çase 11
109 - VERSANA V : Çase 11
111 - CGPL V : Çase 11
113 - HALVAD V : Çase 11

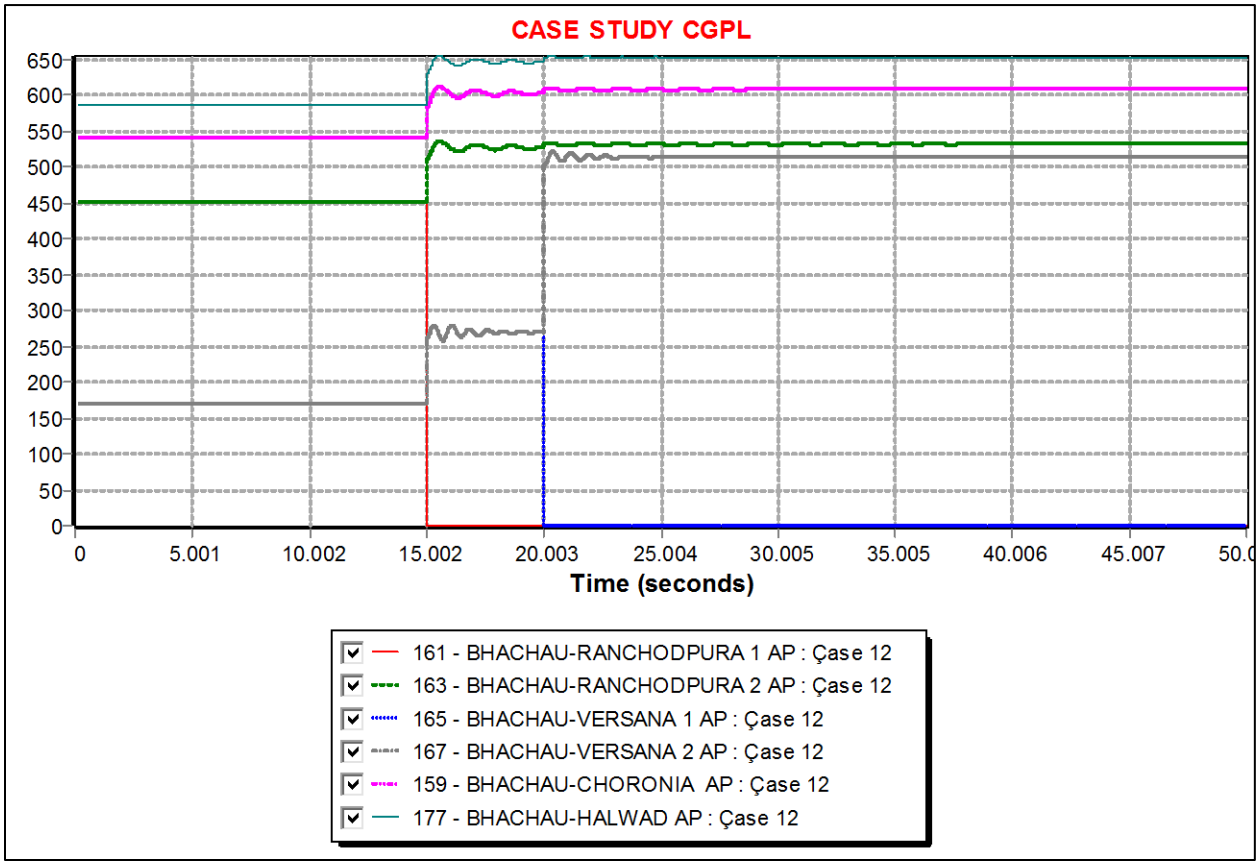

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 11
189 - CGPL-JETPUR 2 AP : Çase 11
191 - CGPL-BHACHAU 1 AP : Çase 11
193 - CGPL-BHACHAU 2 AP : Çase 11
195 - CGPL-BHACHAU 3 AP : Çase 11
197 - CGPL-BHACHAU 4 AP : Çase 11


CASE STUDY CGPL
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 11
163 - BHACHAU-RANCHODPURA 2 AP : Çase 11
165 - BHACHAU-VERSANA 1 AP : Çase 11
167 - BHACHAU-VERSANA 2 AP : Çase 11
159 - BHACHAU-CHORONIA AP : Çase 11
177 - BHACHAU-HALWAD AP : Çase 11

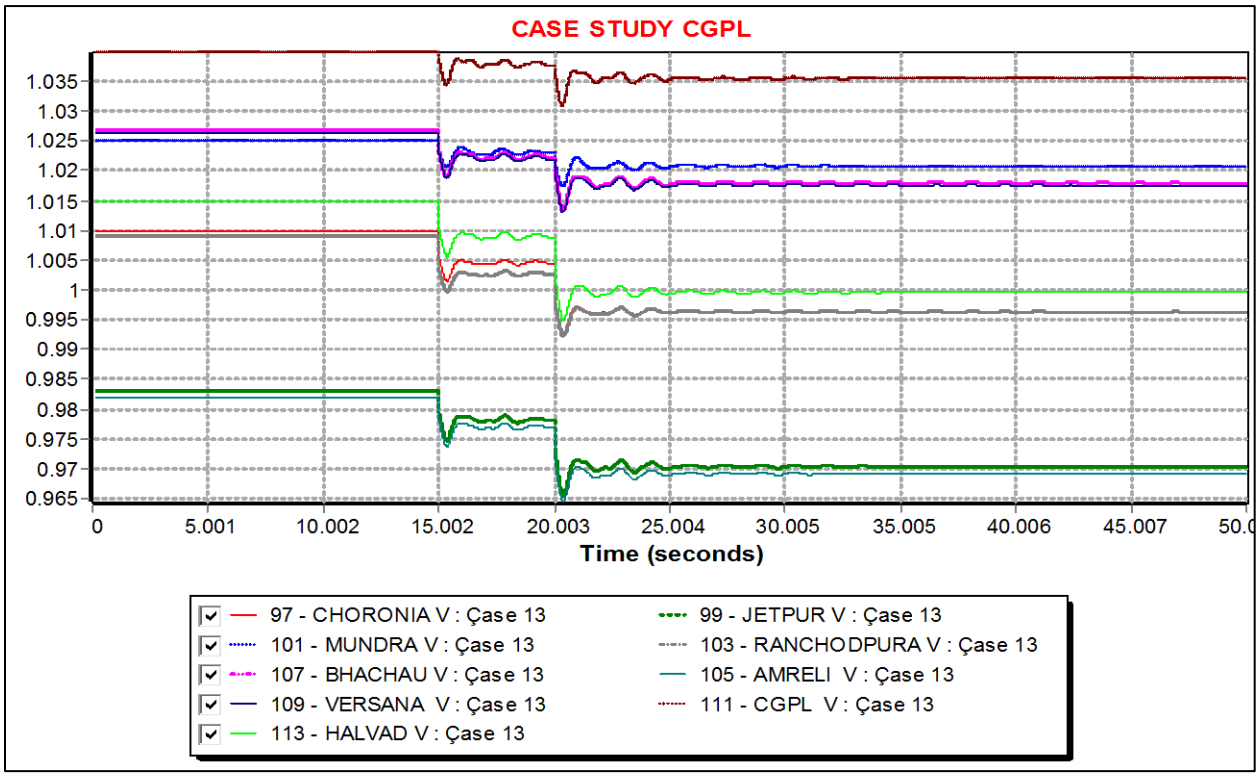
Case 12 :

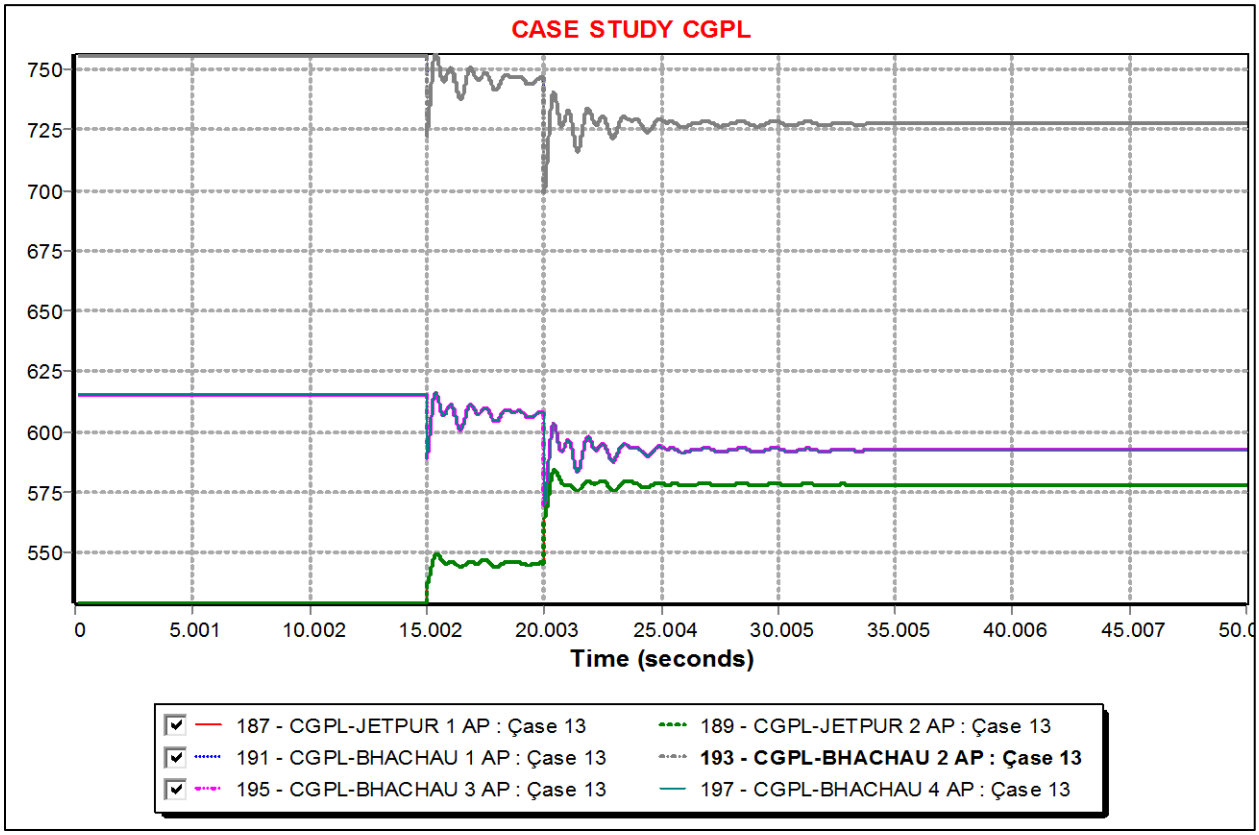

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 12
99 - JETPUR V : Çase 12
101 - MUNDRA V : Çase 12
103 - RANCHODPURA V : Çase 12
107 - BHACHAU V : Çase 12
105 - AMRELI V : Çase 12
109 - VERSANA V : Çase 12
111 - CGPL V : Çase 12
113 - HALVAD V : Çase 12

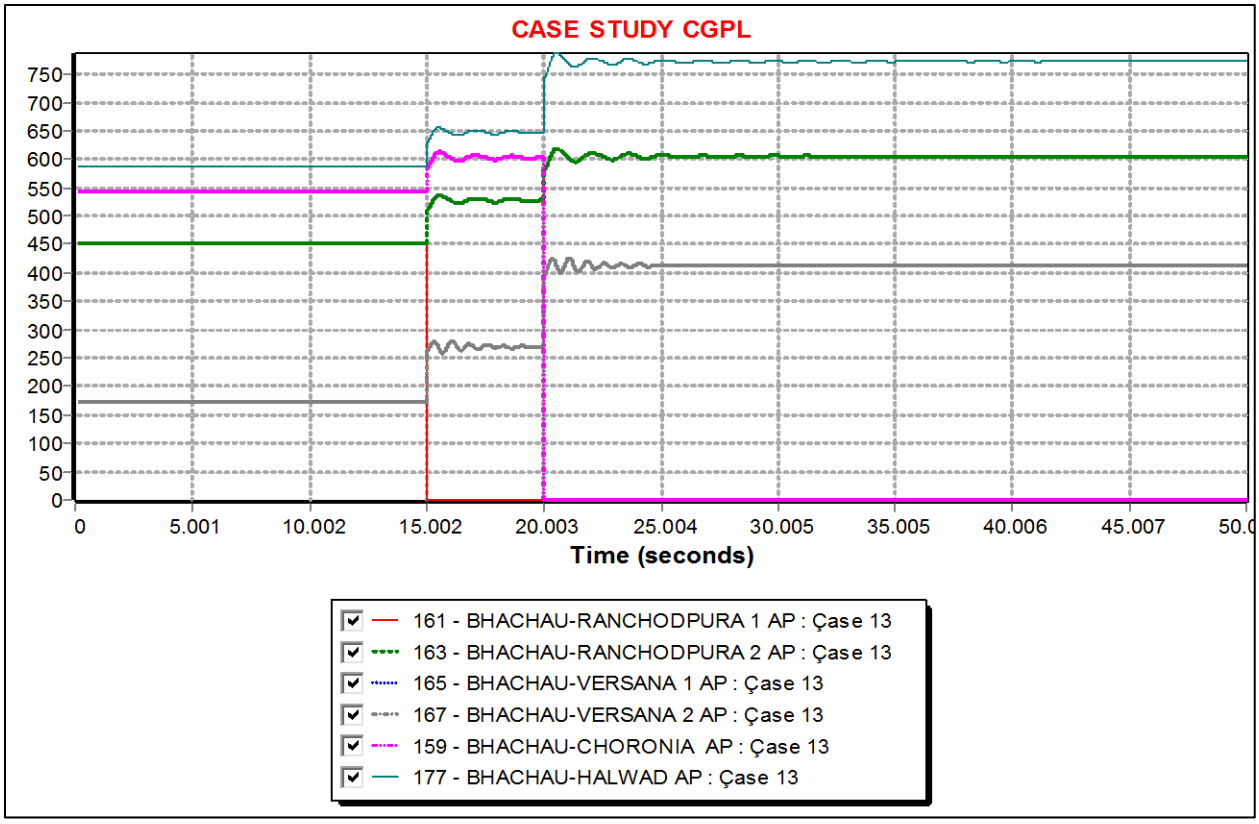

CASE STUDY CGPL
740
720
700
680
660
640
620
600
580
560
540
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 12
189 - CGPL-JETPUR 2 AP : Çase 12
191 - CGPL-BHACHAU 1 AP : Çase 12
193 - CGPL-BHACHAU 2 AP : Çase 12
195 - CGPL-BHACHAU 3 AP : Çase 12
197 - CGPL-BHACHAU 4 AP : Çase 12


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 12
163 - BHACHAU-RANCHODPURA 2 AP : Çase 12
165 - BHACHAU-VERSANA 1 AP : Çase 12
167 - BHACHAU-VERSANA 2 AP : Çase 12
159 - BHACHAU-CHORONIA AP : Çase 12
177 - BHACHAU-HALWAD AP : Çase 12

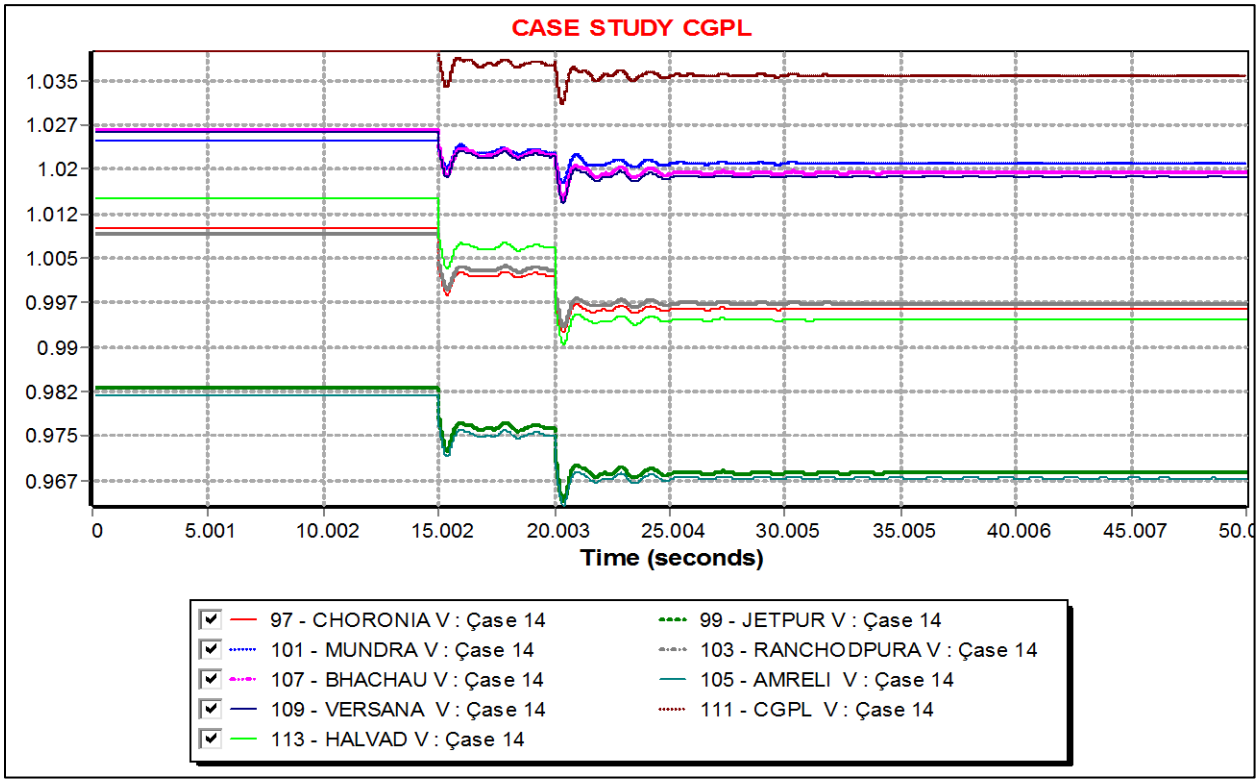
Case 13 :

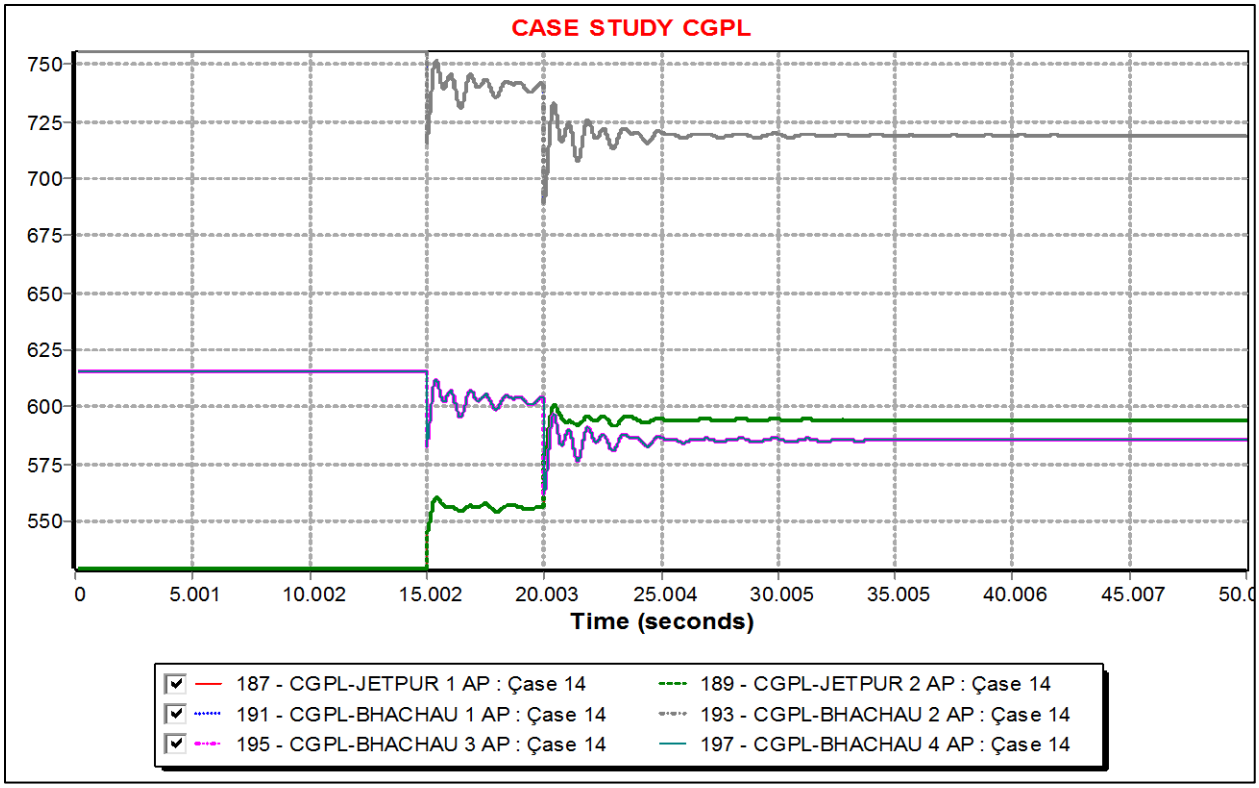

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 13
101 - MUNDRA V : Case 13
107 - BHACHAU V : Case 13
109 - VERSANA V : Case 13
113 - HALVAD V : Case 13
99 - JETPUR V : Case 13
103 - RANCHODPURA V : Case 13
105 - AMRELI V : Case 13
111 - CGPL V : Case 13

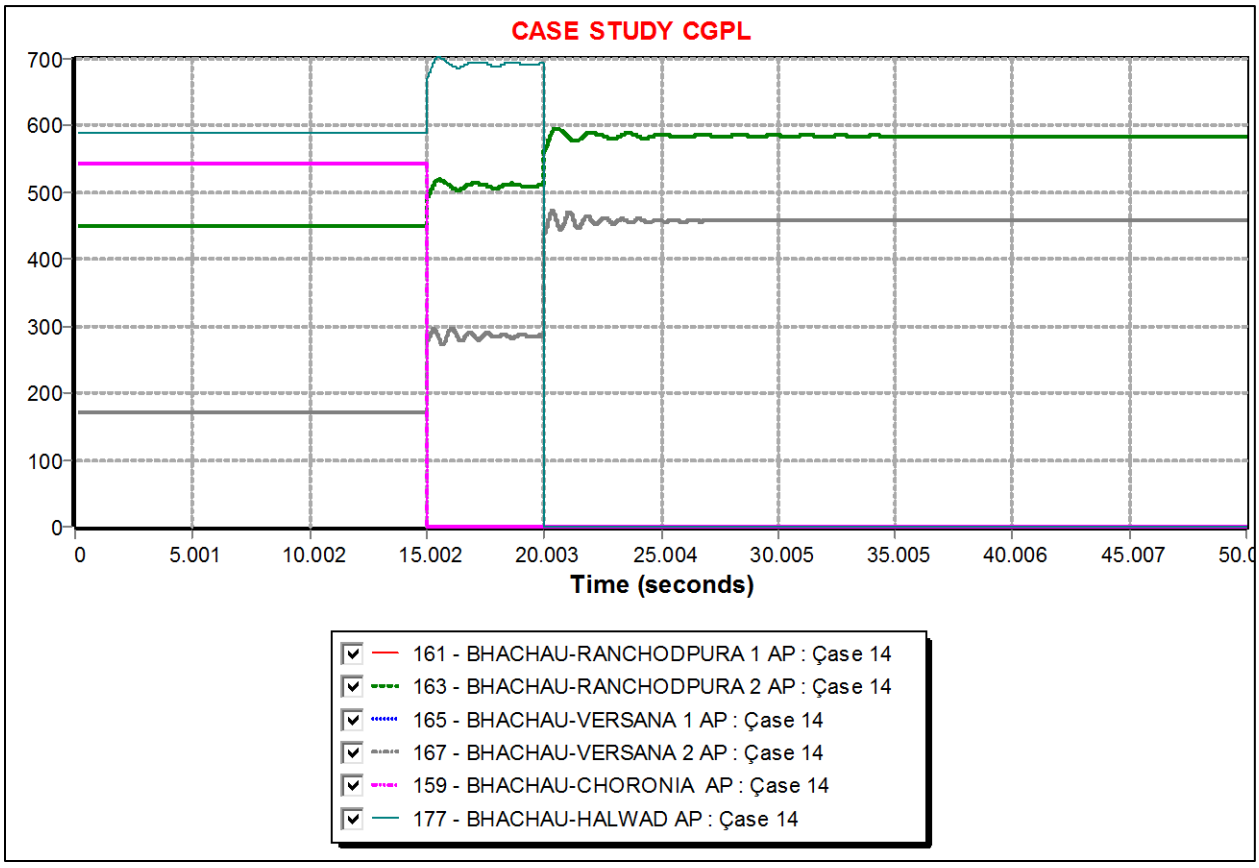

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 13
191 - CGPL-BHACHAU 1 AP : Case 13
195 - CGPL-BHACHAU 3 AP : Case 13
189 - CGPL-JETPUR 2 AP : Case 13
193 - CGPL-BHACHAU 2 AP : Case 13
197 - CGPL-BHACHAU 4 AP : Case 13


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 13
163 - BHACHAU-RANCHODPURA 2 AP : Çase 13
165 - BHACHAU-VERSANA 1 AP : Çase 13
167 - BHACHAU-VERSANA 2 AP : Çase 13
159 - BHACHAU-CHORONIA AP : Çase 13
177 - BHACHAU-HALWAD AP : Çase 13

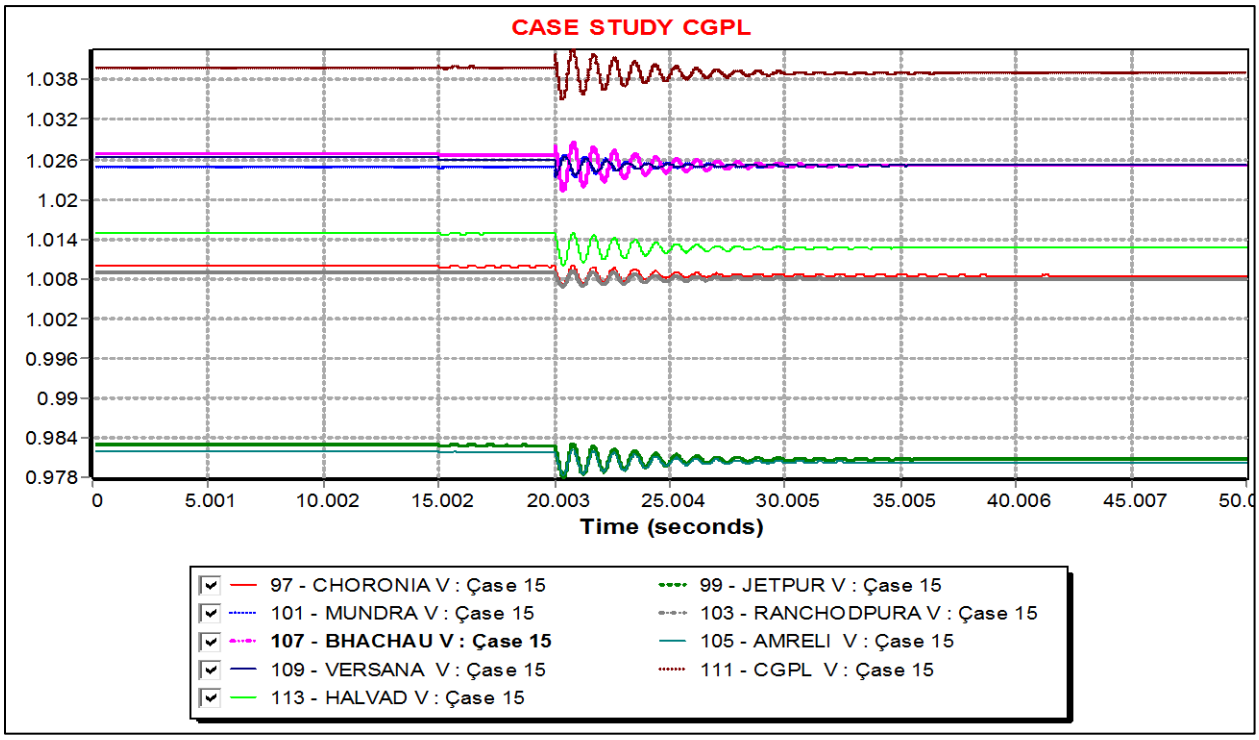
Case 14

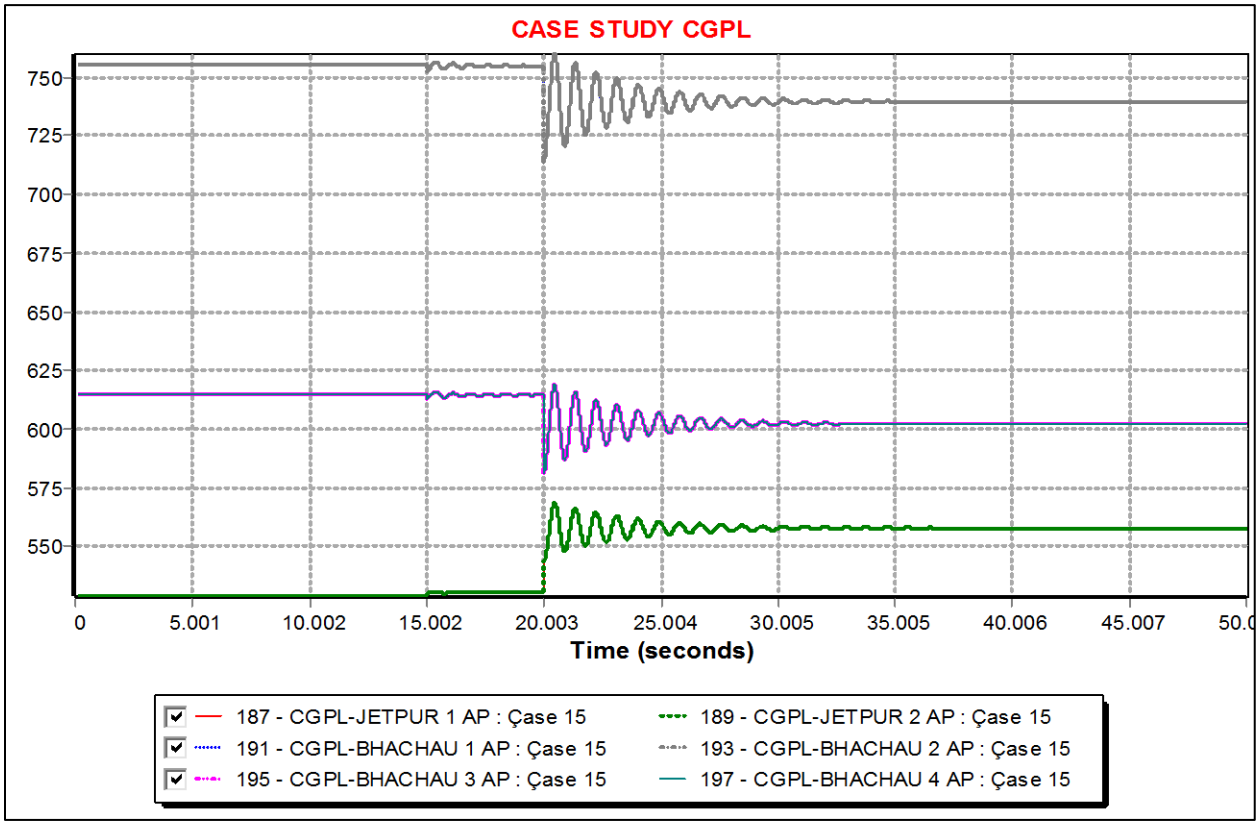

CASE STUDY CGPL
1.035
1.027
1.02
1.012
1.005
0.997
0.99
0.982
0.975
0.967
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 14
99 - JETPUR V : Çase 14
101 - MUNDRA V : Çase 14
103 - RANCHODPURA V : Çase 14
107 - BHACHAU V : Çase 14
105 - AMRELI V : Çase 14
109 - VERSANA V : Çase 14
111 - CGPL V : Çase 14
113 - HALVAD V : Çase 14

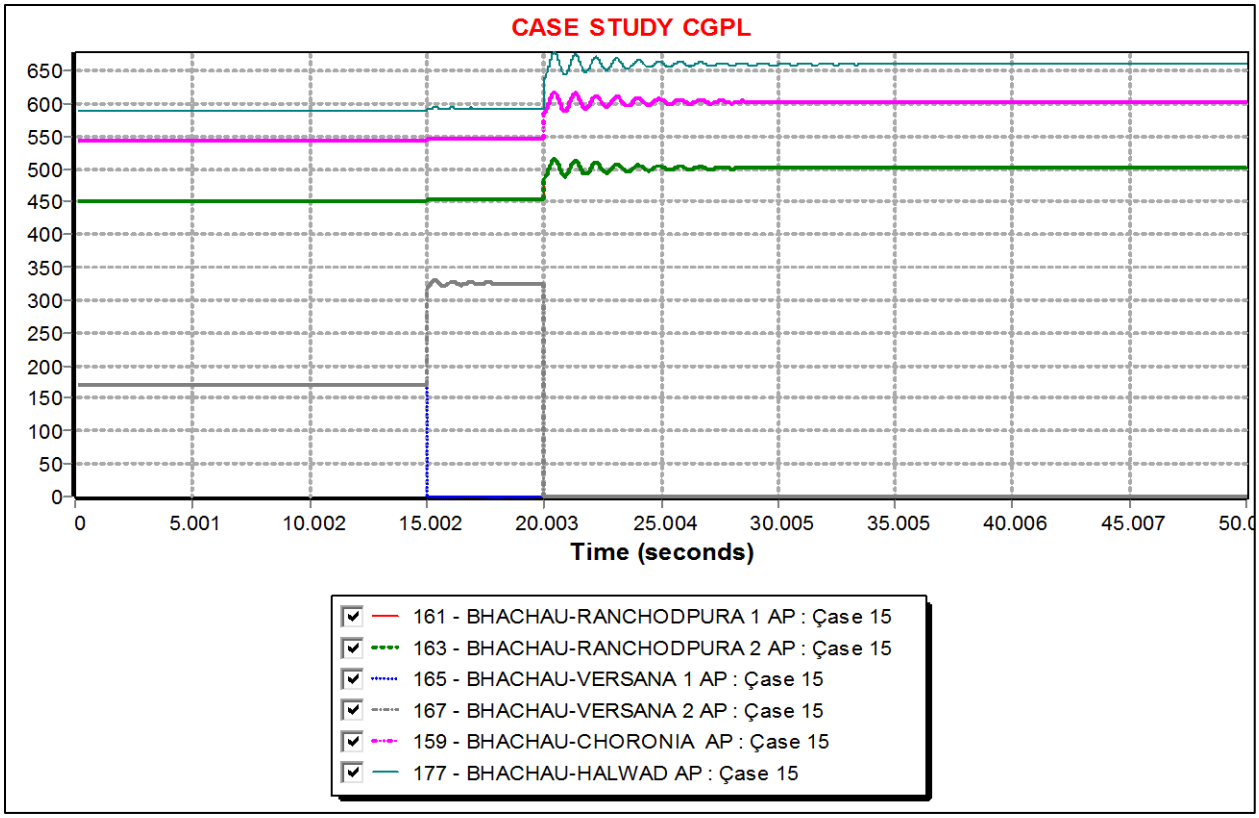

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 14
189 - CGPL-JETPUR 2 AP : Çase 14
191 - CGPL-BHACHAU 1 AP : Çase 14
193 - CGPL-BHACHAU 2 AP : Çase 14
195 - CGPL-BHACHAU 3 AP : Çase 14
197 - CGPL-BHACHAU 4 AP : Çase 14


CASE STUDY CGPL
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 14
163 - BHACHAU-RANCHODPURA 2 AP : Çase 14
165 - BHACHAU-VERSANA 1 AP : Çase 14
167 - BHACHAU-VERSANA 2 AP : Çase 14
159 - BHACHAU-CHORONIA AP : Çase 14
177 - BHACHAU-HALWAD AP : Çase 14

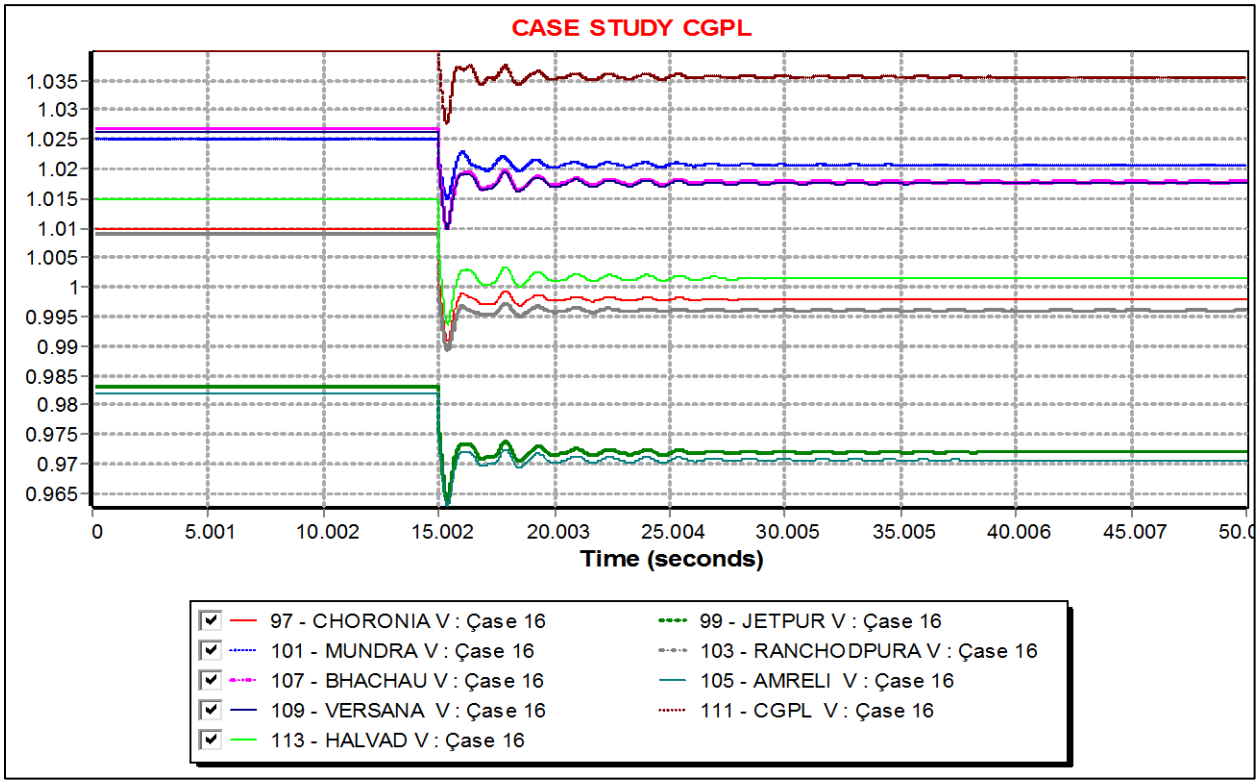
Case 15:

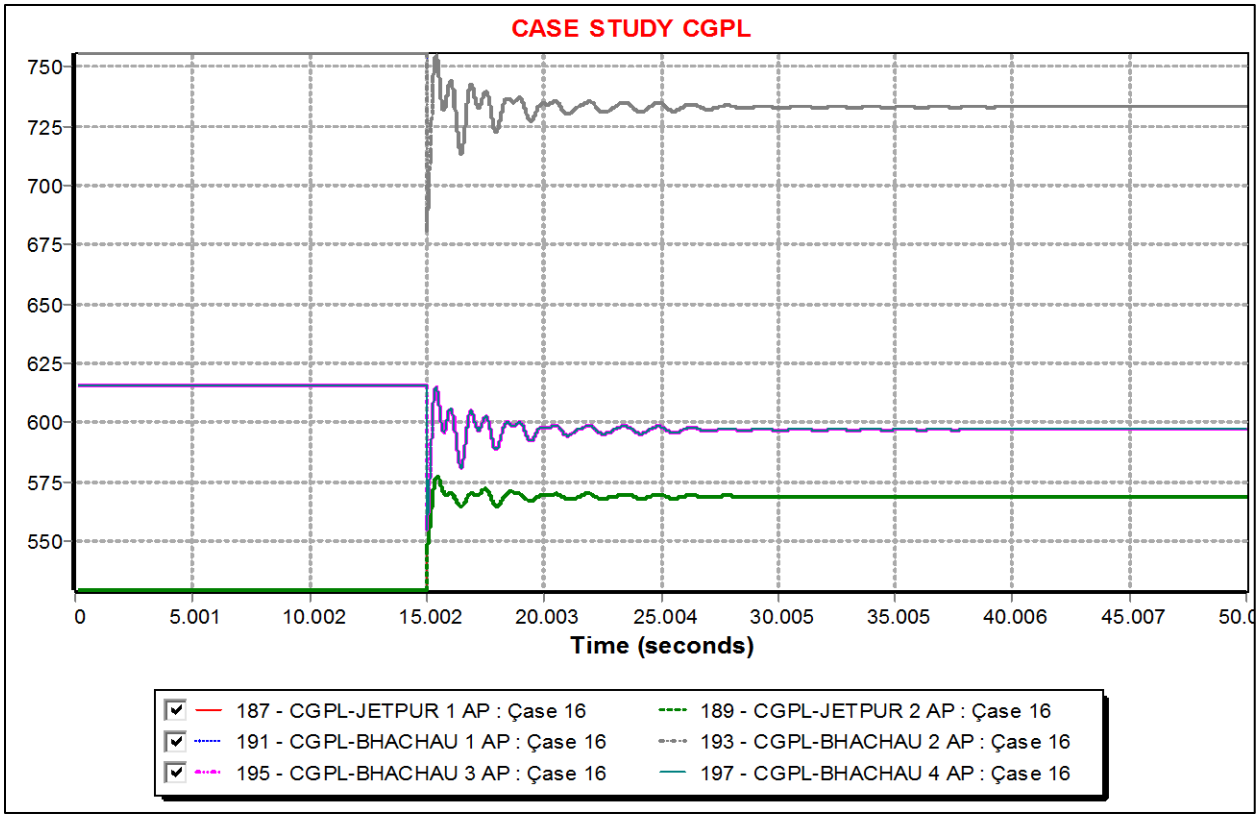

CASE STUDY CGPL
1.038
1.032
1.026
1.02
1.014
1.008
1.002
0.996
0.99
0.984
0.978
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Case 15
101 - MUNDRA V : Case 15
107 - BHACHAU V : Case 15
109 - VERSANA V : Case 15
113 - HALVAD V : Case 15
99 - JETPUR V : Case 15
103 - RANCHODPURA V : Case 15
105 - AMRELI V : Case 15
111 - CGPL V : Case 15

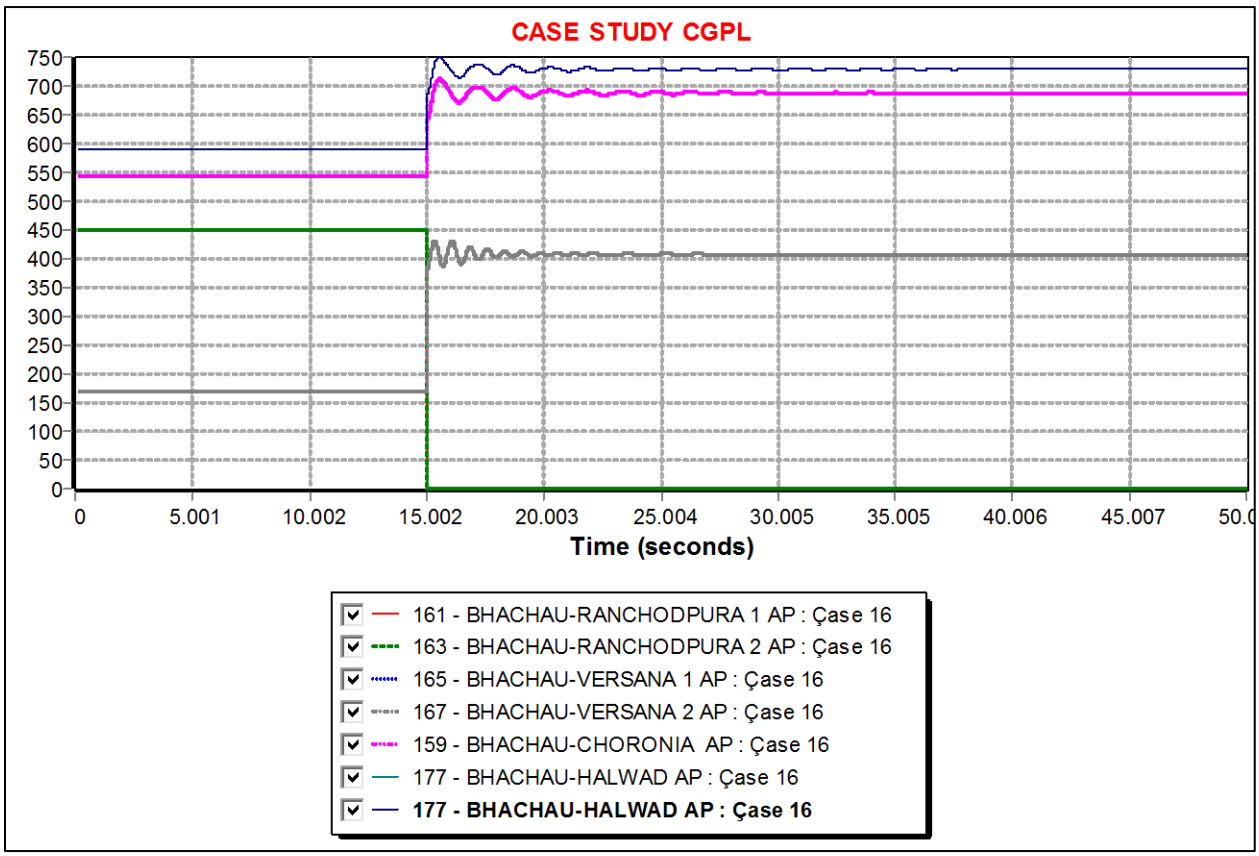

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Case 15
191 - CGPL-BHACHAU 1 AP : Case 15
195 - CGPL-BHACHAU 3 AP : Case 15
189 - CGPL-JETPUR 2 AP : Case 15
193 - CGPL-BHACHAU 2 AP : Case 15
197 - CGPL-BHACHAU 4 AP : Case 15


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 15
163 - BHACHAU-RANCHODPURA 2 AP : Çase 15
165 - BHACHAU-VERSANA 1 AP : Çase 15
167 - BHACHAU-VERSANA 2 AP : Çase 15
159 - BHACHAU-CHORONIA AP : Çase 15
177 - BHACHAU-HALWAD AP : Çase 15

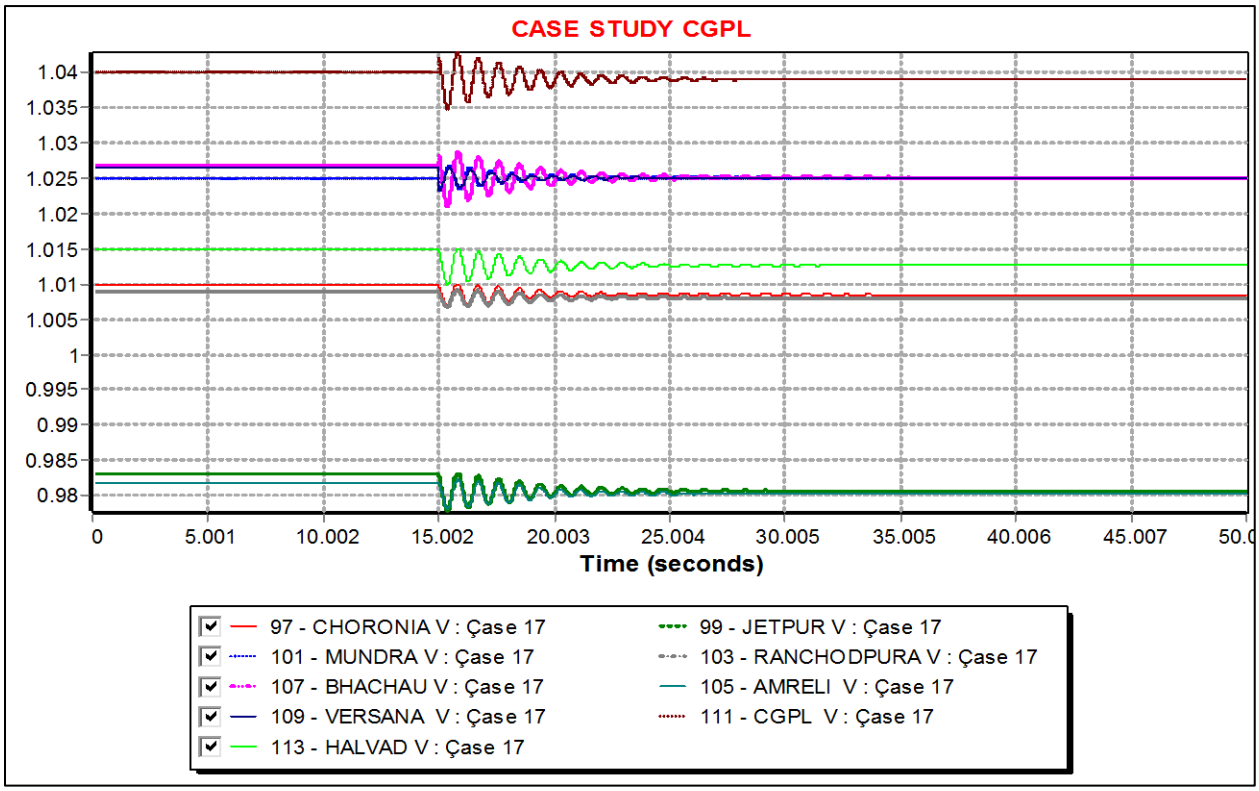
Case 16 :

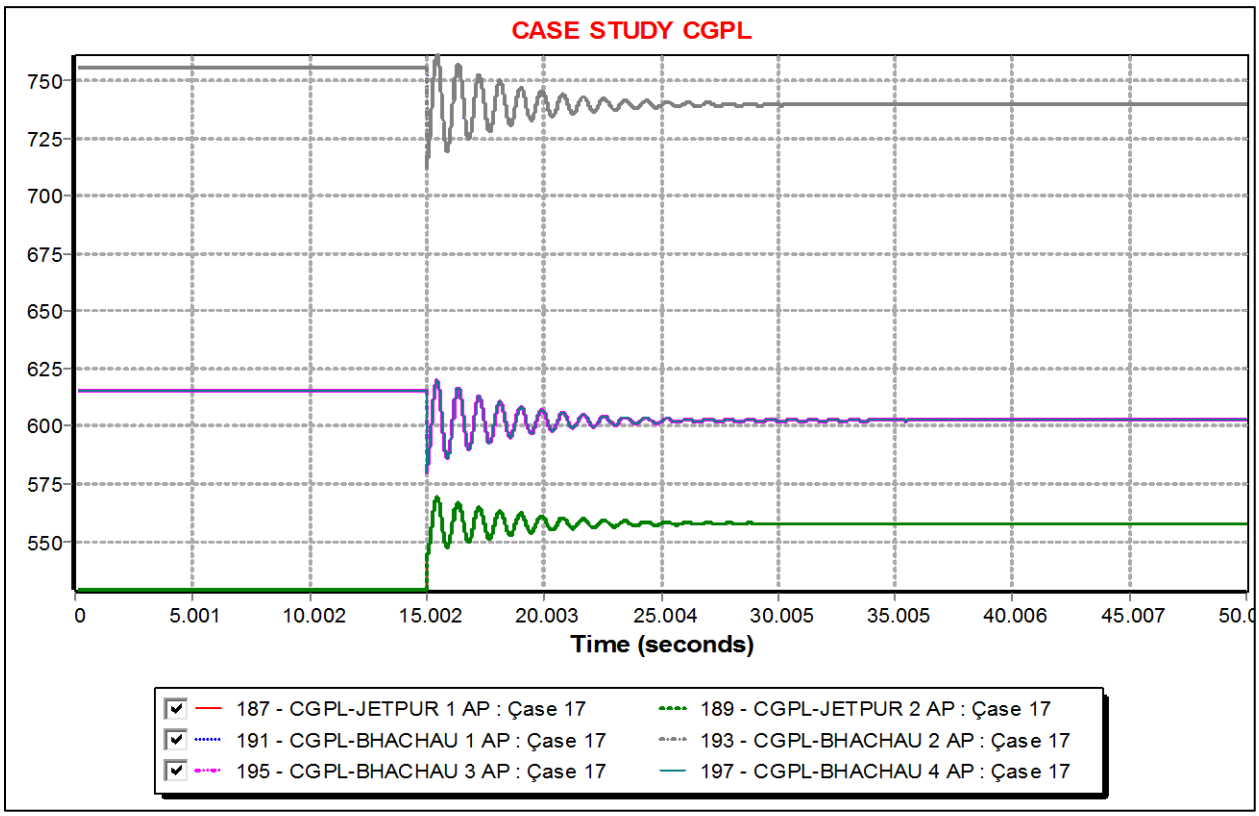

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 16
99 - JETPUR V : Çase 16
101 - MUNDRA V : Çase 16
103 - RANCHODPURA V : Çase 16
107 - BHACHAU V : Çase 16
105 - AMRELI V : Çase 16
109 - VERSANA V : Çase 16
111 - CGPL V : Çase 16
113 - HALVAD V : Çase 16

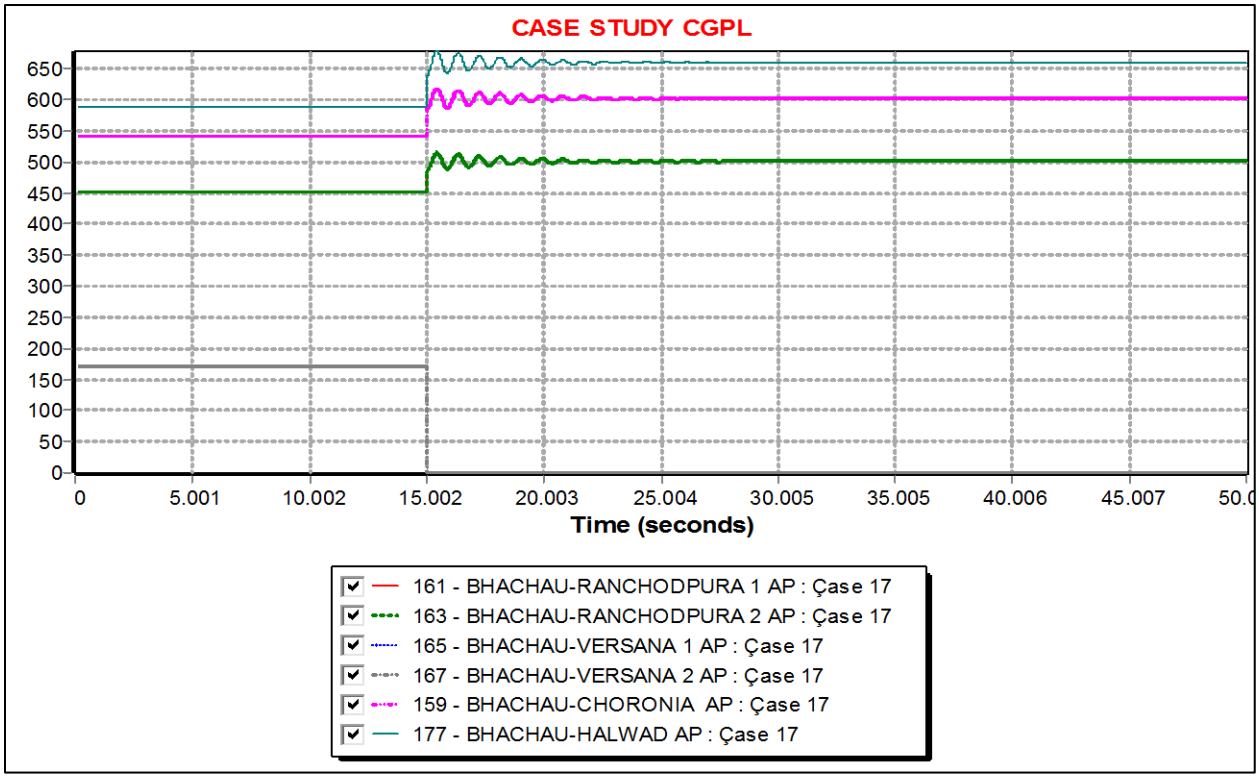

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 16
189 - CGPL-JETPUR 2 AP : Çase 16
191 - CGPL-BHACHAU 1 AP : Çase 16
193 - CGPL-BHACHAU 2 AP : Çase 16
195 - CGPL-BHACHAU 3 AP : Çase 16
197 - CGPL-BHACHAU 4 AP : Çase 16


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 16
163 - BHACHAU-RANCHODPURA 2 AP : Çase 16
165 - BHACHAU-VERSANA 1 AP : Çase 16
167 - BHACHAU-VERSANA 2 AP : Çase 16
159 - BHACHAU-CHORONIA AP : Çase 16
177 - BHACHAU-HALWAD AP : Çase 16
177 - BHACHAU-HALWAD AP : Çase 16

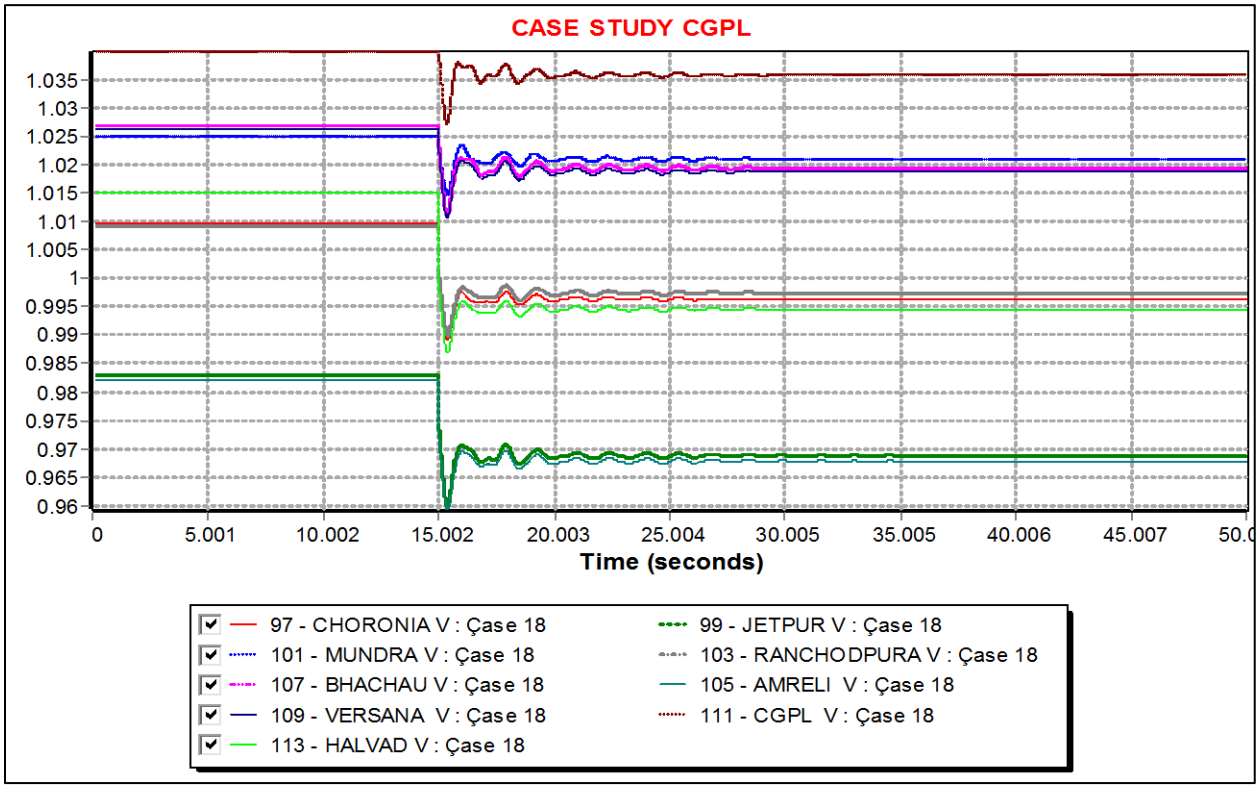
Case 17:

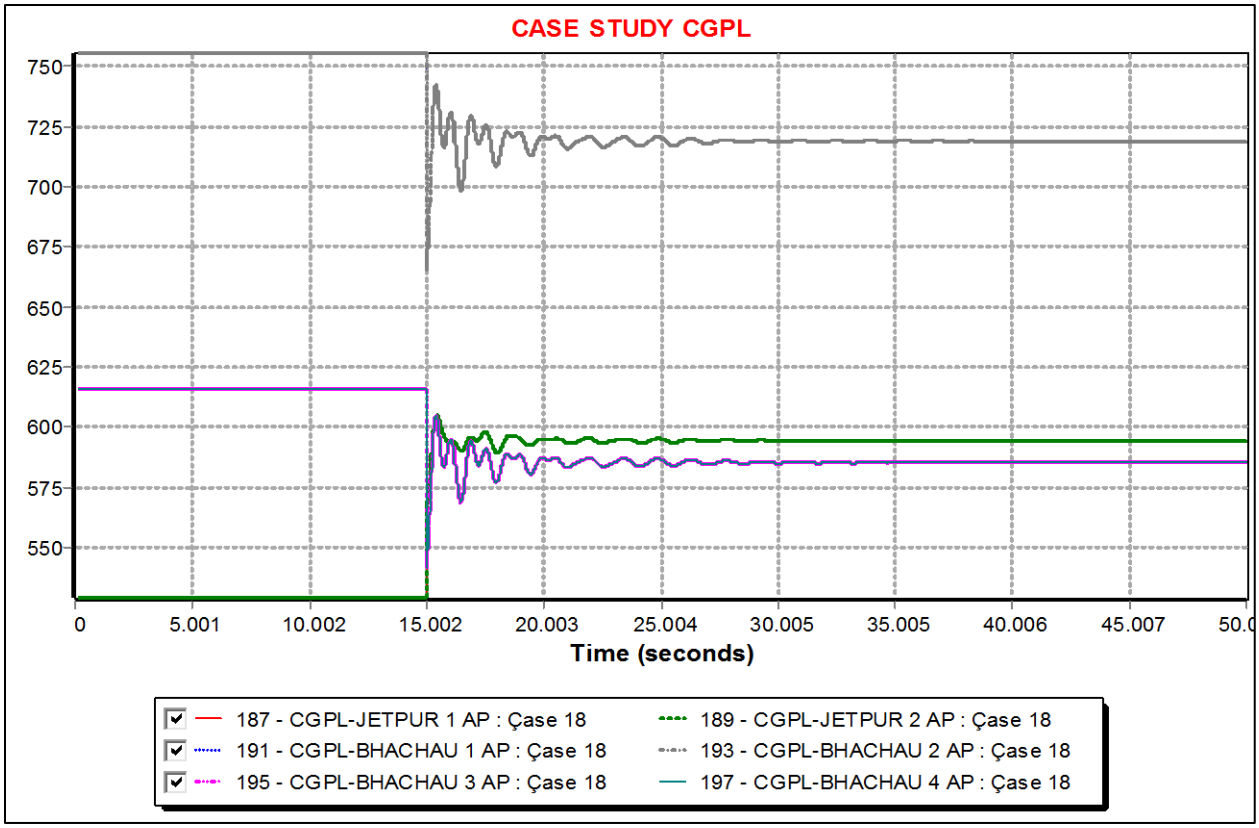

CASE STUDY CGPL
1.04
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 17
101 - MUNDRA V : Çase 17
107 - BHACHAU V : Çase 17
109 - VERSANA V : Çase 17
113 - HALVAD V : Çase 17
99 - JETPUR V : Çase 17
103 - RANCHODPURA V : Çase 17
105 - AMRELI V : Çase 17
111 - CGPL V : Çase 17

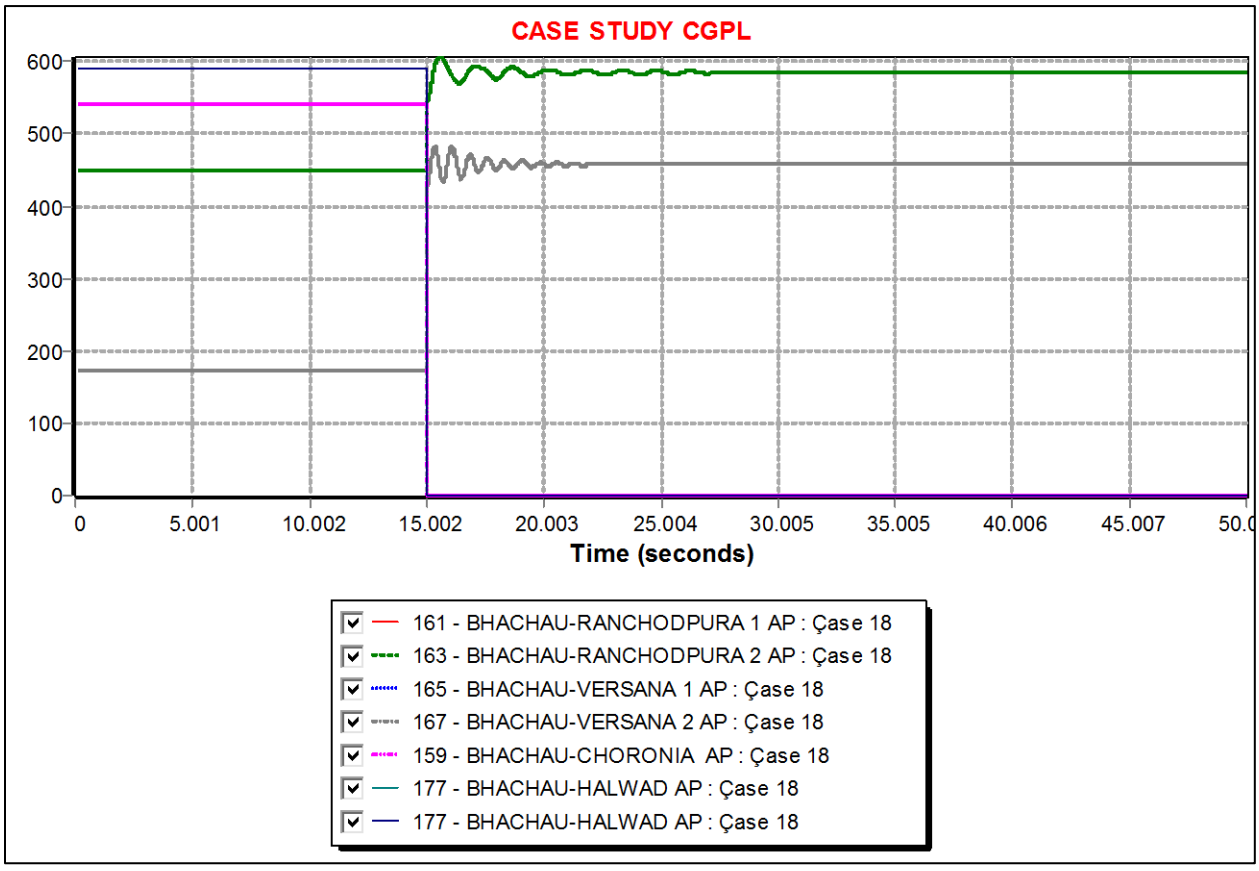

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 17
191 - CGPL-BHACHAU 1 AP : Çase 17
195 - CGPL-BHACHAU 3 AP : Çase 17
189 - CGPL-JETPUR 2 AP : Çase 17
193 - CGPL-BHACHAU 2 AP : Çase 17
197 - CGPL-BHACHAU 4 AP : Çase 17


CASE STUDY CGPL
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 17
163 - BHACHAU-RANCHODPURA 2 AP : Çase 17
165 - BHACHAU-VERSANA 1 AP : Çase 17
167 - BHACHAU-VERSANA 2 AP : Çase 17
159 - BHACHAU-CHORONIA AP : Çase 17
177 - BHACHAU-HALWAD AP : Çase 17

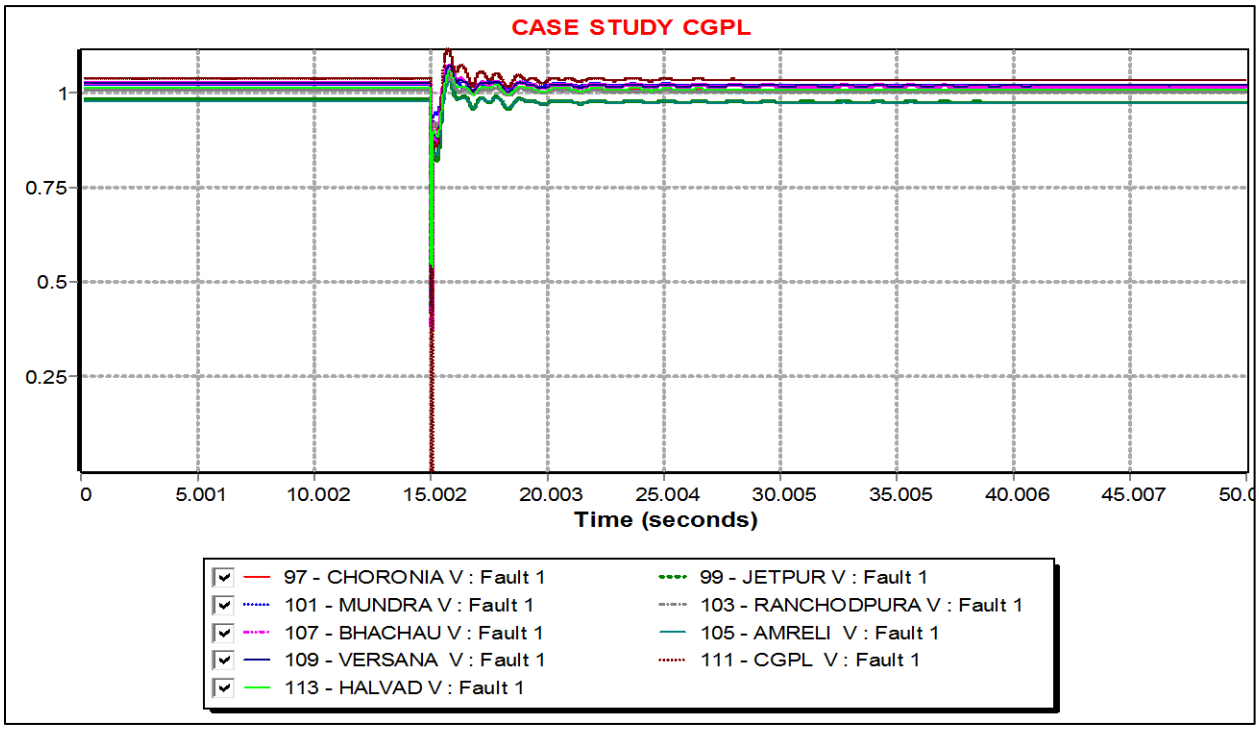
Case 18:

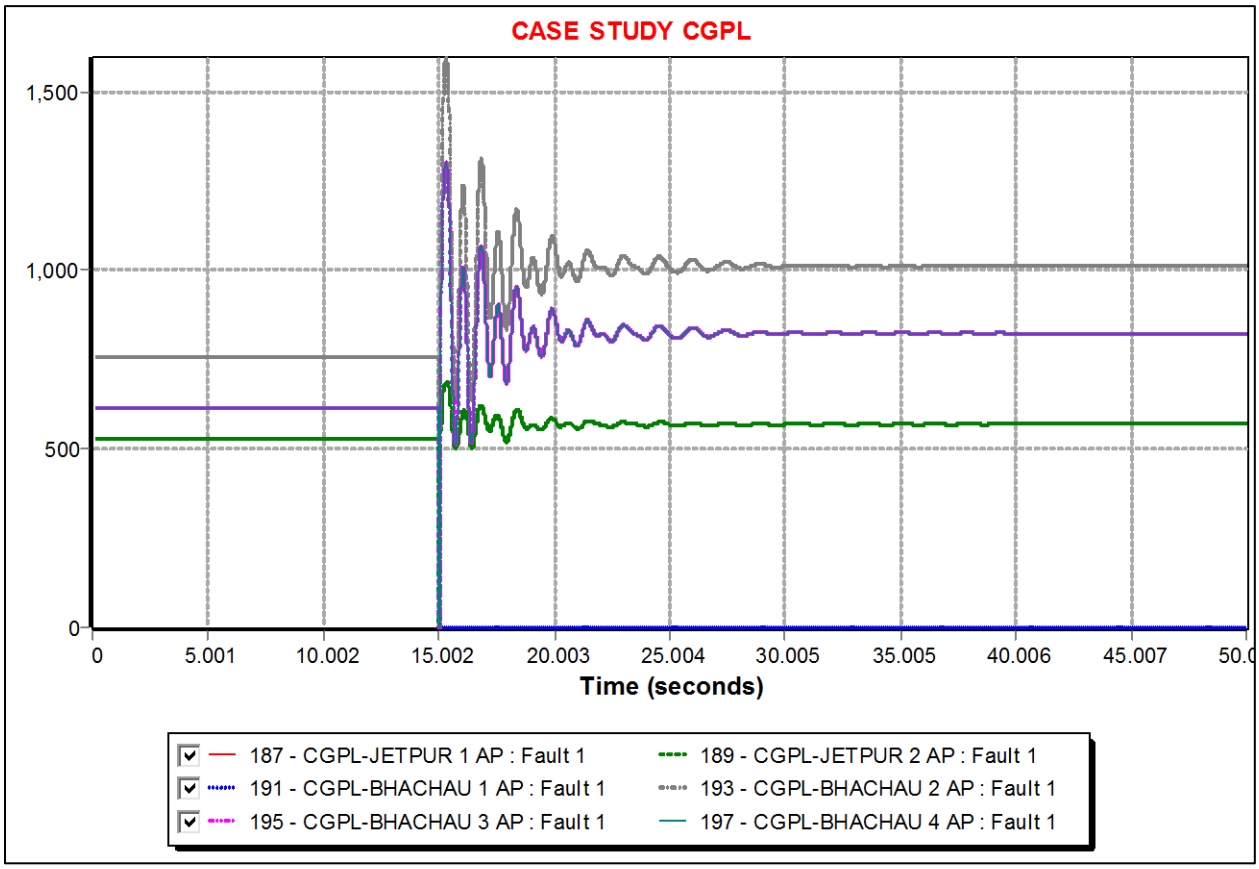

CASE STUDY CGPL
1.035
1.03
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Çase 18
99 - JETPUR V : Çase 18
101 - MUNDRA V : Çase 18
103 - RANCHODPURA V : Çase 18
107 - BHACHAU V : Çase 18
105 - AMRELI V : Çase 18
109 - VERSANA V : Çase 18
111 - CGPL V : Çase 18
113 - HALVAD V : Çase 18

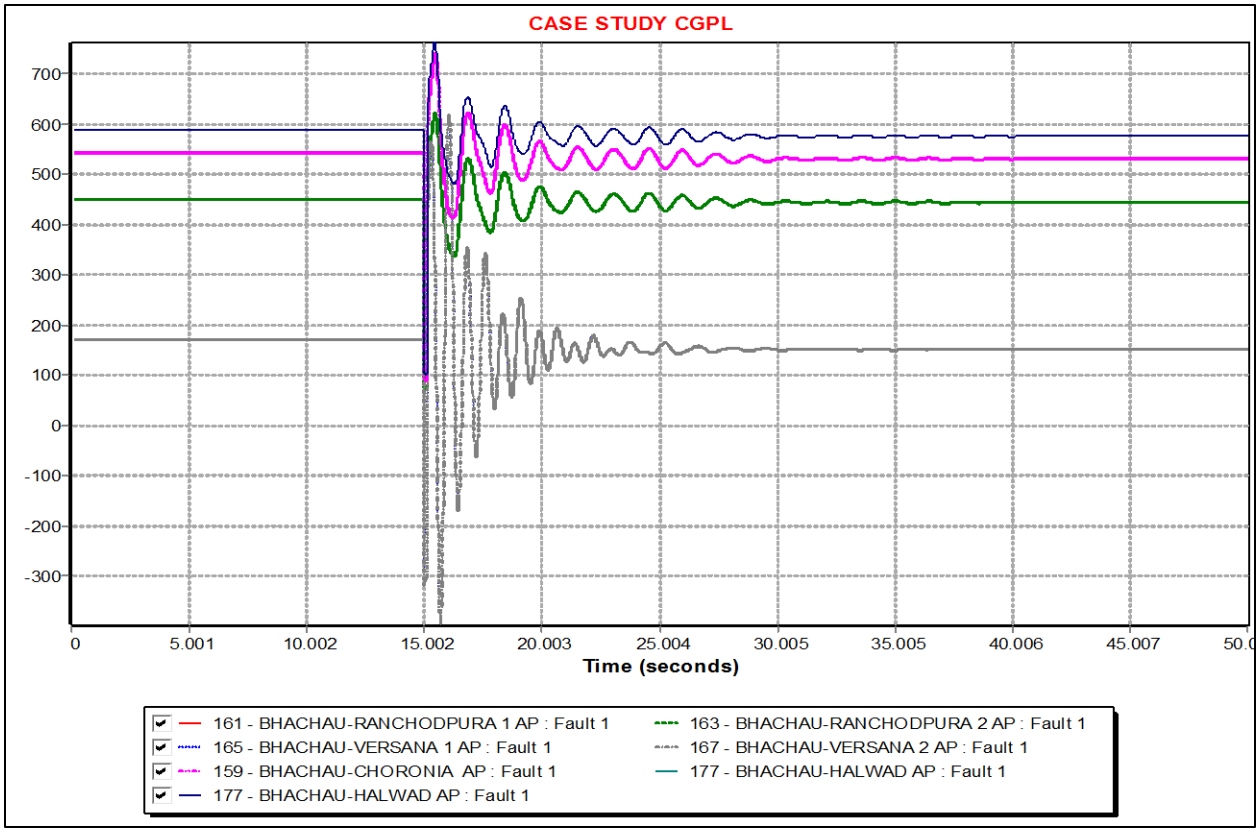

CASE STUDY CGPL
750
725
700
675
650
625
600
575
550
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Çase 18
189 - CGPL-JETPUR 2 AP : Çase 18
191 - CGPL-BHACHAU 1 AP : Çase 18
193 - CGPL-BHACHAU 2 AP : Çase 18
195 - CGPL-BHACHAU 3 AP : Çase 18
197 - CGPL-BHACHAU 4 AP : Çase 18


CASE STUDY CGPL
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Çase 18
163 - BHACHAU-RANCHODPURA 2 AP : Çase 18
165 - BHACHAU-VERSANA 1 AP : Çase 18
167 - BHACHAU-VERSANA 2 AP : Çase 18
159 - BHACHAU-CHORONIA AP : Çase 18
177 - BHACHAU-HALWAD AP : Çase 18
177 - BHACHAU-HALWAD AP : Çase 18

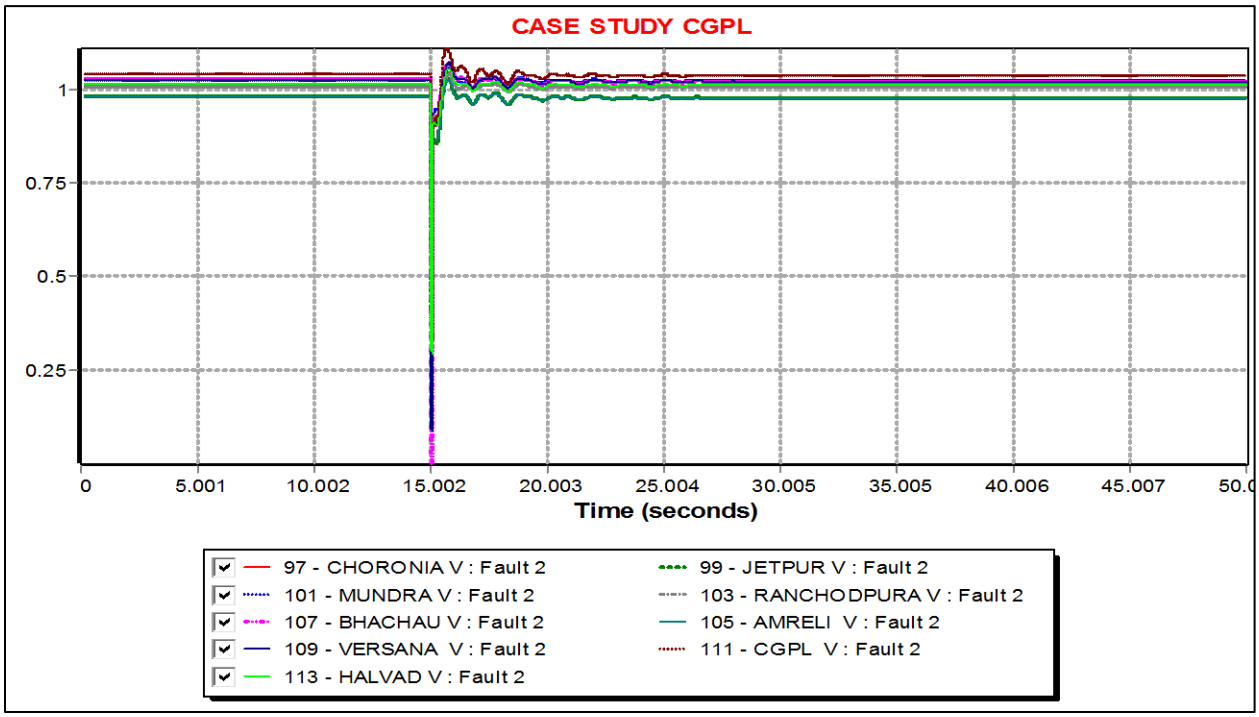
Fault 1:

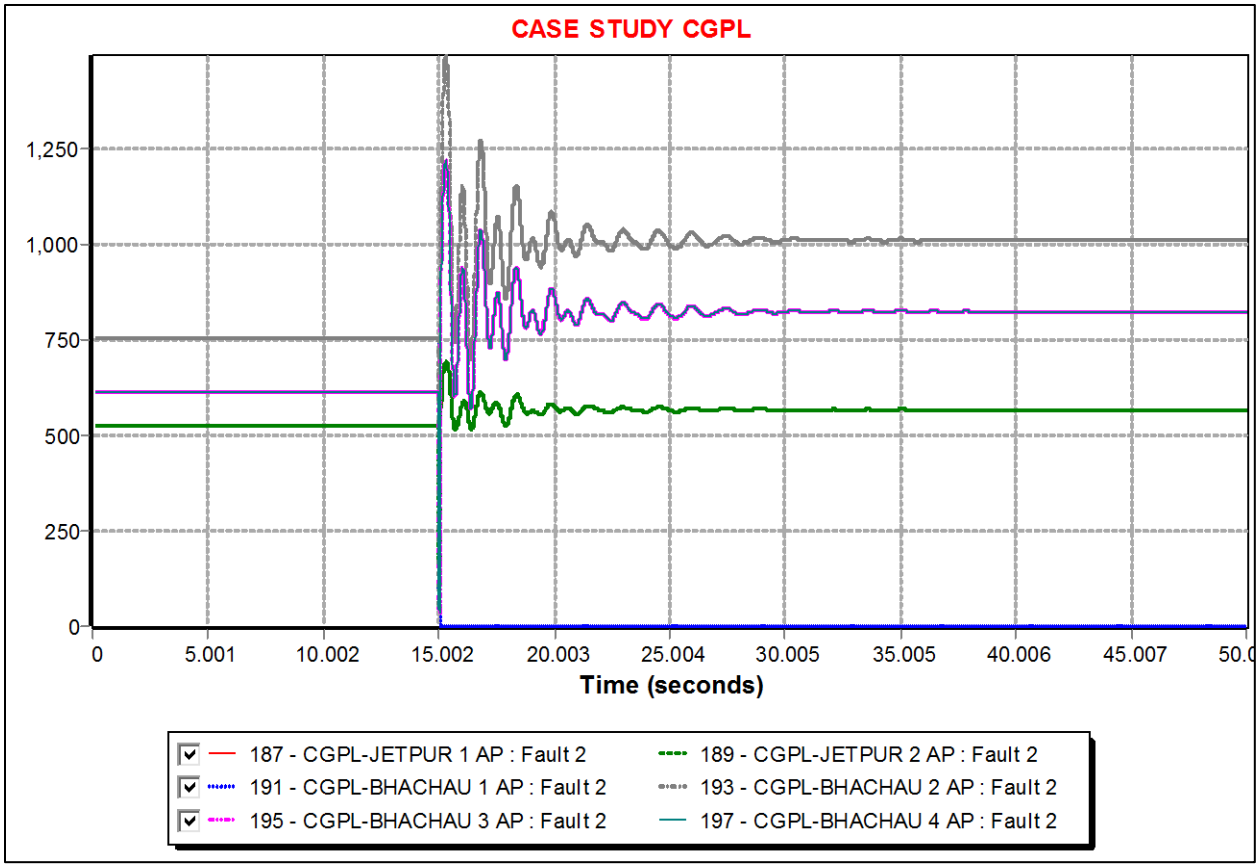

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 1
99 - JETPUR V : Fault 1
101 - MUNDRA V : Fault 1
103 - RANCHODPURA V : Fault 1
107 - BHACHAU V : Fault 1
105 - AMRELI V : Fault 1
109 - VERSANA V : Fault 1
111 - CGPL V : Fault 1
113 - HALVAD V : Fault 1

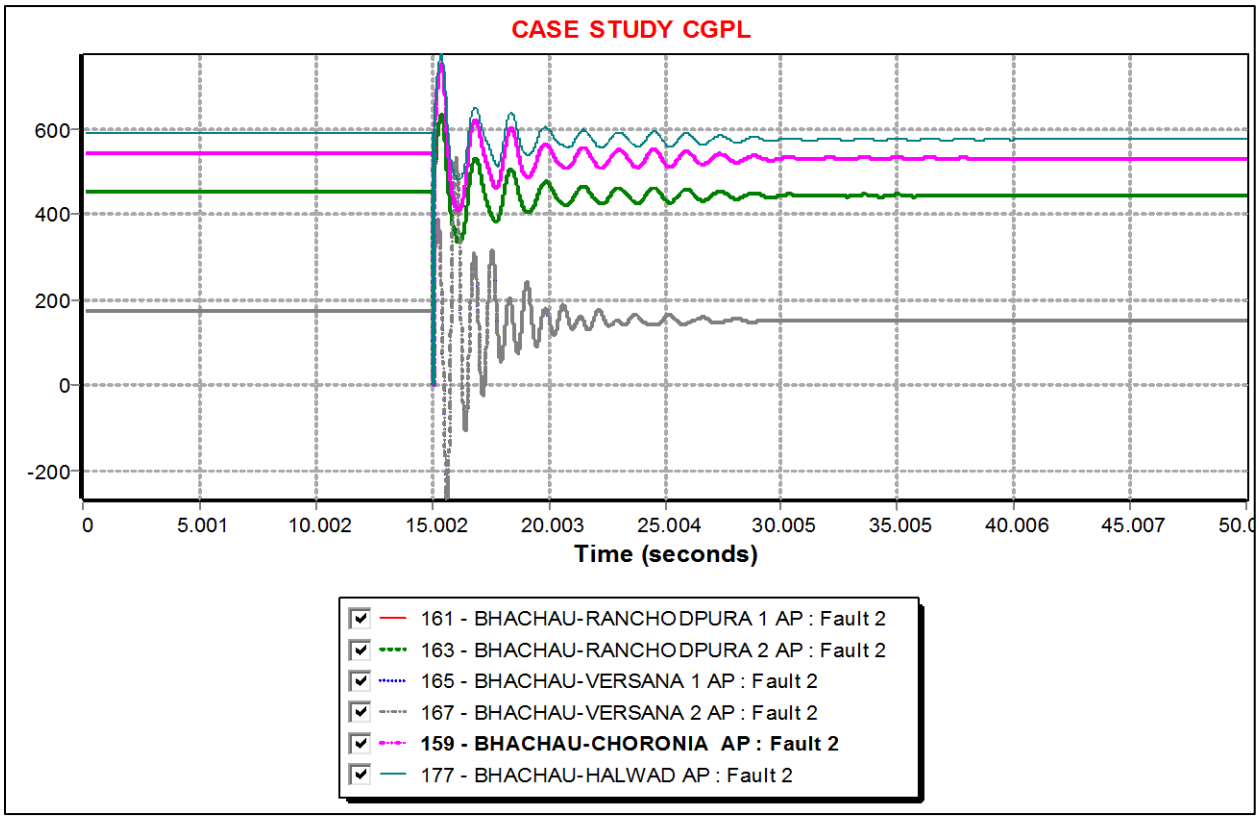

CASE STUDY CGPL
1,500
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 1
189 - CGPL-JETPUR 2 AP : Fault 1
191 - CGPL-BHACHAU 1 AP : Fault 1
193 - CGPL-BHACHAU 2 AP : Fault 1
195 - CGPL-BHACHAU 3 AP : Fault 1
197 - CGPL-BHACHAU 4 AP : Fault 1


CASE STUDY CGPL
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 1
165 - BHACHAU-VERSANA 1 AP : Fault 1
159 - BHACHAU-CHORONIA AP : Fault 1
177 - BHACHAU-HALWAD AP : Fault 1
163 - BHACHAU-RANCHODPURA 2 AP : Fault 1
167 - BHACHAU-VERSANA 2 AP : Fault 1
177 - BHACHAU-HALWAD AP : Fault 1

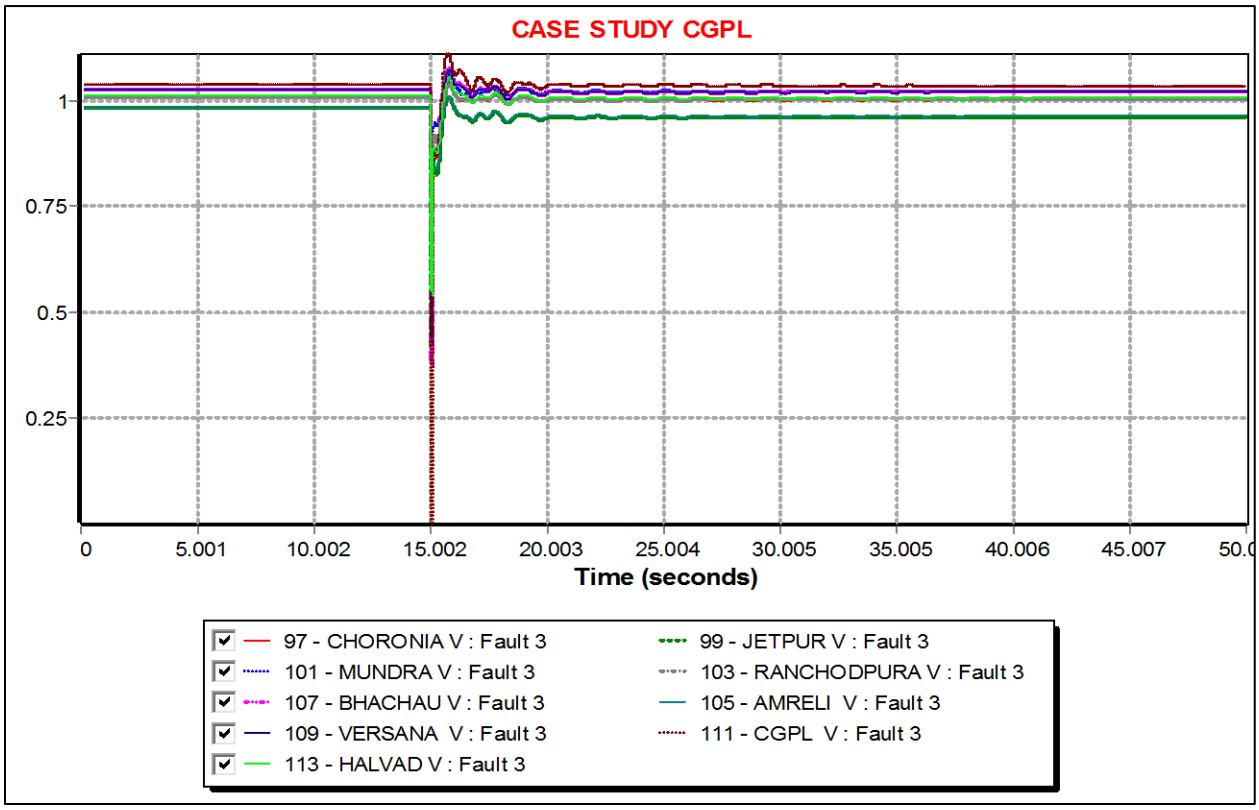
Fault 2:

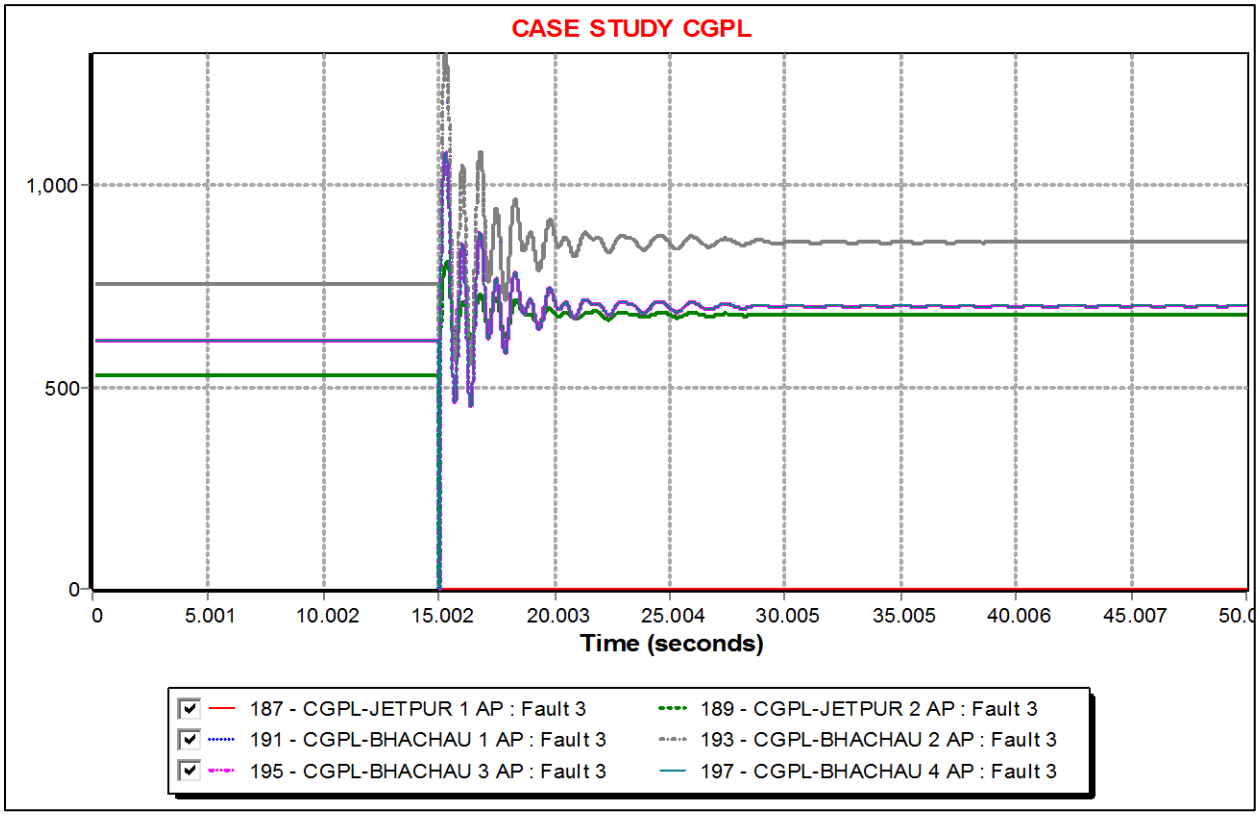

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 2
101 - MUNDRA V : Fault 2
107 - BHACHAU V : Fault 2
109 - VERSANA V : Fault 2
113 - HALVAD V : Fault 2
99 - JETPUR V : Fault 2
103 - RANCHODPURA V : Fault 2
105 - AMRELI V : Fault 2
111 - CGPL V : Fault 2

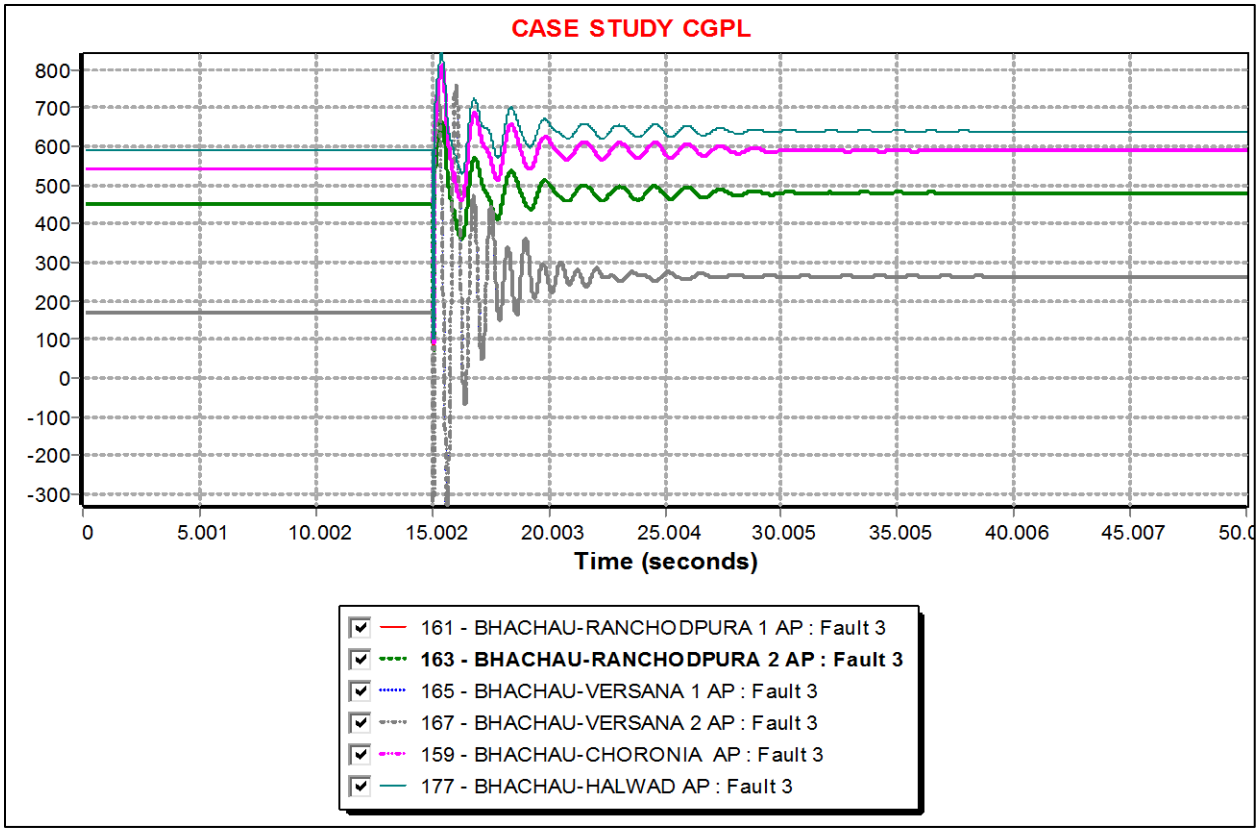

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 2
189 - CGPL-JETPUR 2 AP : Fault 2
191 - CGPL-BHACHAU 1 AP : Fault 2
193 - CGPL-BHACHAU 2 AP : Fault 2
195 - CGPL-BHACHAU 3 AP : Fault 2
197 - CGPL-BHACHAU 4 AP : Fault 2


CASE STUDY CGPL
600
400
200
0
-200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 2
163 - BHACHAU-RANCHODPURA 2 AP : Fault 2
165 - BHACHAU-VERSANA 1 AP : Fault 2
167 - BHACHAU-VERSANA 2 AP : Fault 2
159 - BHACHAU-CHORONIA AP : Fault 2
177 - BHACHAU-HALWAD AP : Fault 2

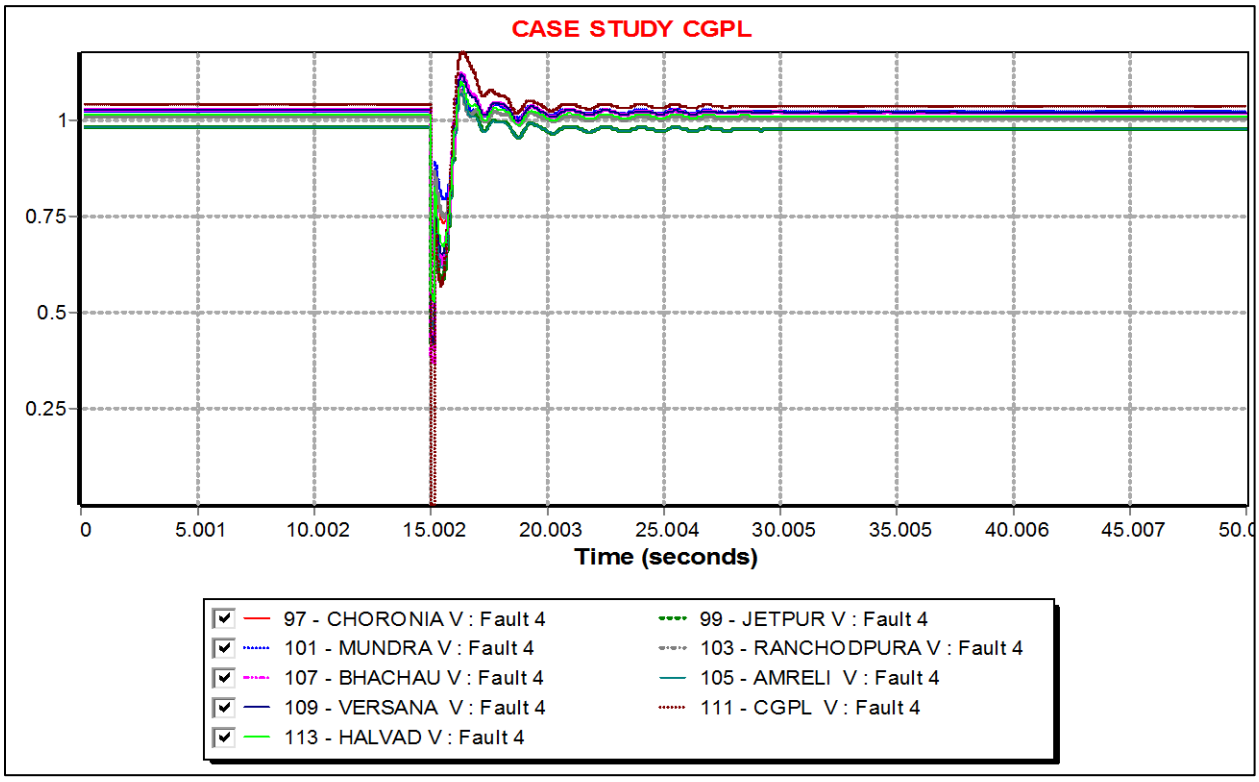
Fault 3:

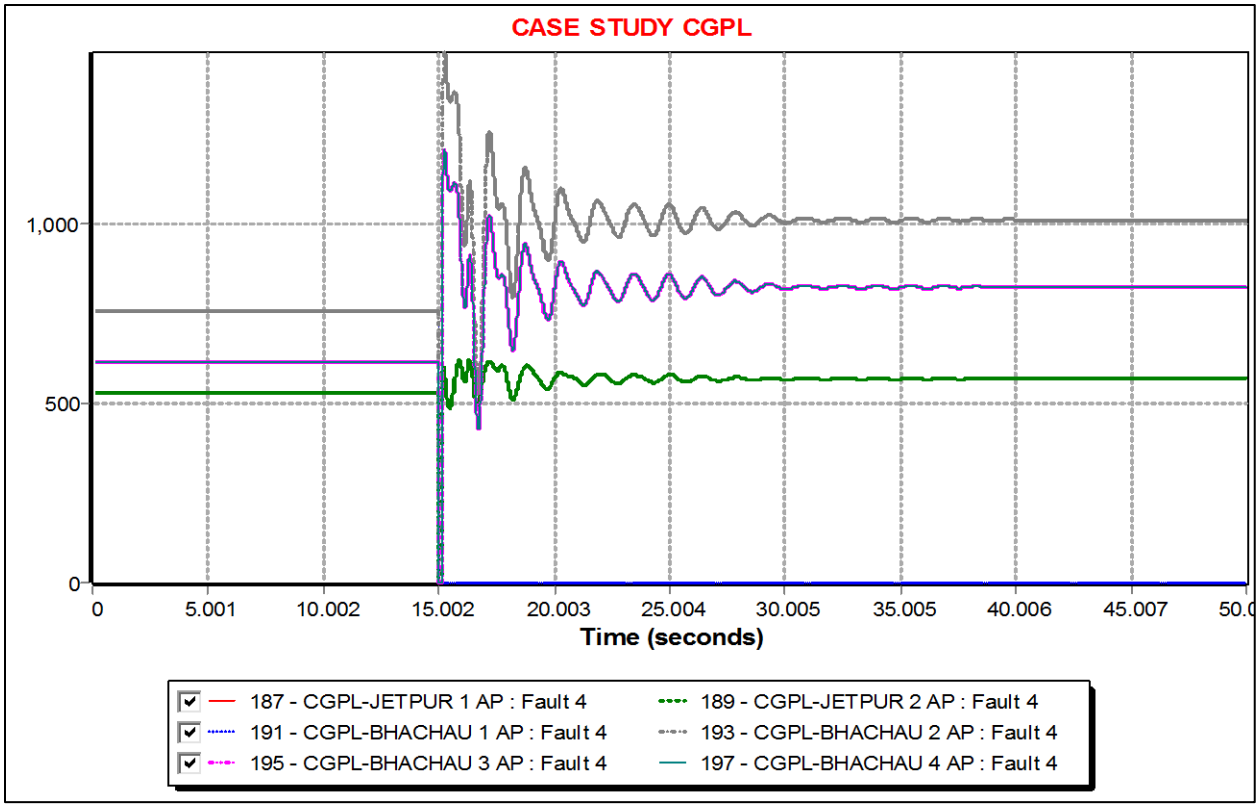

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 3
99 - JETPUR V : Fault 3
101 - MUNDRA V : Fault 3
103 - RANCHODPURA V : Fault 3
107 - BHACHAU V : Fault 3
105 - AMRELI V : Fault 3
109 - VERSANA V : Fault 3
111 - CGPL V : Fault 3
113 - HALVAD V : Fault 3

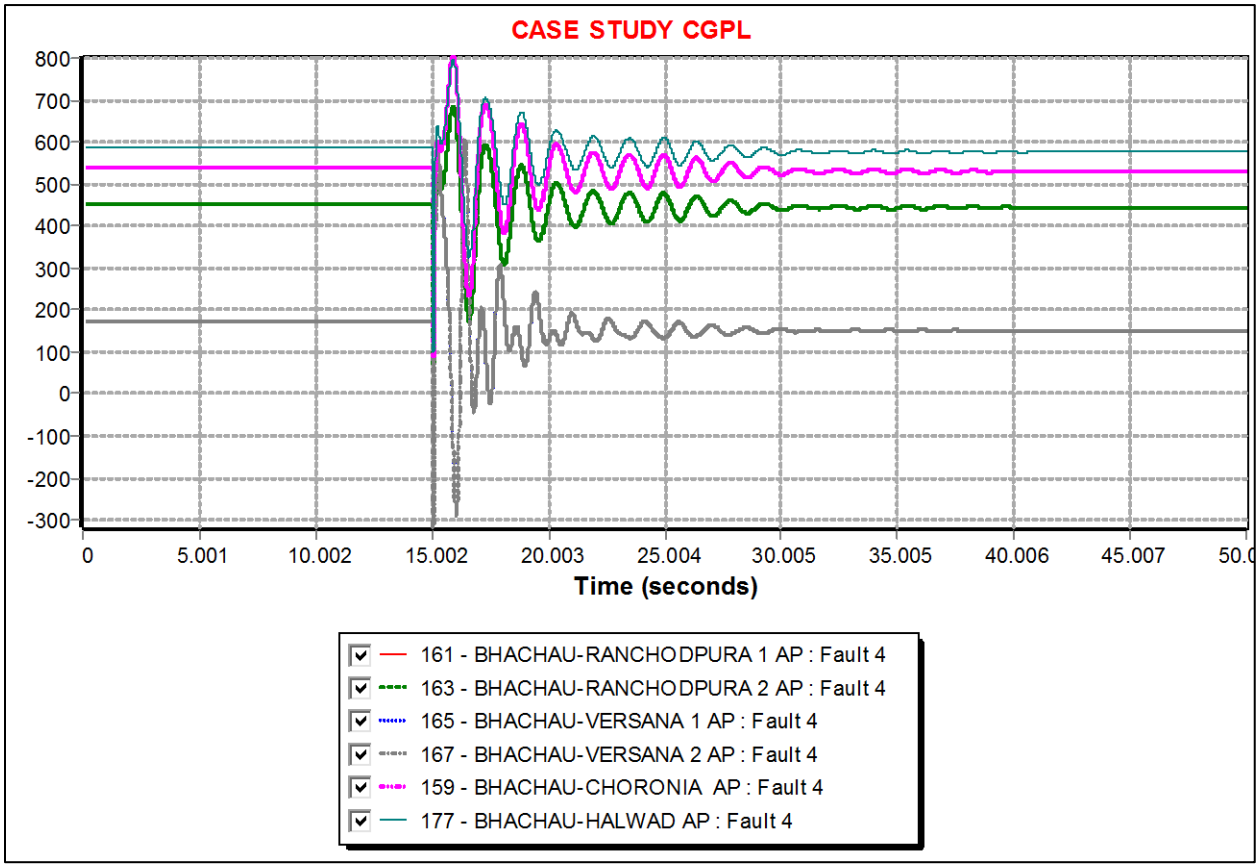

CASE STUDY CGPL
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 3
189 - CGPL-JETPUR 2 AP : Fault 3
191 - CGPL-BHACHAU 1 AP : Fault 3
193 - CGPL-BHACHAU 2 AP : Fault 3
195 - CGPL-BHACHAU 3 AP : Fault 3
197 - CGPL-BHACHAU 4 AP : Fault 3


CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 3
163 - BHACHAU-RANCHODPURA 2 AP : Fault 3
165 - BHACHAU-VERSANA 1 AP : Fault 3
167 - BHACHAU-VERSANA 2 AP : Fault 3
159 - BHACHAU-CHORONIA AP : Fault 3
177 - BHACHAU-HALWAD AP : Fault 3

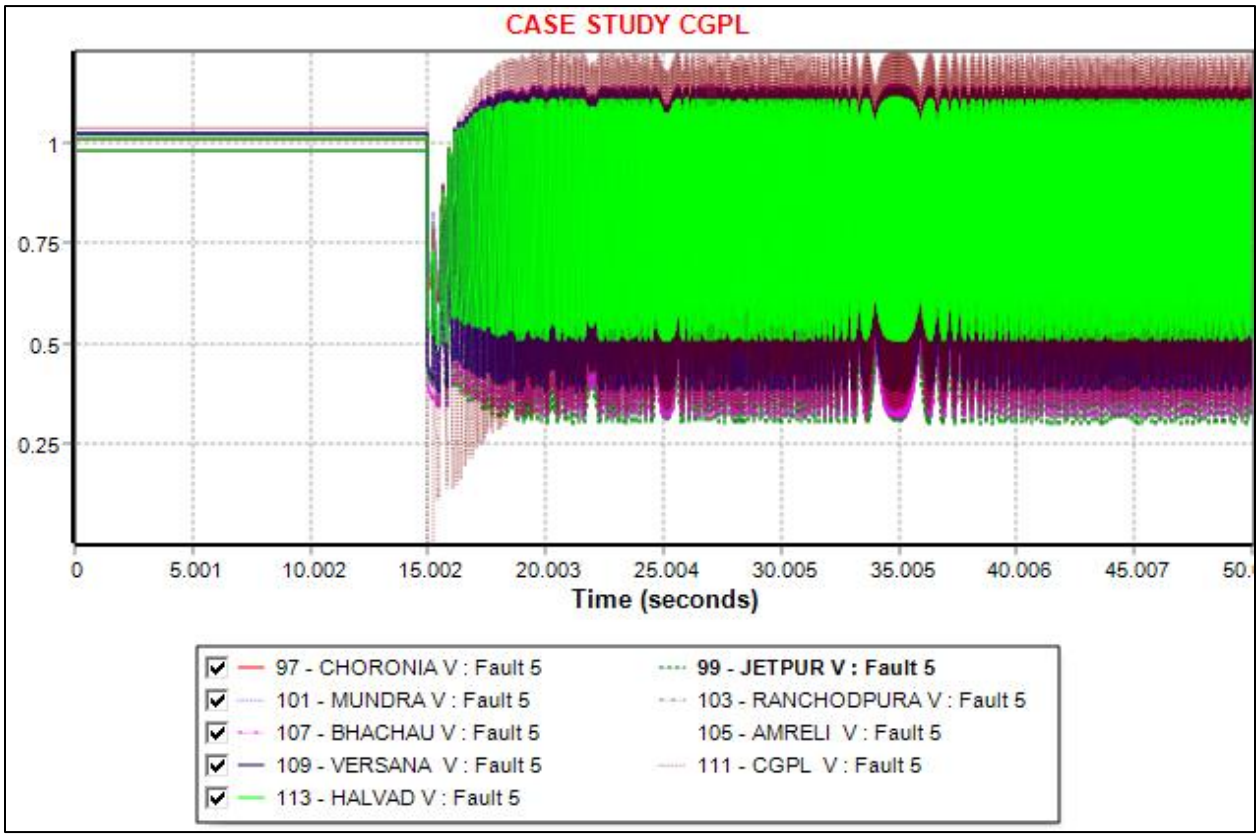
Fault 4:

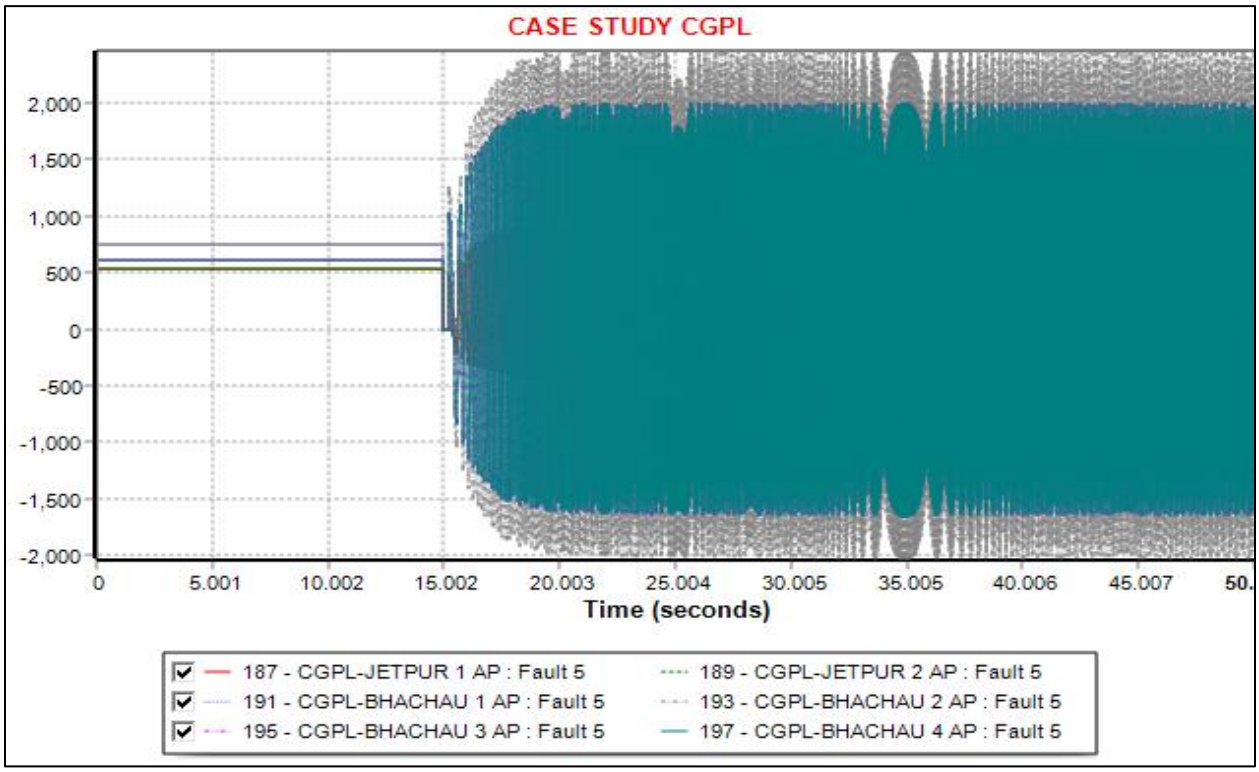

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 4
99 - JETPUR V : Fault 4
101 - MUNDRA V : Fault 4
103 - RANCHODPURA V : Fault 4
107 - BHACHAU V : Fault 4
105 - AMRELI V : Fault 4
109 - VERSANA V : Fault 4
111 - CGPL V : Fault 4
113 - HALVAD V : Fault 4


CASE STUDY CGPL
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 4
189 - CGPL-JETPUR 2 AP : Fault 4
191 - CGPL-BHACHAU 1 AP : Fault 4
193 - CGPL-BHACHAU 2 AP : Fault 4
195 - CGPL-BHACHAU 3 AP : Fault 4
197 - CGPL-BHACHAU 4 AP : Fault 4

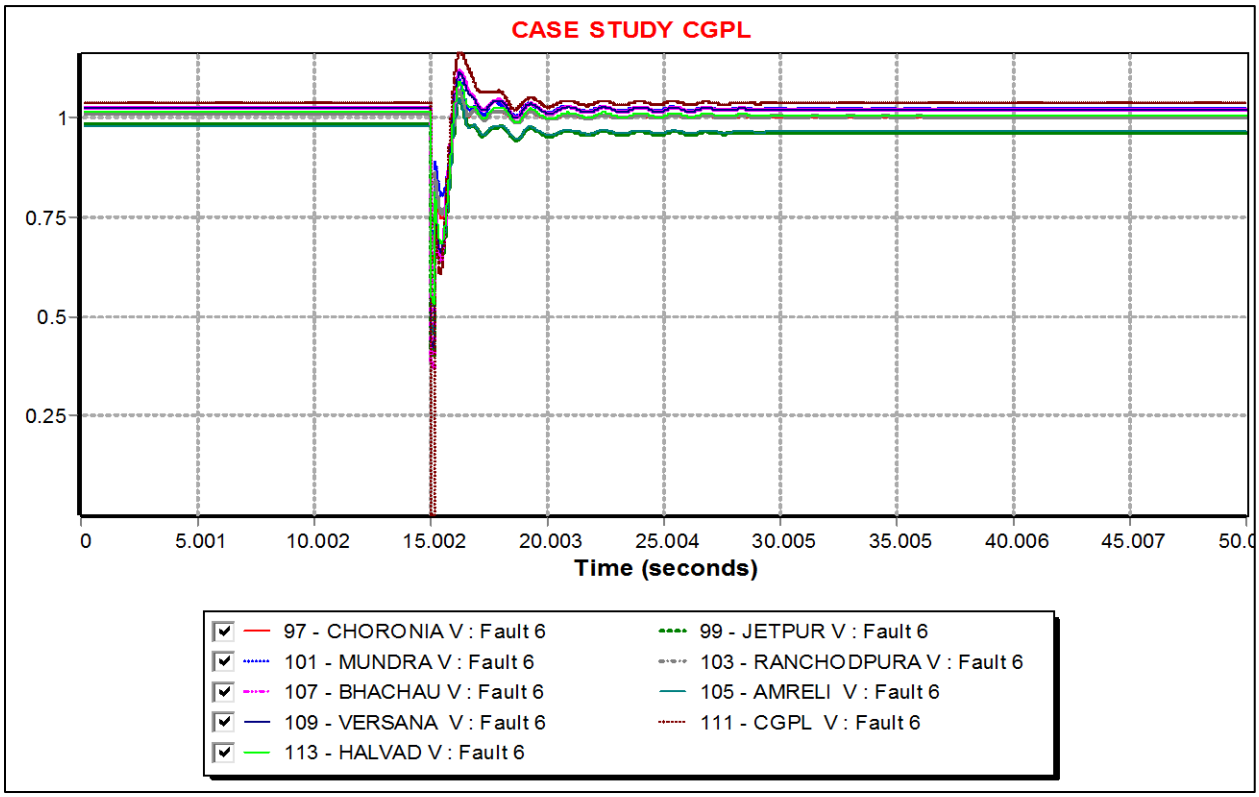

CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 4
163 - BHACHAU-RANCHODPURA 2 AP : Fault 4
165 - BHACHAU-VERSANA 1 AP : Fault 4
167 - BHACHAU-VERSANA 2 AP : Fault 4
159 - BHACHAU-CHORONIA AP : Fault 4
177 - BHACHAU-HALWAD AP : Fault 4

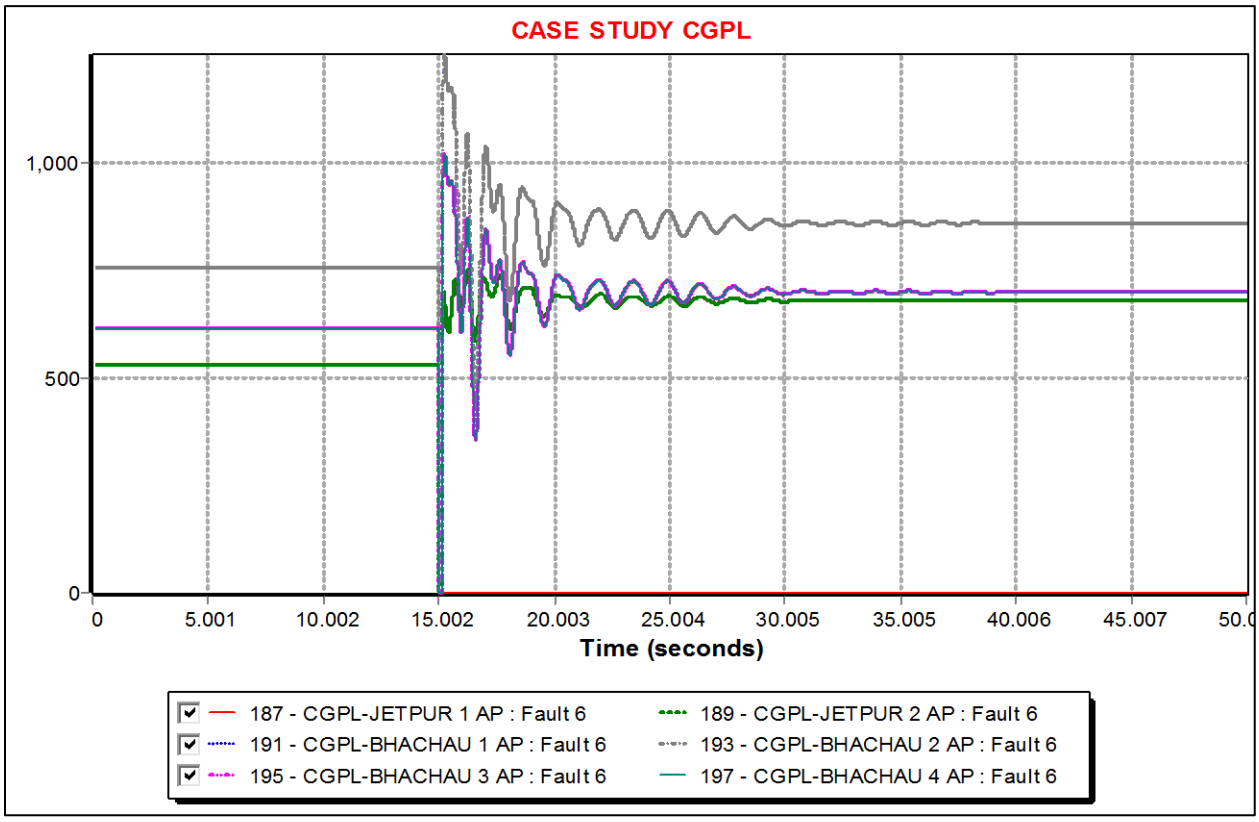
Fault 5:

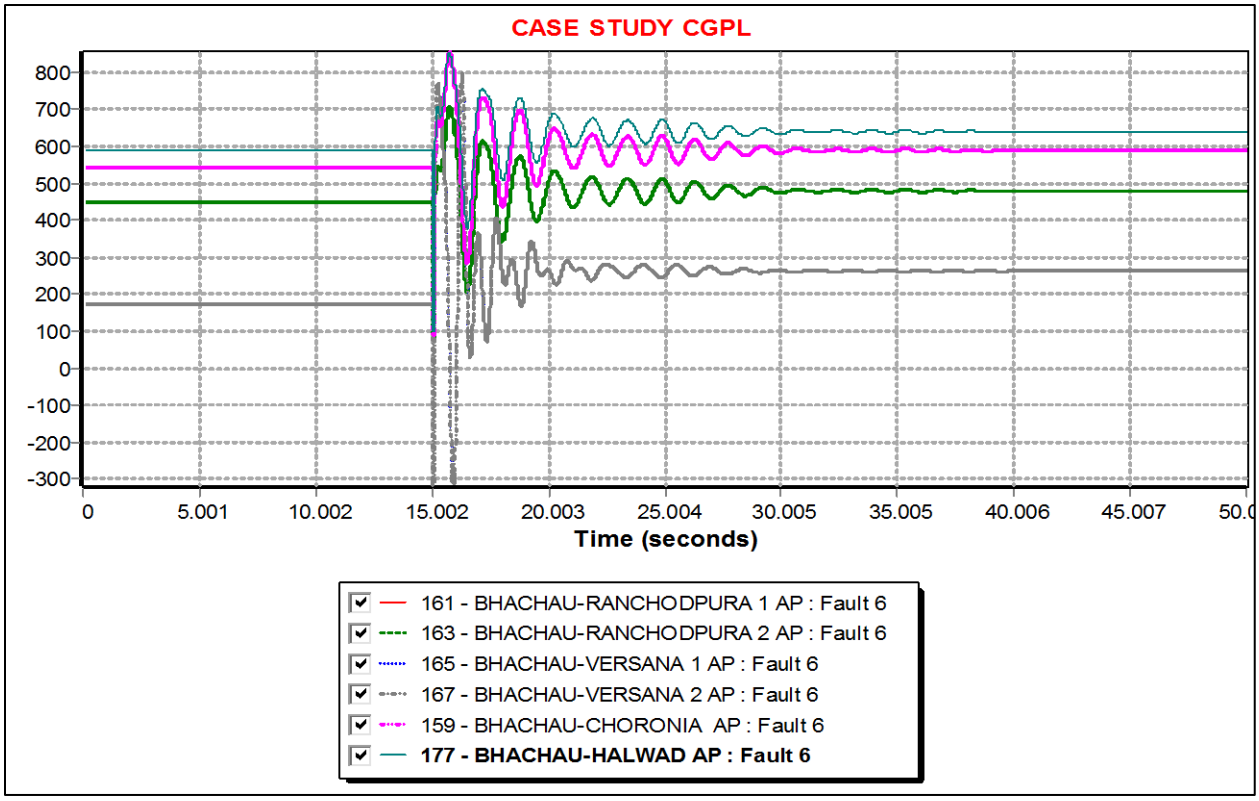

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 5
99 - JETPUR V : Fault 5
101 - MUNDRA V : Fault 5
103 - RANCHODPURA V : Fault 5
107 - BHACHAU V : Fault 5
105 - AMRELI V : Fault 5
109 - VERSANA V : Fault 5
111 - CGPL V : Fault 5
113 - HALVAD V : Fault 5


CASE STUDY CGPL
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 5
189 - CGPL-JETPUR 2 AP : Fault 5
191 - CGPL-BHACHAU 1 AP : Fault 5
193 - CGPL-BHACHAU 2 AP : Fault 5
195 - CGPL-BHACHAU 3 AP : Fault 5
197 - CGPL-BHACHAU 4 AP : Fault 5

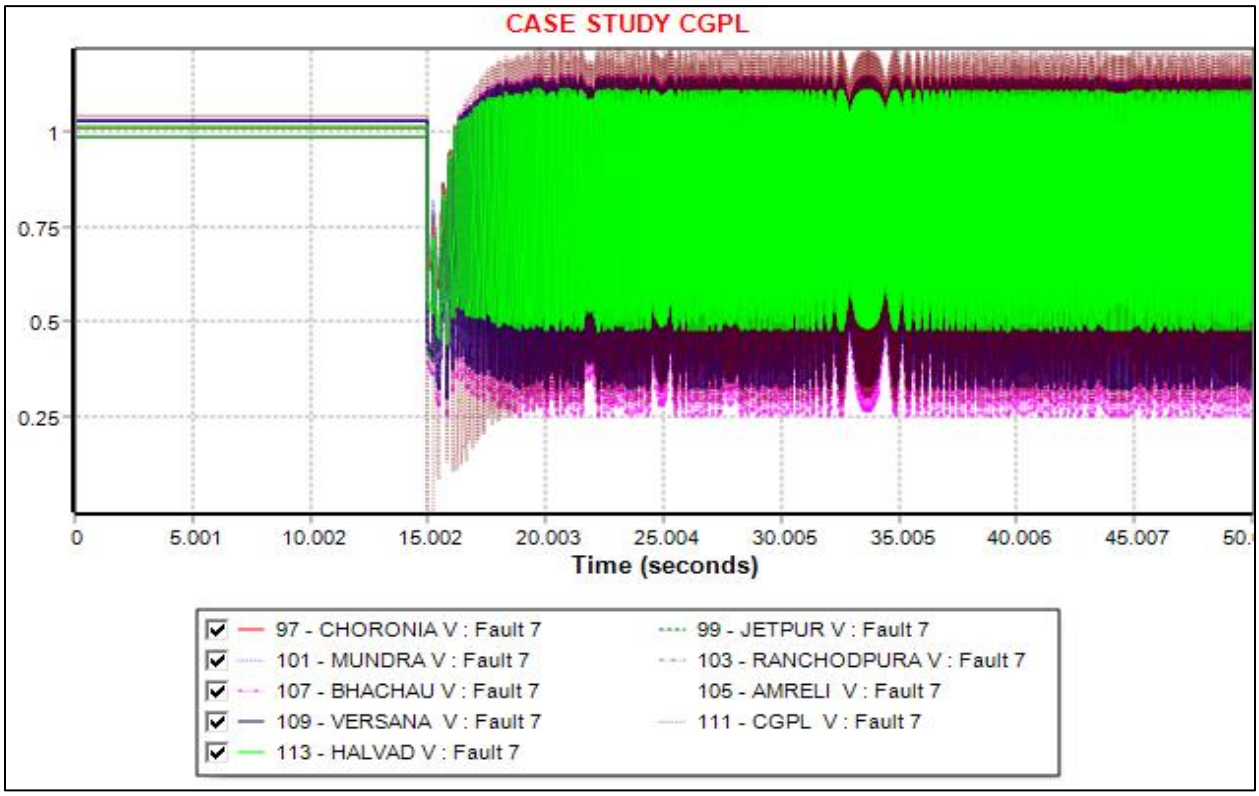
Fault 6:

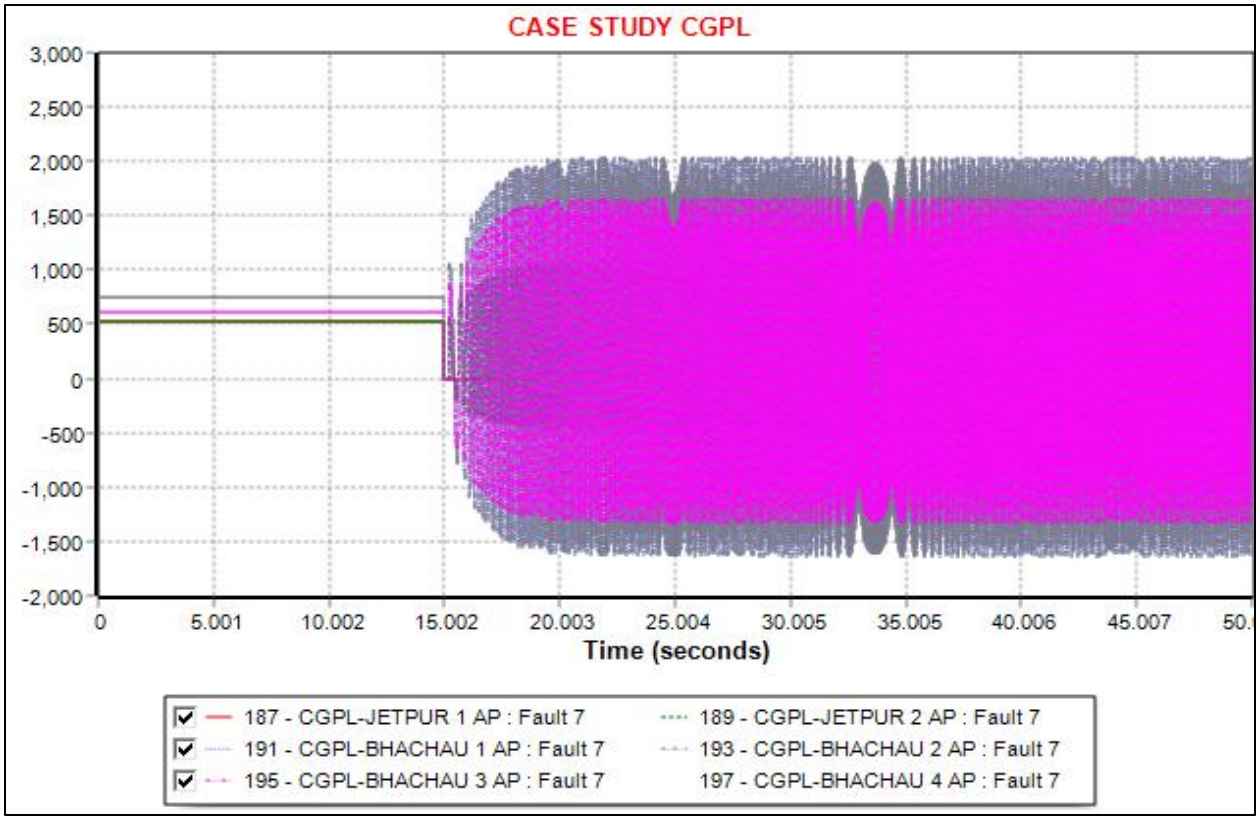

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 6
99 - JETPUR V : Fault 6
101 - MUNDRA V : Fault 6
103 - RANCHODPURA V : Fault 6
107 - BHACHAU V : Fault 6
105 - AMRELI V : Fault 6
109 - VERSANA V : Fault 6
111 - CGPL V : Fault 6
113 - HALVAD V : Fault 6


CASE STUDY CGPL
1,000
500
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 6
189 - CGPL-JETPUR 2 AP : Fault 6
191 - CGPL-BHACHAU 1 AP : Fault 6
193 - CGPL-BHACHAU 2 AP : Fault 6
195 - CGPL-BHACHAU 3 AP : Fault 6
197 - CGPL-BHACHAU 4 AP : Fault 6

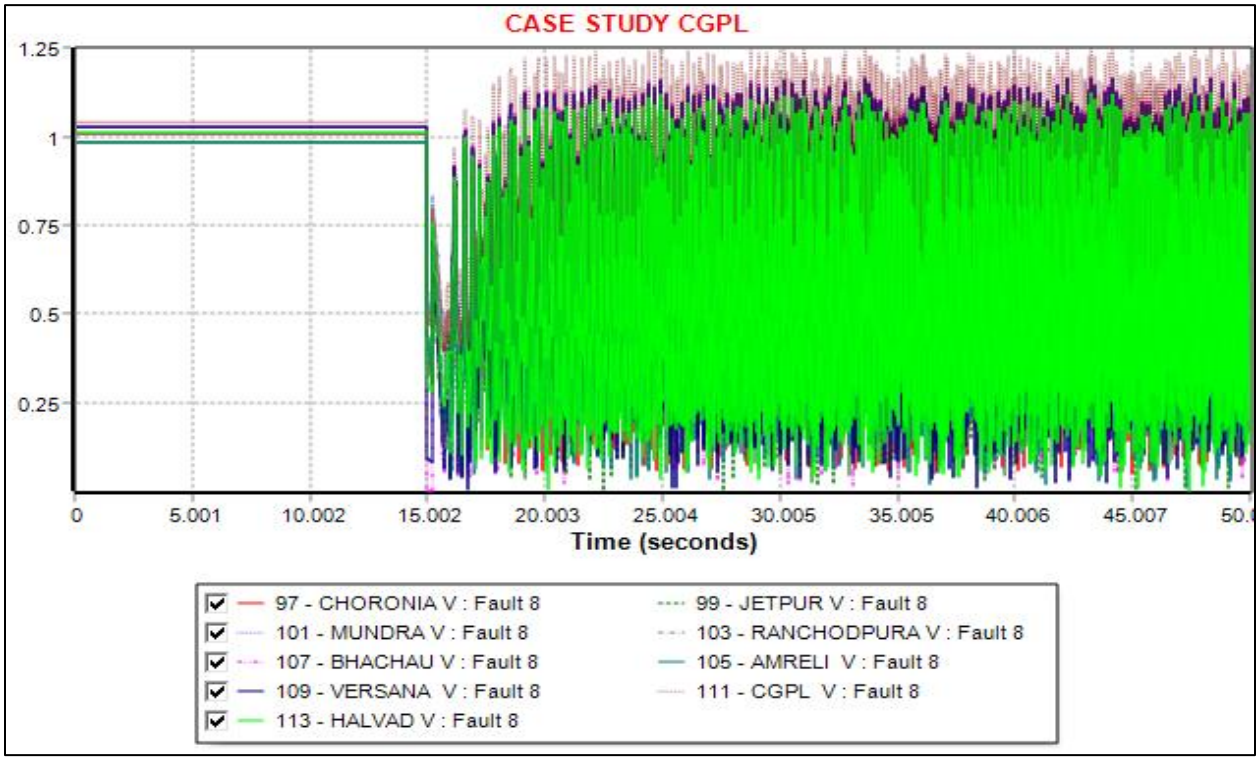

CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 6
163 - BHACHAU-RANCHODPURA 2 AP : Fault 6
165 - BHACHAU-VERSANA 1 AP : Fault 6
167 - BHACHAU-VERSANA 2 AP : Fault 6
159 - BHACHAU-CHORONIA AP : Fault 6
177 - BHACHAU-HALWAD AP : Fault 6

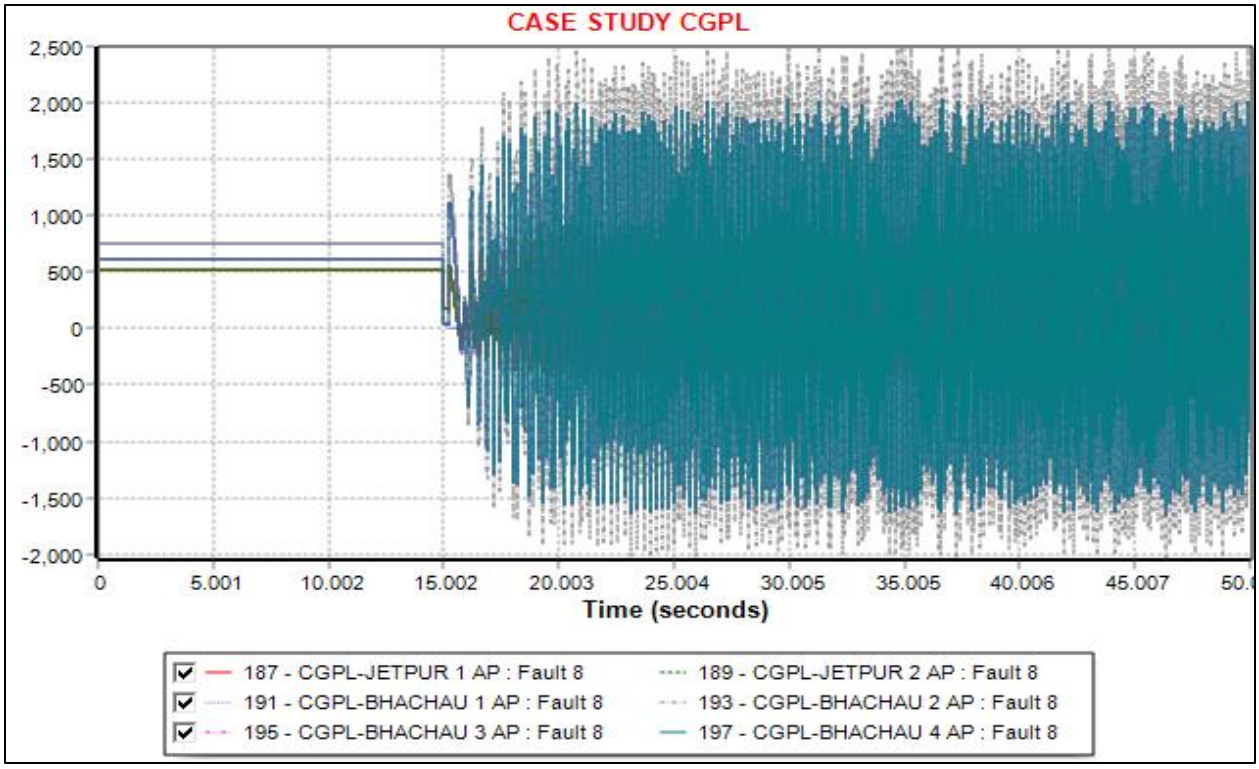
Fault 7 :


CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 7
99 - JETPUR V : Fault 7
101 - MUNDRA V : Fault 7
103 - RANCHODPURA V : Fault 7
107 - BHACHAU V : Fault 7
105 - AMRELI V : Fault 7
109 - VERSANA V : Fault 7
111 - CGPL V : Fault 7
113 - HALVAD V : Fault 7

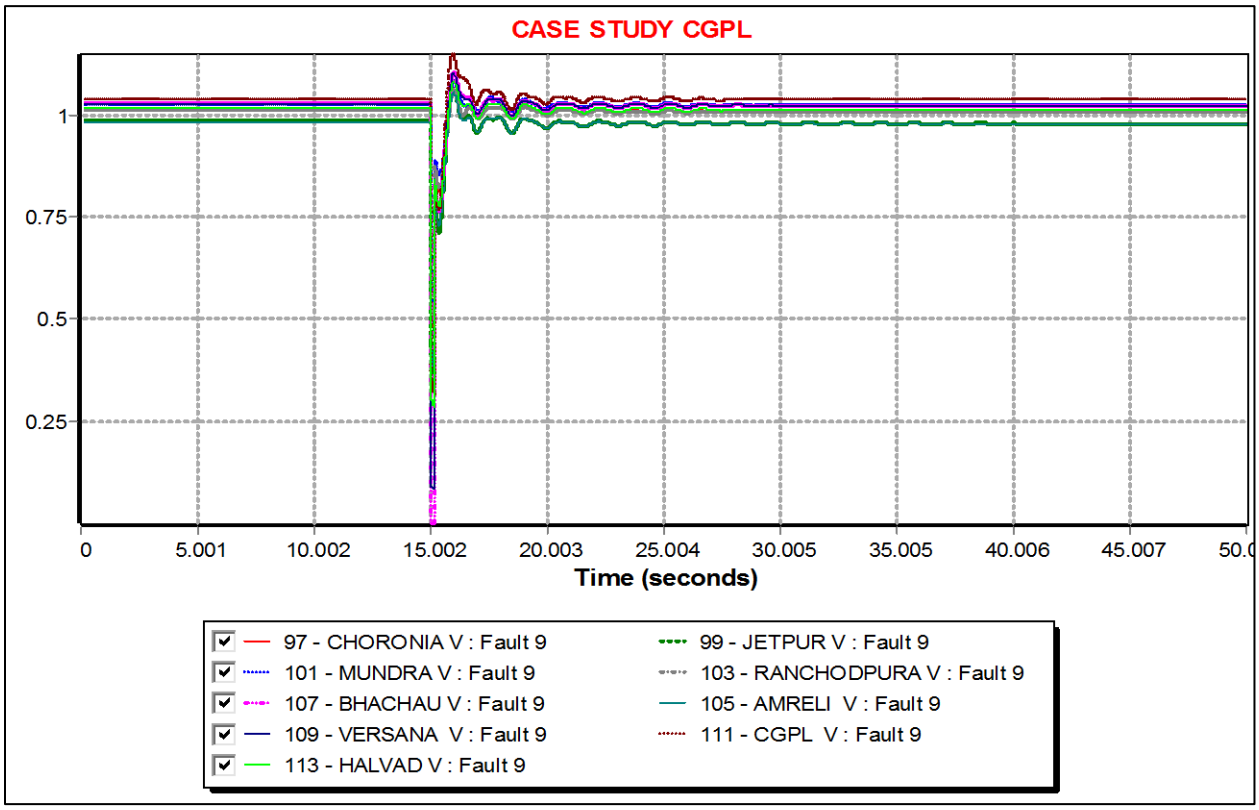

CASE STUDY CGPL
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 7
189 - CGPL-JETPUR 2 AP : Fault 7
191 - CGPL-BHACHAU 1 AP : Fault 7
193 - CGPL-BHACHAU 2 AP : Fault 7
195 - CGPL-BHACHAU 3 AP : Fault 7
197 - CGPL-BHACHAU 4 AP : Fault 7

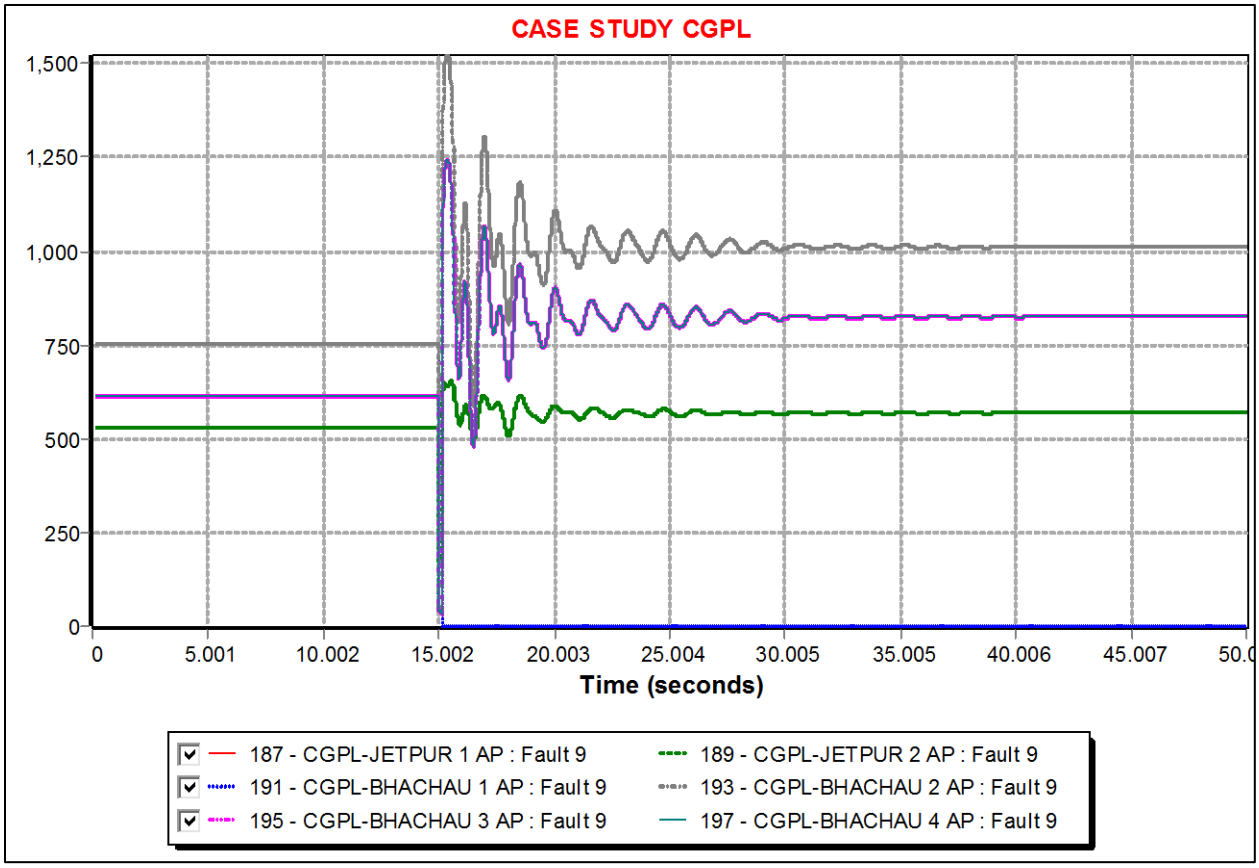
Fault 8 :

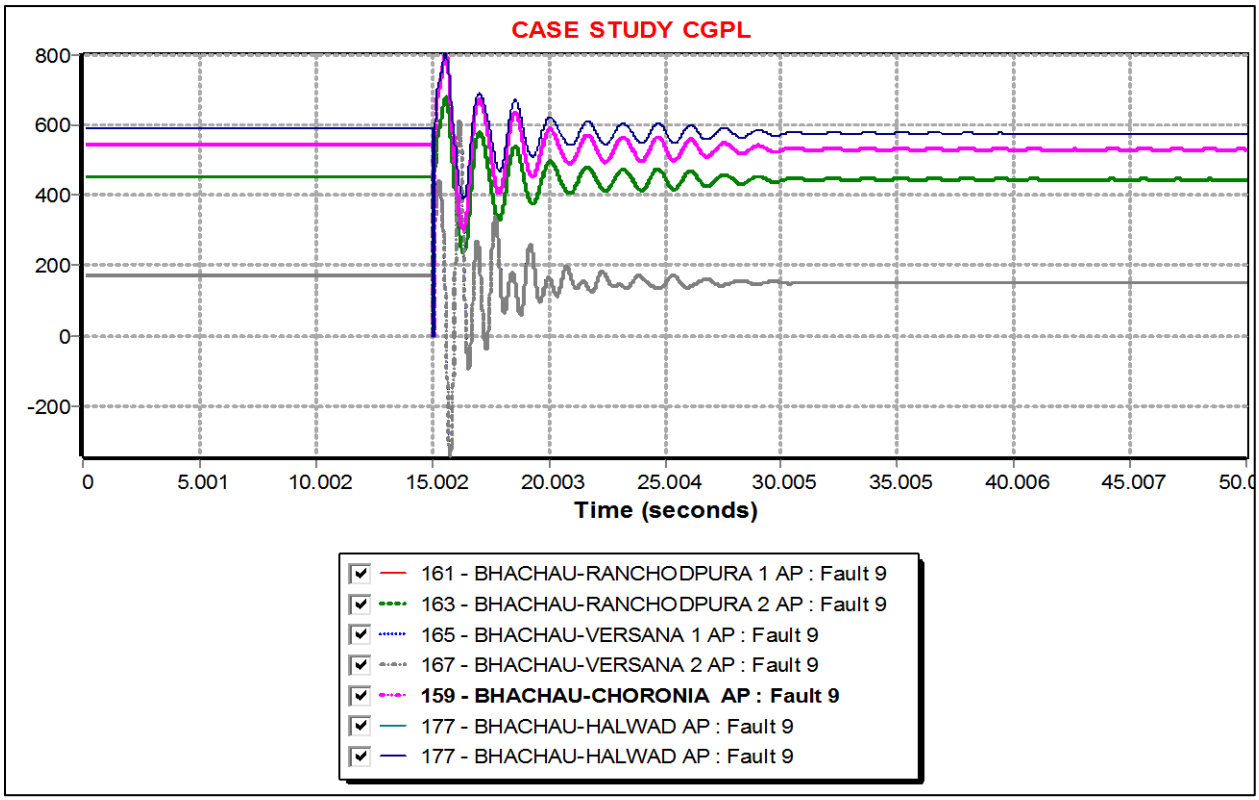

CASE STUDY CGPL
1.25
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 8
99 - JETPUR V : Fault 8
101 - MUNDRA V : Fault 8
103 - RANCHODPURA V : Fault 8
107 - BHACHAU V : Fault 8
105 - AMRELI V : Fault 8
109 - VERSANA V : Fault 8
111 - CGPL V : Fault 8
113 - HALVAD V : Fault 8


CASE STUDY CGPL
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 8
189 - CGPL-JETPUR 2 AP : Fault 8
191 - CGPL-BHACHAU 1 AP : Fault 8
193 - CGPL-BHACHAU 2 AP : Fault 8
195 - CGPL-BHACHAU 3 AP : Fault 8
197 - CGPL-BHACHAU 4 AP : Fault 8

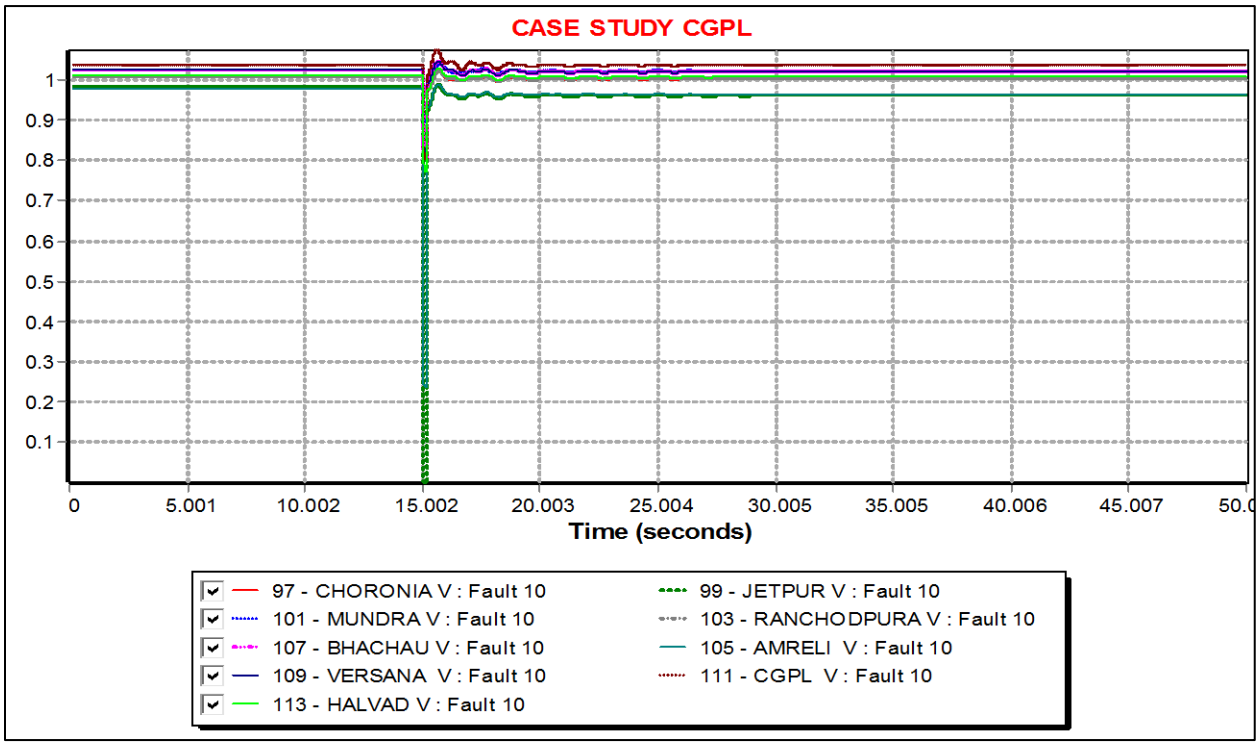
Fault 9:

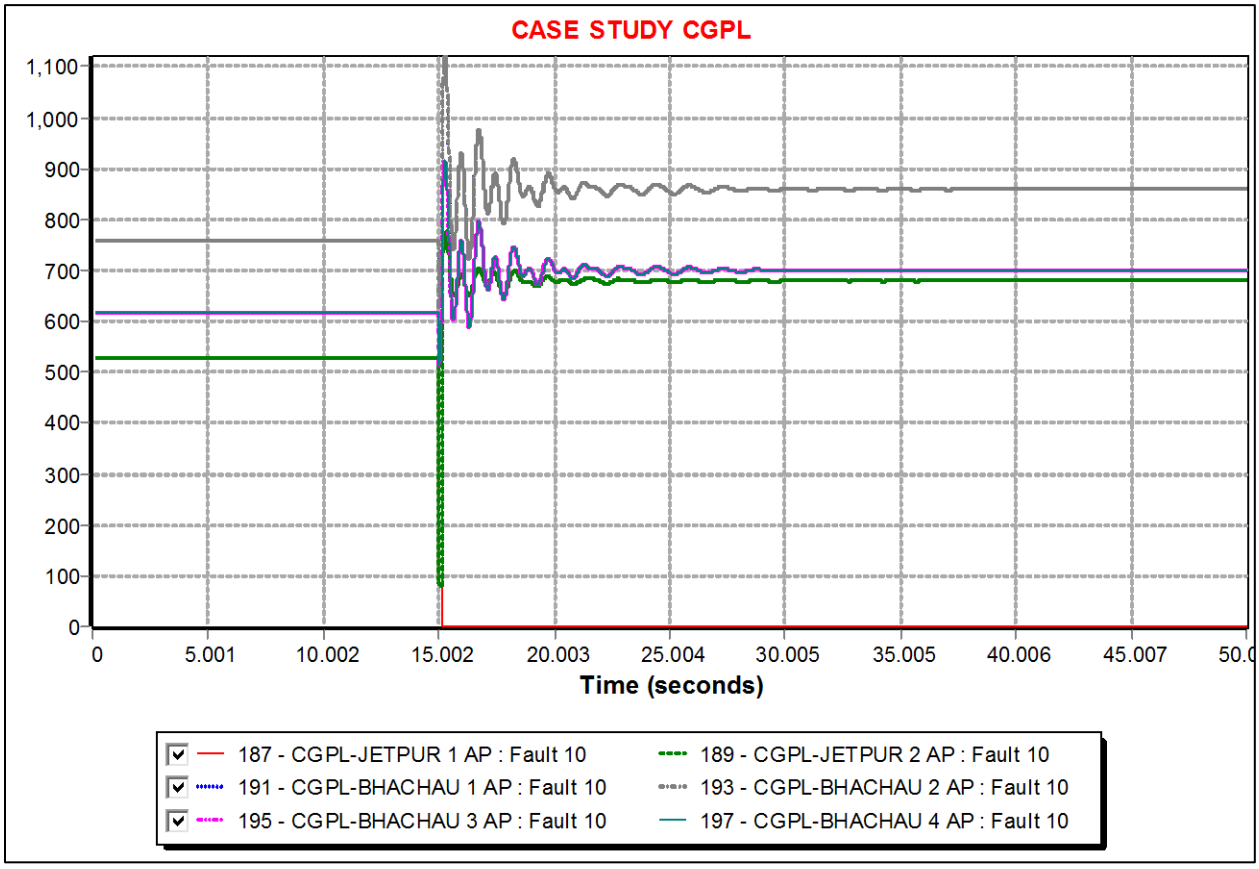

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 9
99 - JETPUR V : Fault 9
101 - MUNDRA V : Fault 9
103 - RANCHODPURA V : Fault 9
107 - BHACHAU V : Fault 9
105 - AMRELI V : Fault 9
109 - VERSANA V : Fault 9
111 - CGPL V : Fault 9
113 - HALVAD V : Fault 9

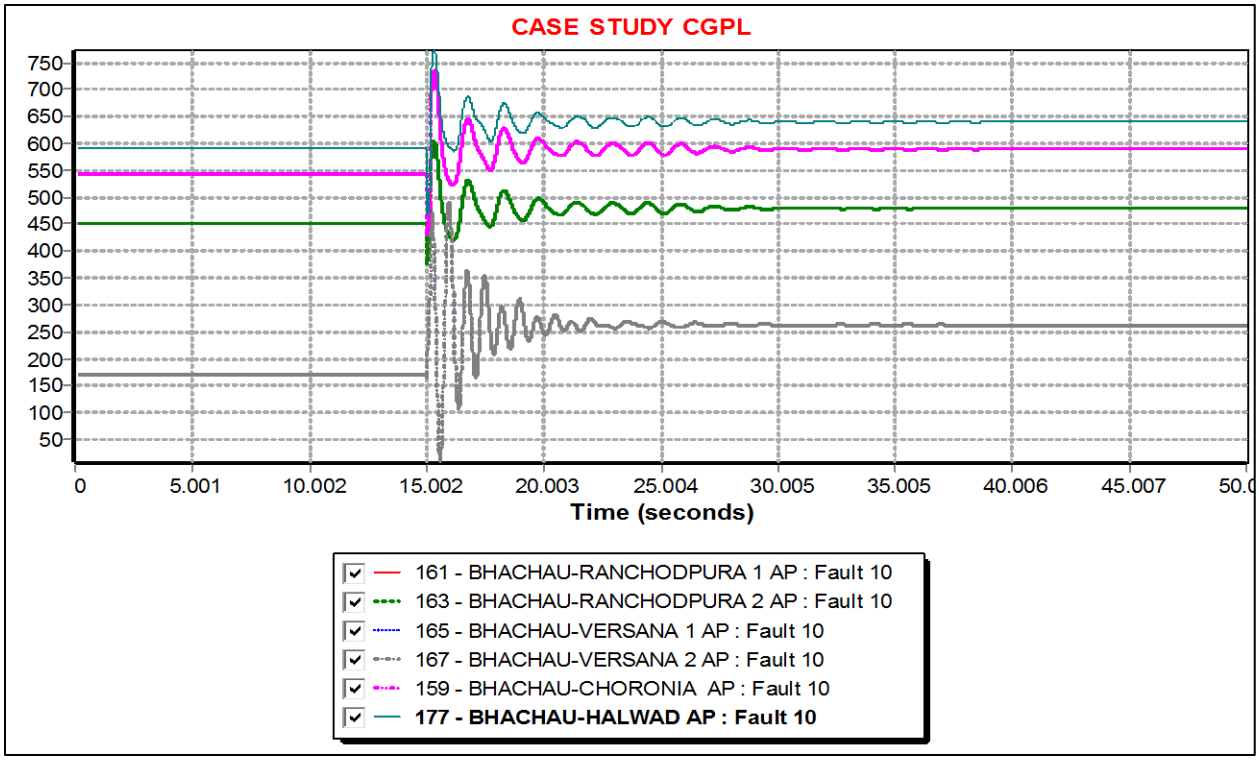

CASE STUDY CGPL
1,500
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 9
189 - CGPL-JETPUR 2 AP : Fault 9
191 - CGPL-BHACHAU 1 AP : Fault 9
193 - CGPL-BHACHAU 2 AP : Fault 9
195 - CGPL-BHACHAU 3 AP : Fault 9
197 - CGPL-BHACHAU 4 AP : Fault 9


CASE STUDY CGPL
800
600
400
200
0
-200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 9
163 - BHACHAU-RANCHODPURA 2 AP : Fault 9
165 - BHACHAU-VERSANA 1 AP : Fault 9
167 - BHACHAU-VERSANA 2 AP : Fault 9
159 - BHACHAU-CHORONIA AP : Fault 9
177 - BHACHAU-HALWAD AP : Fault 9
177 - BHACHAU-HALWAD AP : Fault 9

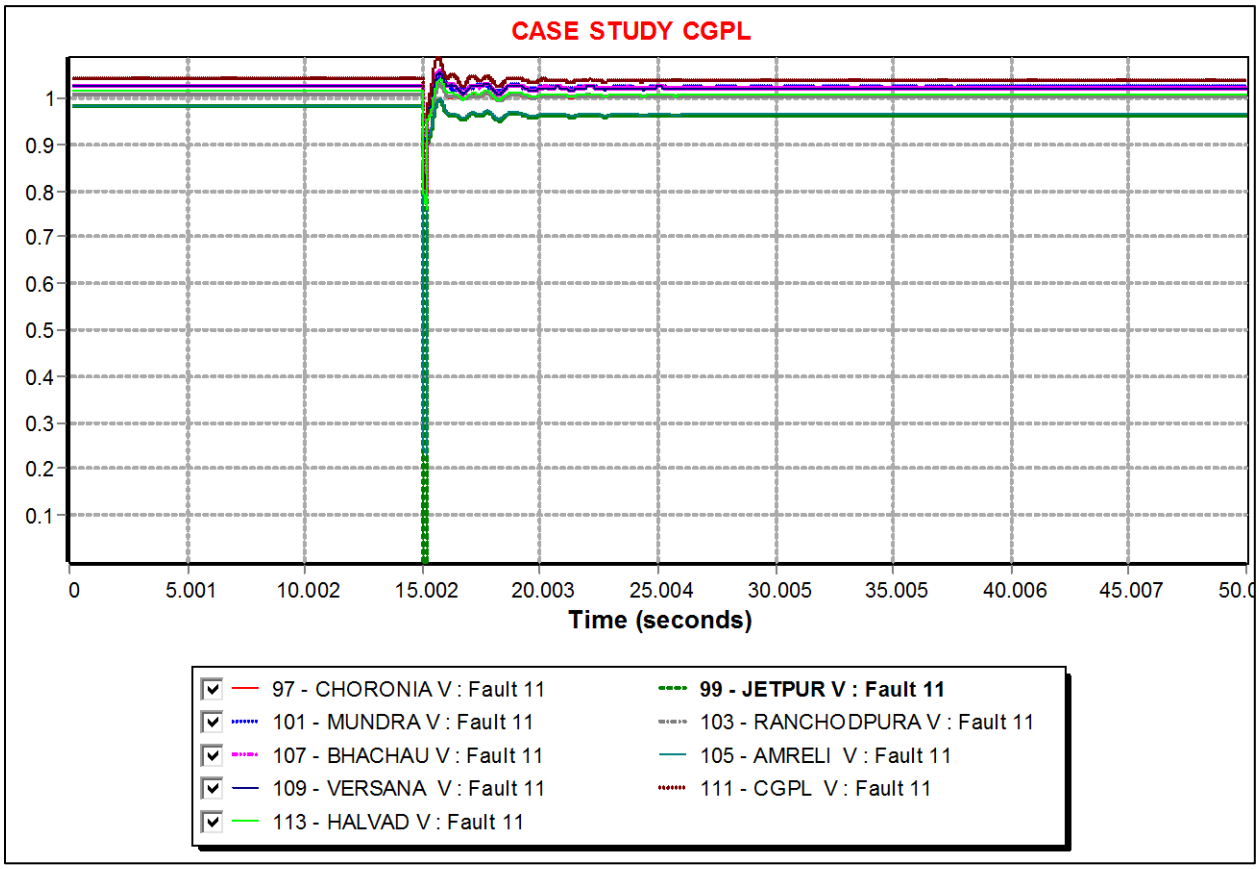
Fault 10:

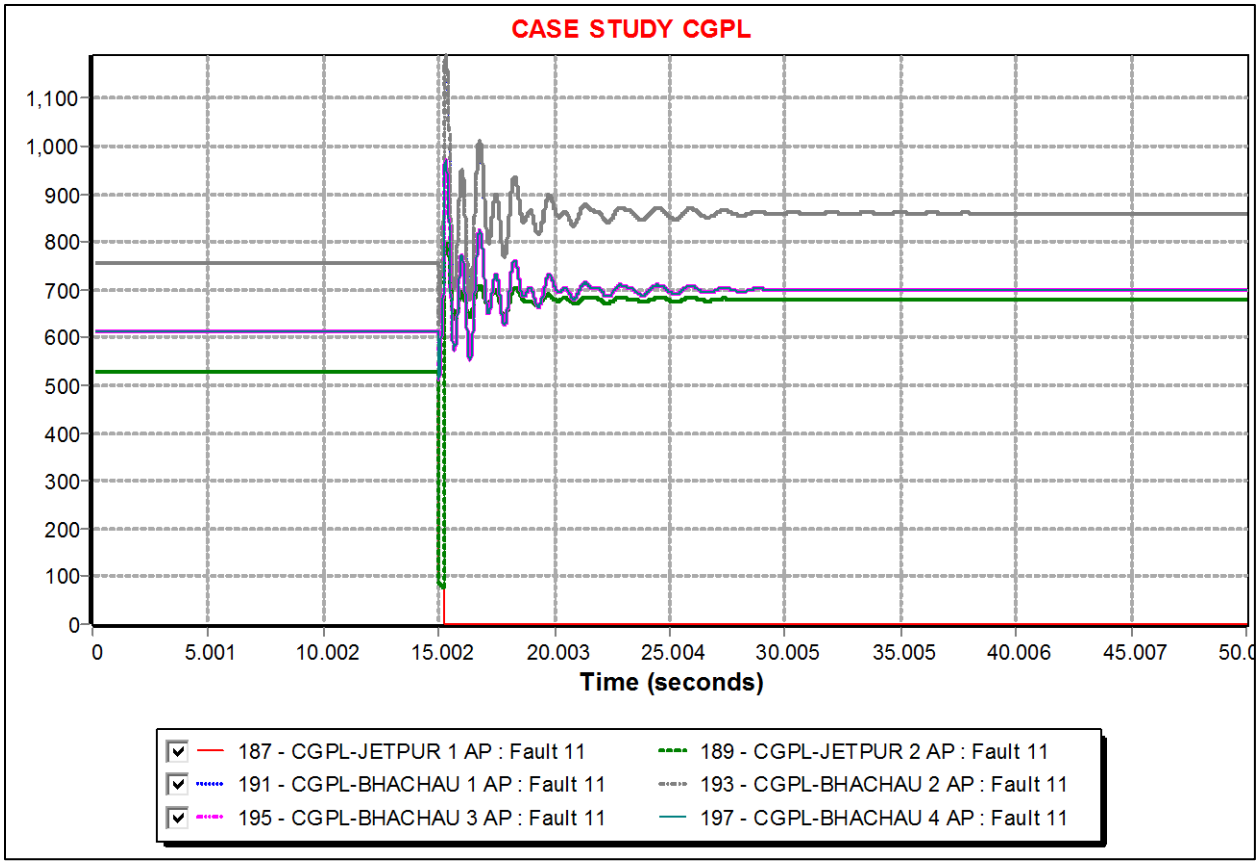

CASE STUDY CGPL
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 10
99 - JETPUR V : Fault 10
101 - MUNDRA V : Fault 10
103 - RANCHODPURA V : Fault 10
107 - BHACHAU V : Fault 10
105 - AMRELI V : Fault 10
109 - VERSANA V : Fault 10
111 - CGPL V : Fault 10
113 - HALVAD V : Fault 10

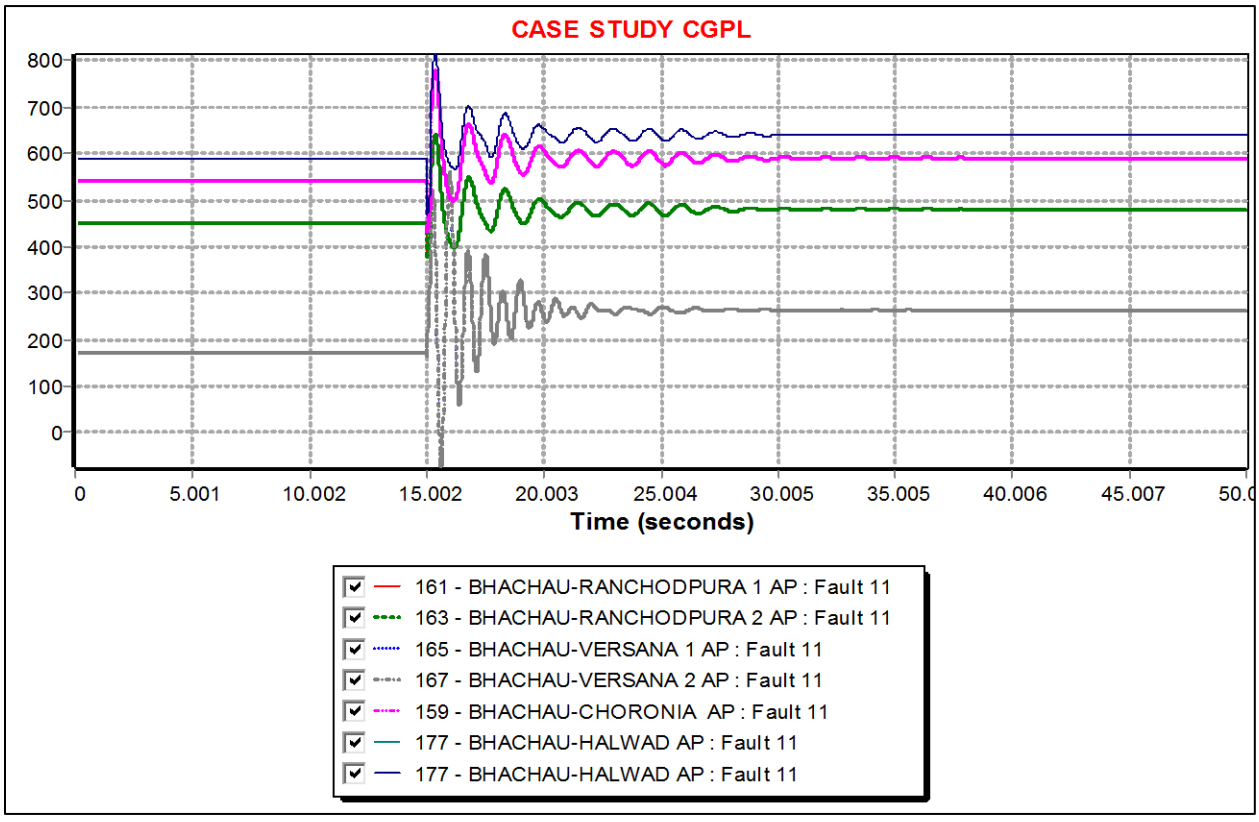

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 10
189 - CGPL-JETPUR 2 AP : Fault 10
191 - CGPL-BHACHAU 1 AP : Fault 10
193 - CGPL-BHACHAU 2 AP : Fault 10
195 - CGPL-BHACHAU 3 AP : Fault 10
197 - CGPL-BHACHAU 4 AP : Fault 10


CASE STUDY CGPL
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 10
163 - BHACHAU-RANCHODPURA 2 AP : Fault 10
165 - BHACHAU-VERSANA 1 AP : Fault 10
167 - BHACHAU-VERSANA 2 AP : Fault 10
159 - BHACHAU-CHORONIA AP : Fault 10
177 - BHACHAU-HALWAD AP : Fault 10

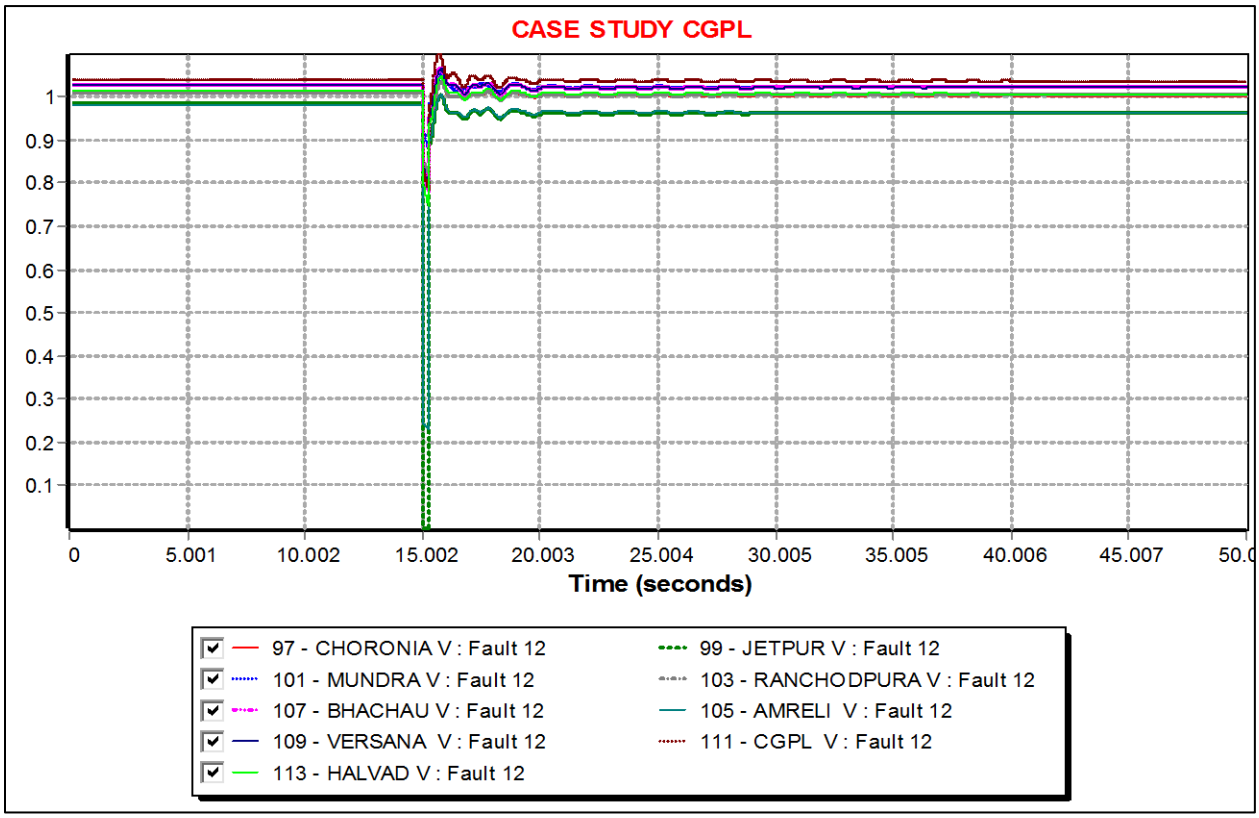
Fault 11:

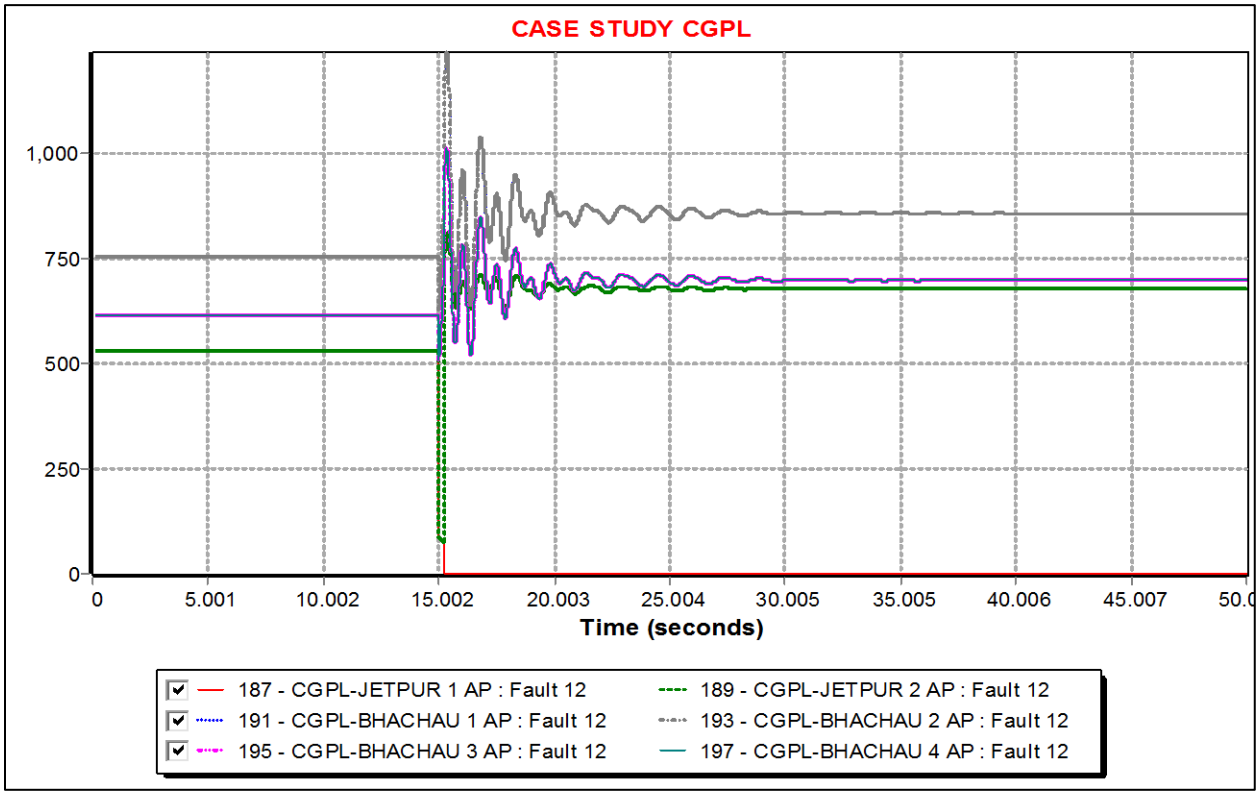

CASE STUDY CGPL
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 11
99 - JETPUR V : Fault 11
101 - MUNDRA V : Fault 11
103 - RANCHODPURA V : Fault 11
107 - BHACHAU V : Fault 11
105 - AMRELI V : Fault 11
109 - VERSANA V : Fault 11
111 - CGPL V : Fault 11
113 - HALVAD V : Fault 11

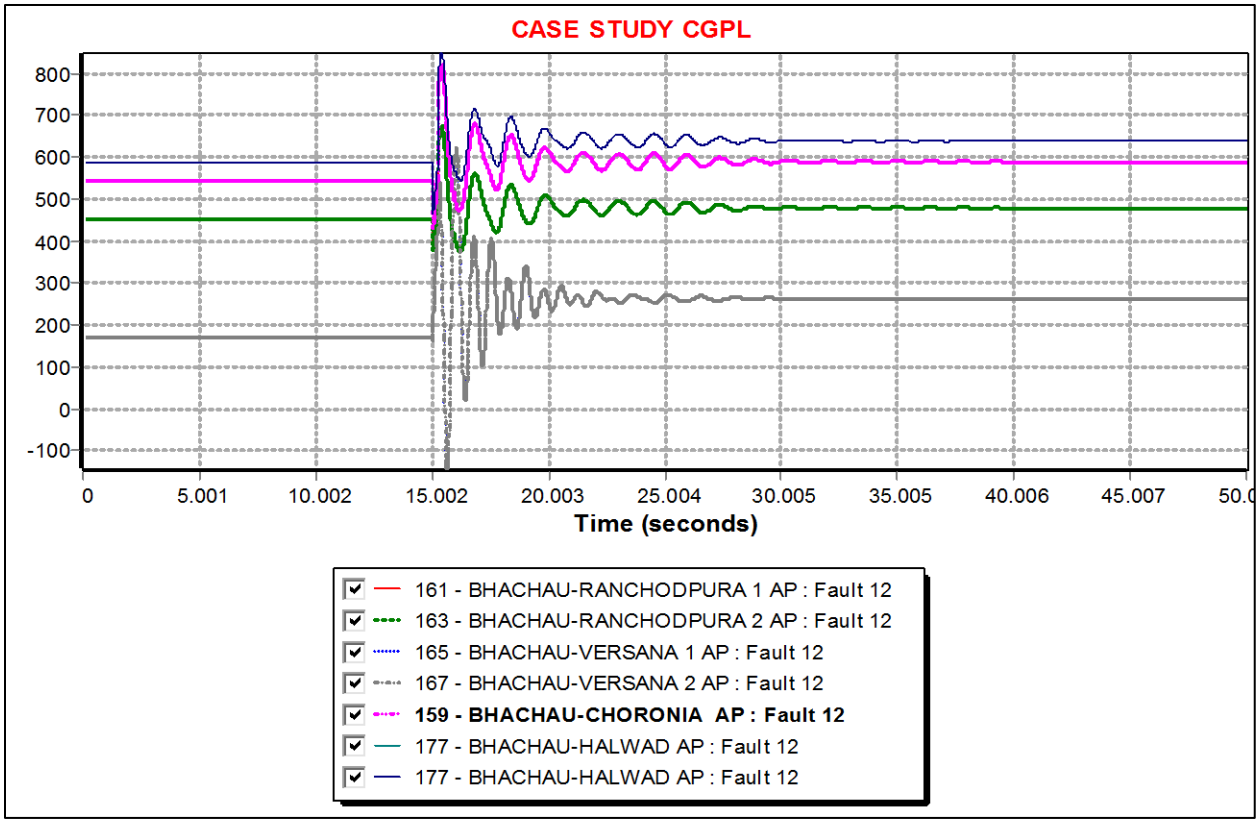

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 11
189 - CGPL-JETPUR 2 AP : Fault 11
191 - CGPL-BHACHAU 1 AP : Fault 11
193 - CGPL-BHACHAU 2 AP : Fault 11
195 - CGPL-BHACHAU 3 AP : Fault 11
197 - CGPL-BHACHAU 4 AP : Fault 11


CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 11
163 - BHACHAU-RANCHODPURA 2 AP : Fault 11
165 - BHACHAU-VERSANA 1 AP : Fault 11
167 - BHACHAU-VERSANA 2 AP : Fault 11
159 - BHACHAU-CHORONIA AP : Fault 11
177 - BHACHAU-HALWAD AP : Fault 11
177 - BHACHAU-HALWAD AP : Fault 11

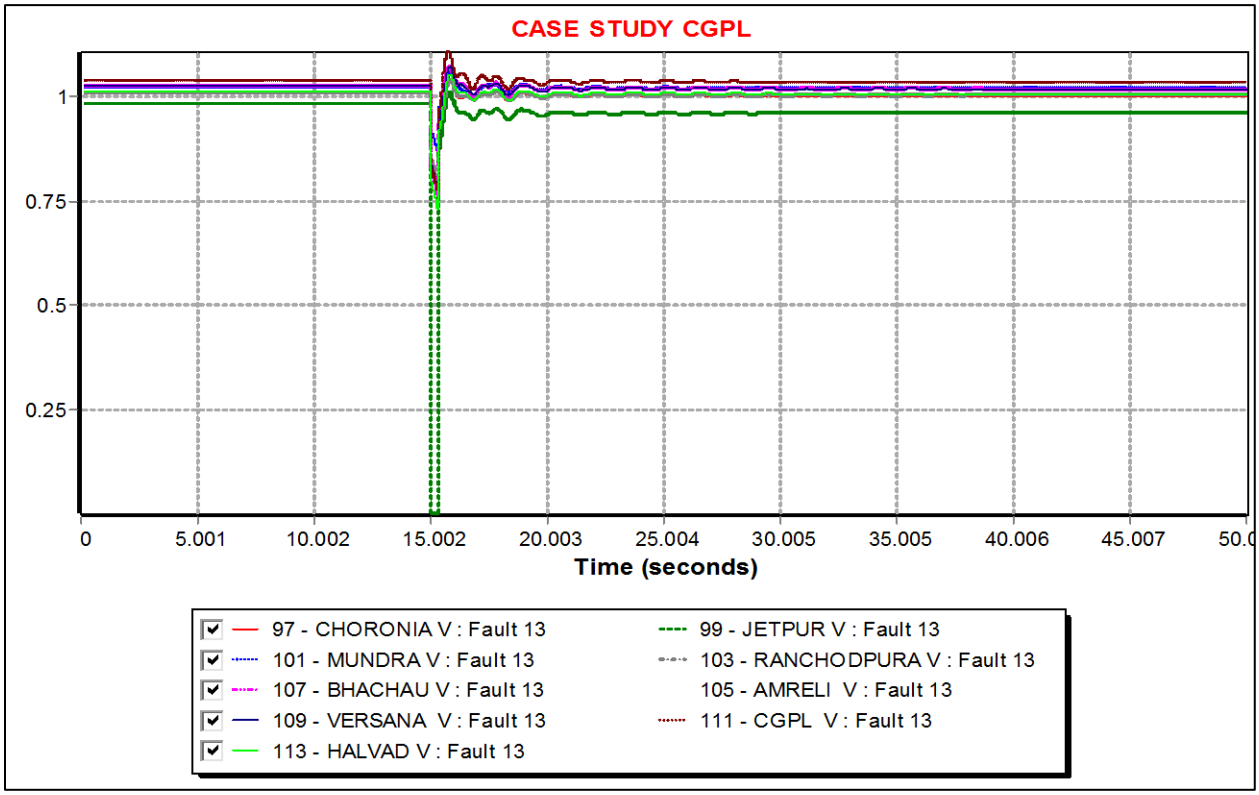
Fault 12:

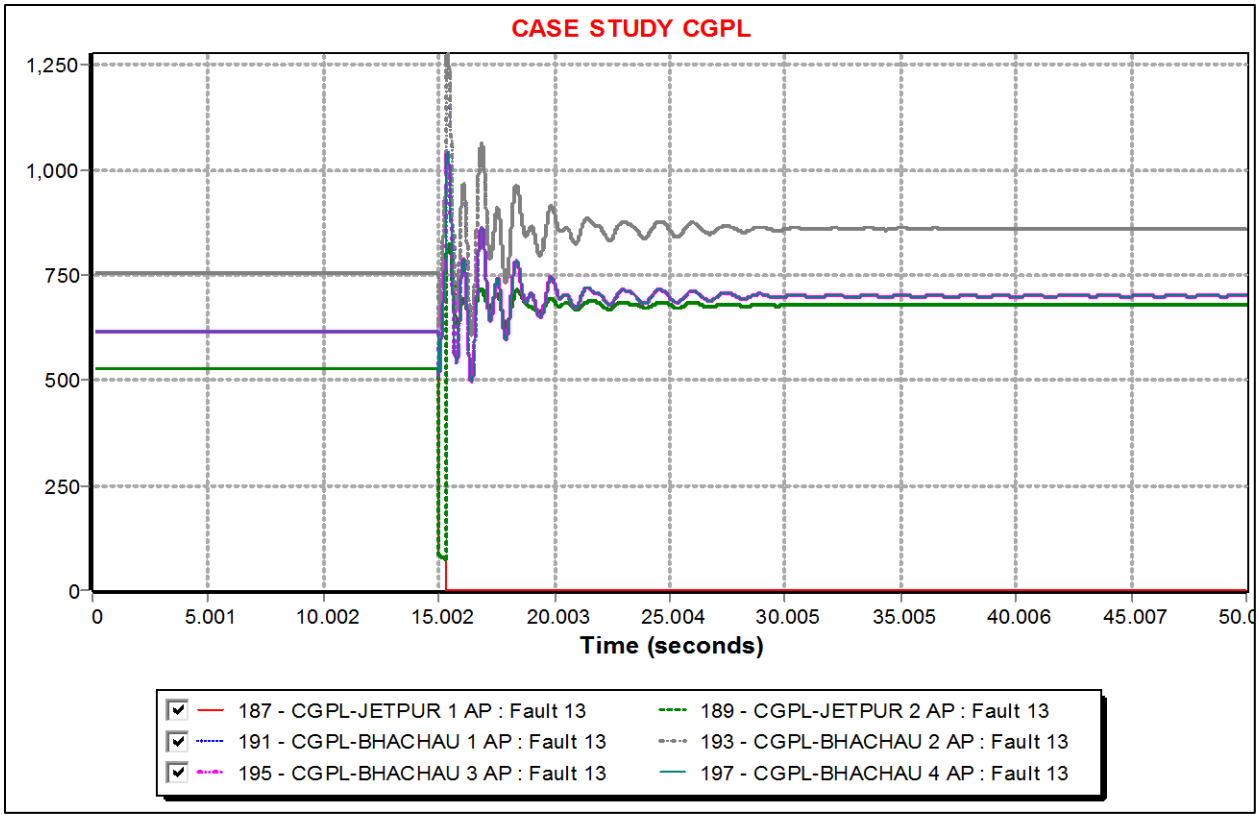

CASE STUDY CGPL
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 12
99 - JETPUR V : Fault 12
101 - MUNDRA V : Fault 12
103 - RANCHODPURA V : Fault 12
107 - BHACHAU V : Fault 12
105 - AMRELI V : Fault 12
109 - VERSANA V : Fault 12
111 - CGPL V : Fault 12
113 - HALVAD V : Fault 12

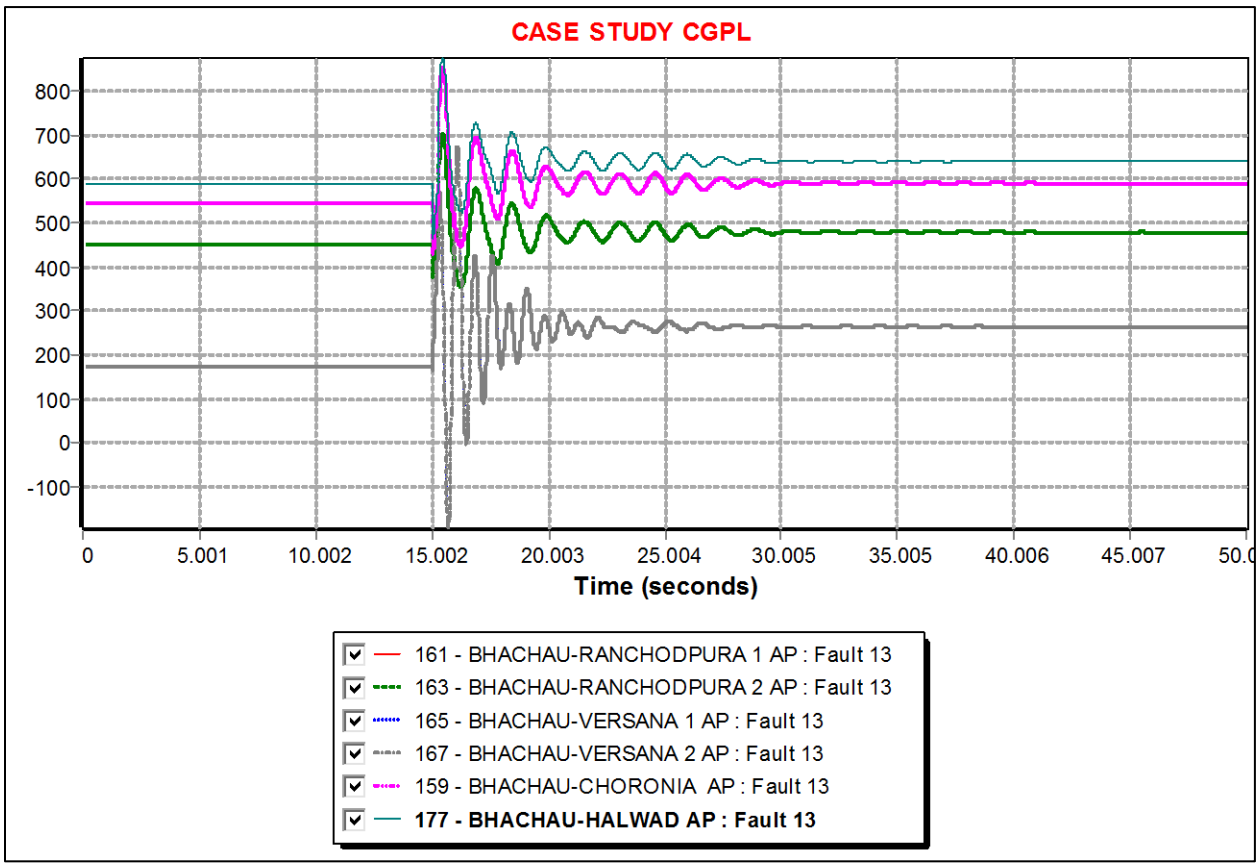

CASE STUDY CGPL
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 12
189 - CGPL-JETPUR 2 AP : Fault 12
191 - CGPL-BHACHAU 1 AP : Fault 12
193 - CGPL-BHACHAU 2 AP : Fault 12
195 - CGPL-BHACHAU 3 AP : Fault 12
197 - CGPL-BHACHAU 4 AP : Fault 12


CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 12
163 - BHACHAU-RANCHODPURA 2 AP : Fault 12
165 - BHACHAU-VERSANA 1 AP : Fault 12
167 - BHACHAU-VERSANA 2 AP : Fault 12
159 - BHACHAU-CHORONIA AP : Fault 12
177 - BHACHAU-HALWAD AP : Fault 12
177 - BHACHAU-HALWAD AP : Fault 12

Fault 13:

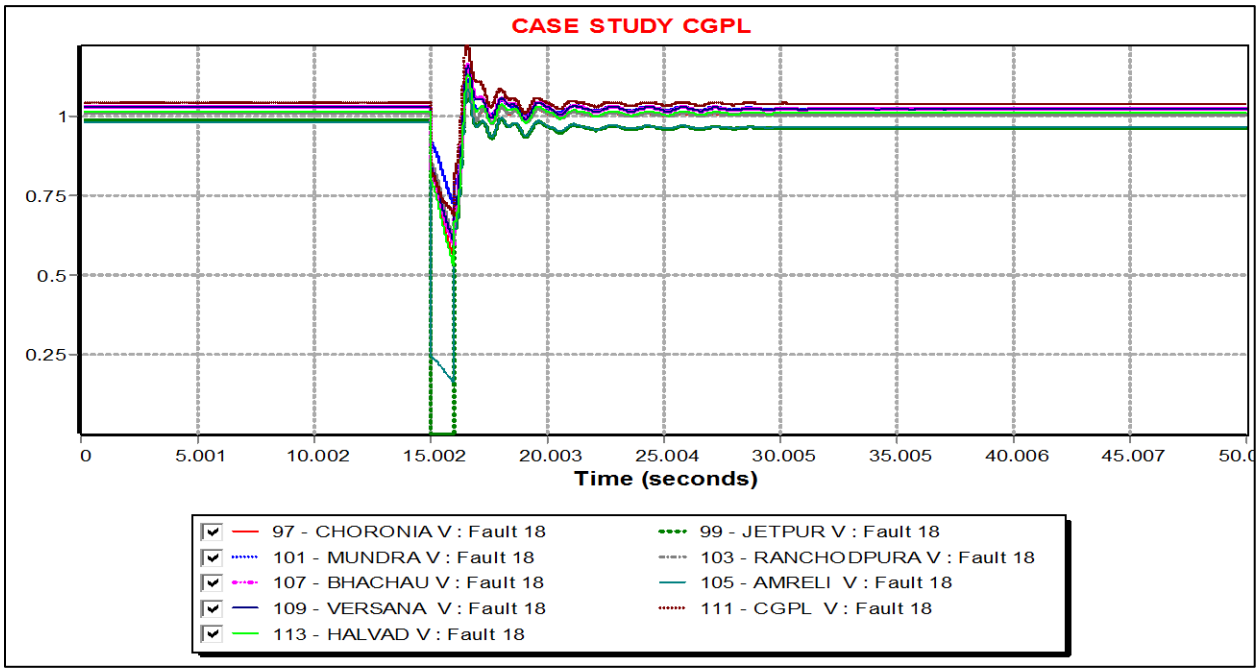

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 13
99 - JETPUR V : Fault 13
101 - MUNDRA V : Fault 13
103 - RANCHODPURA V : Fault 13
107 - BHACHAU V : Fault 13
105 - AMRELI V : Fault 13
109 - VERSANA V : Fault 13
111 - CGPL V : Fault 13
113 - HALVAD V : Fault 13

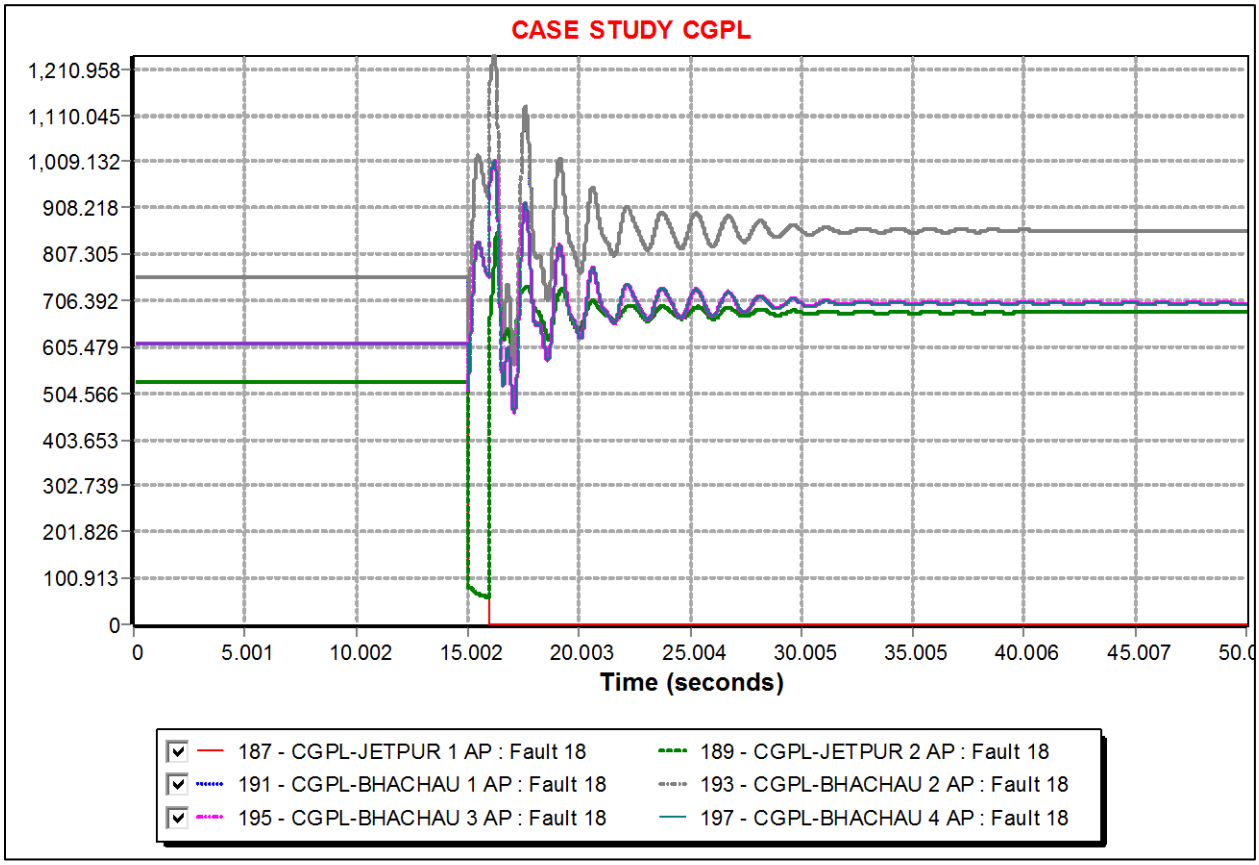

CASE STUDY CGPL
1,250
1,000
750
500
250
0
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 13
189 - CGPL-JETPUR 2 AP : Fault 13
191 - CGPL-BHACHAU 1 AP : Fault 13
193 - CGPL-BHACHAU 2 AP : Fault 13
195 - CGPL-BHACHAU 3 AP : Fault 13
197 - CGPL-BHACHAU 4 AP : Fault 13

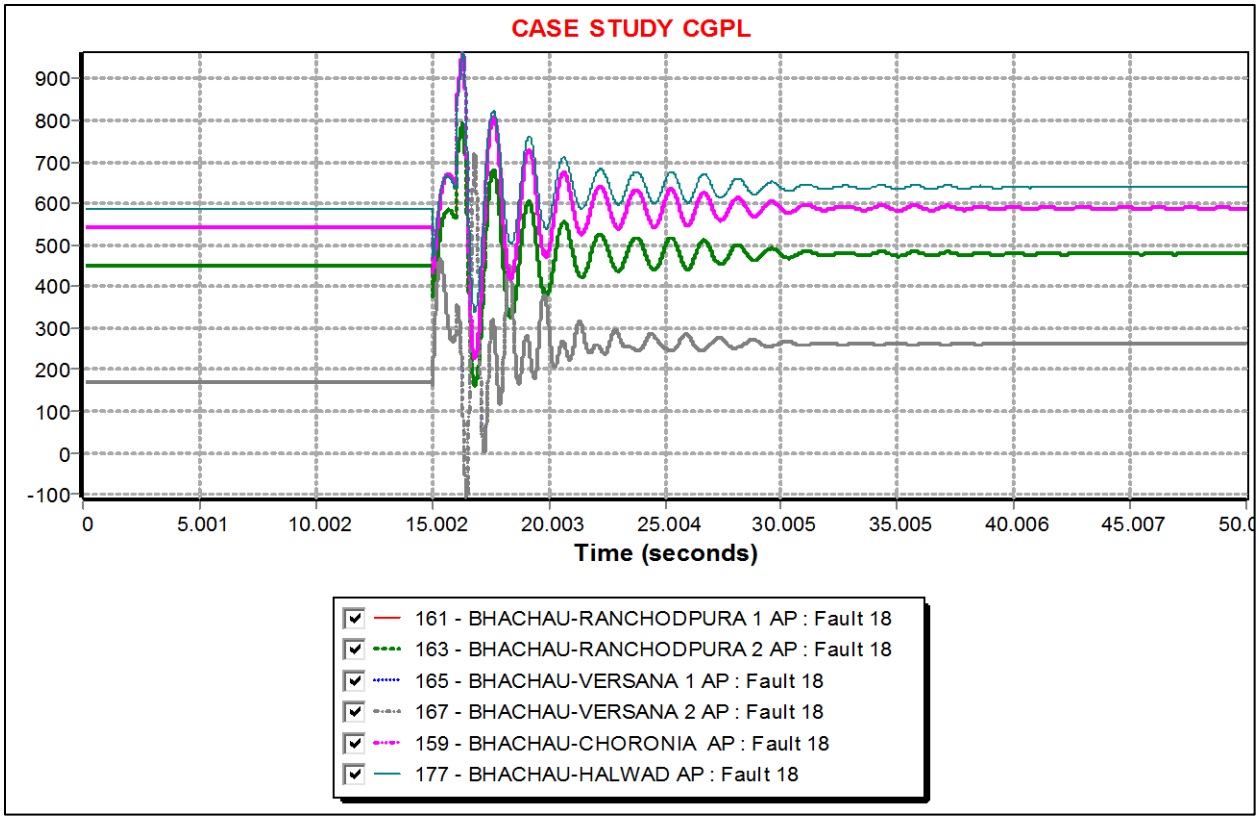

CASE STUDY CGPL
800
700
600
500
400
300
200
100
0
-100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 13
163 - BHACHAU-RANCHODPURA 2 AP : Fault 13
165 - BHACHAU-VERSANA 1 AP : Fault 13
167 - BHACHAU-VERSANA 2 AP : Fault 13
159 - BHACHAU-CHORONIA AP : Fault 13
177 - BHACHAU-HALWAD AP : Fault 13

Fault 14, 15,16,17, stable.

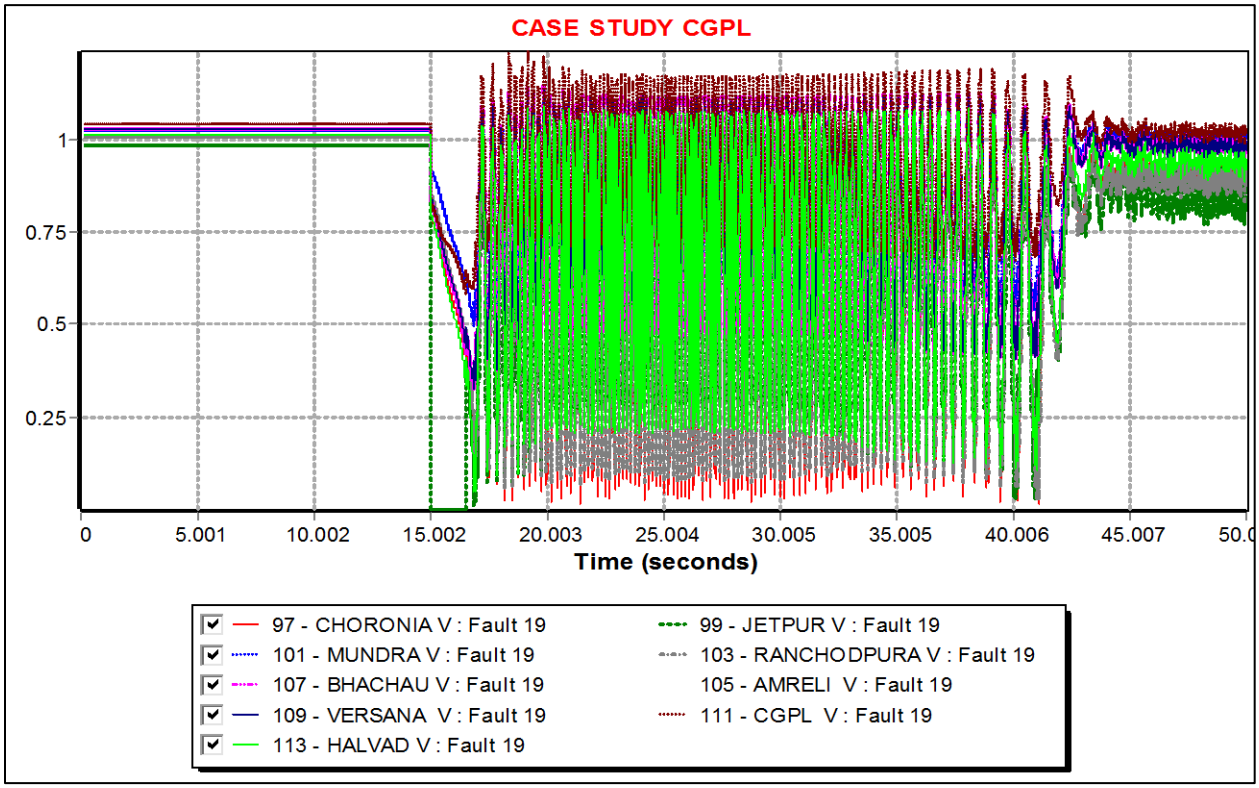
Fault 18:

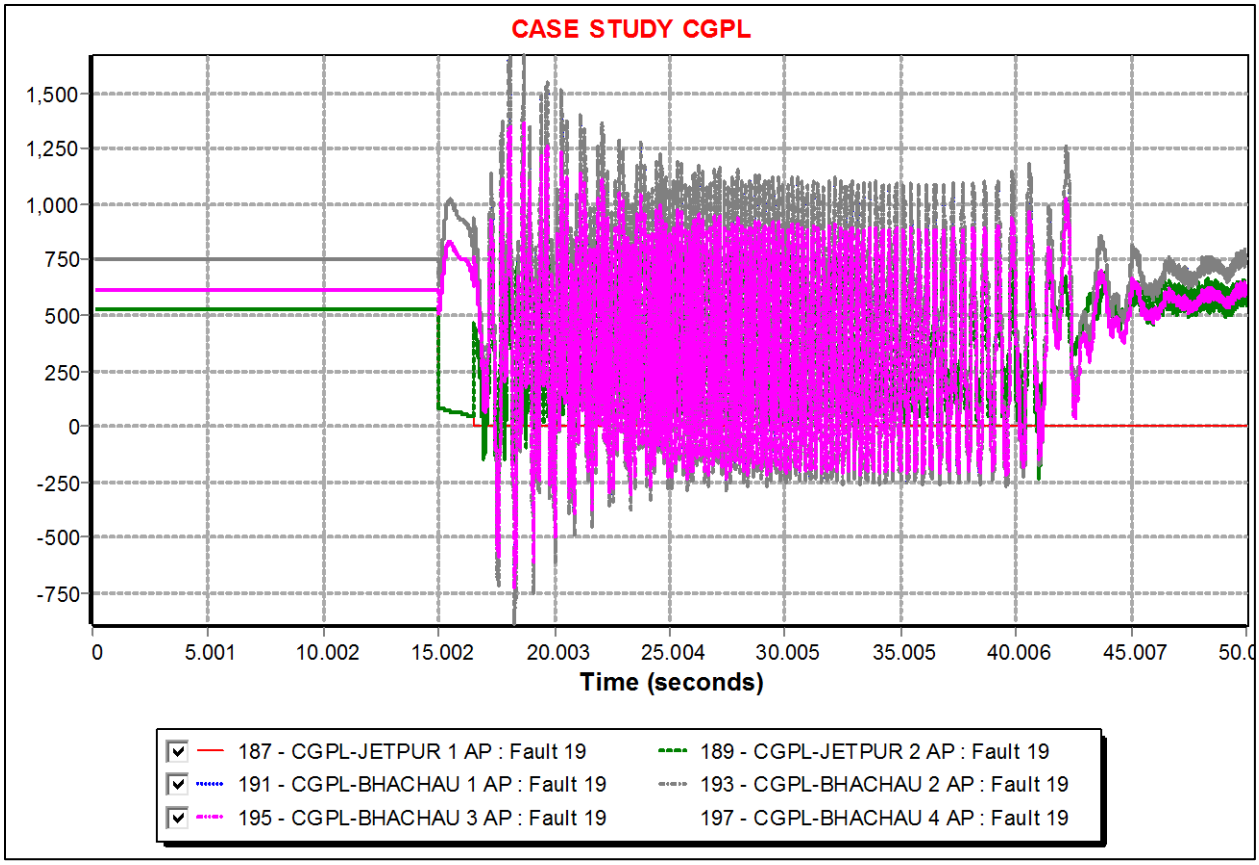




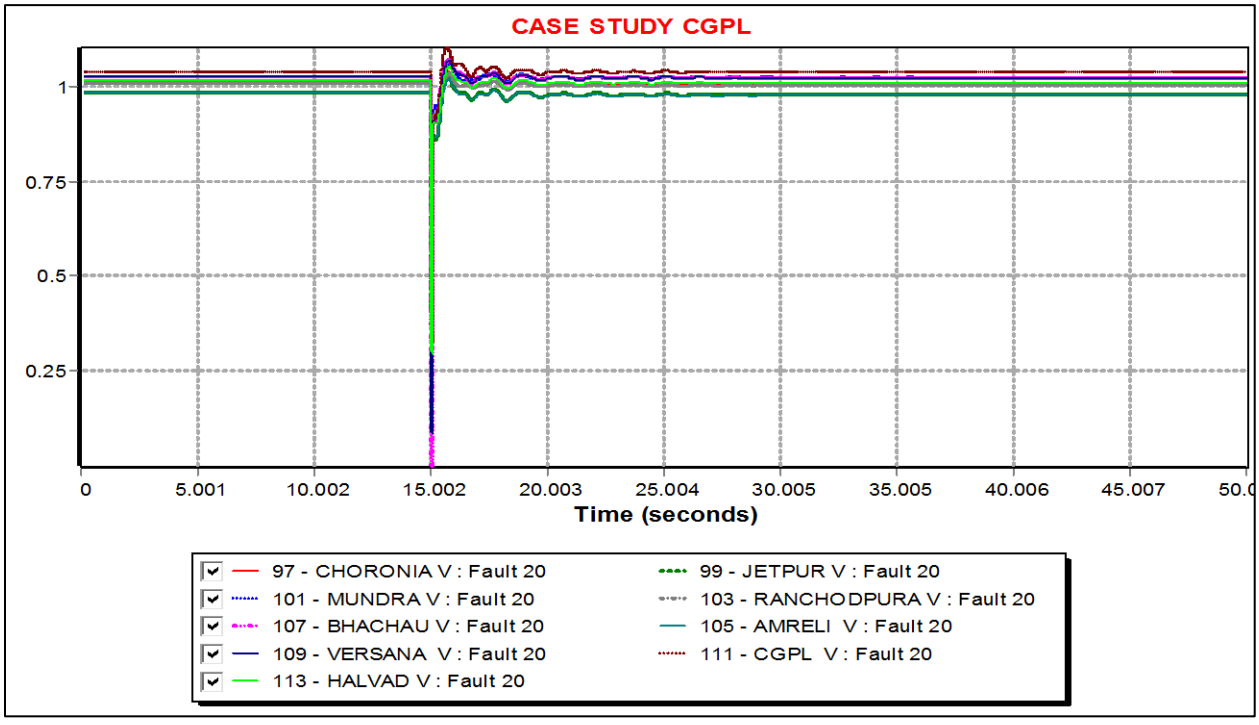

CASE STUDY CGPL
900
800
700
600
500
400
300
200
100
0
-100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 18
163 - BHACHAU-RANCHODPURA 2 AP : Fault 18
165 - BHACHAU-VERSANA 1 AP : Fault 18
167 - BHACHAU-VERSANA 2 AP : Fault 18
159 - BHACHAU-CHORONIA AP : Fault 18
177 - BHACHAU-HALWAD AP : Fault 18

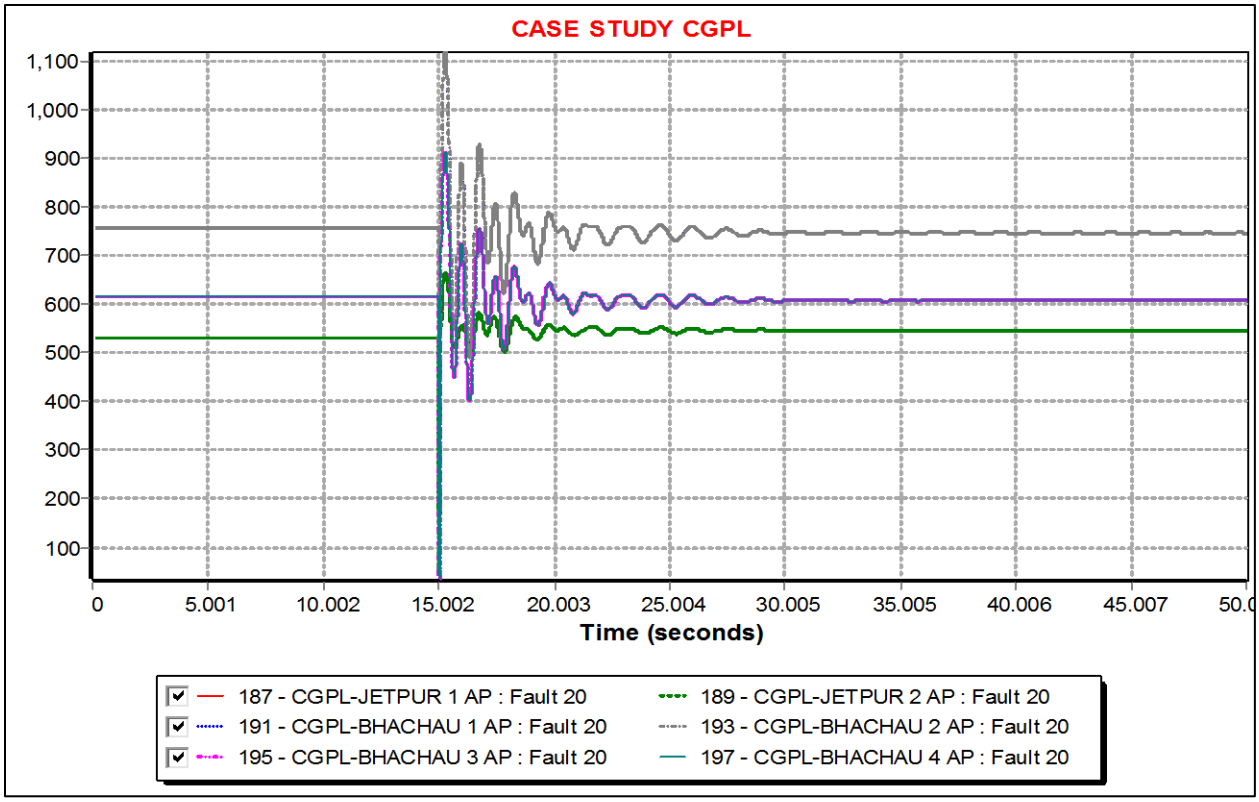
Fault 19:

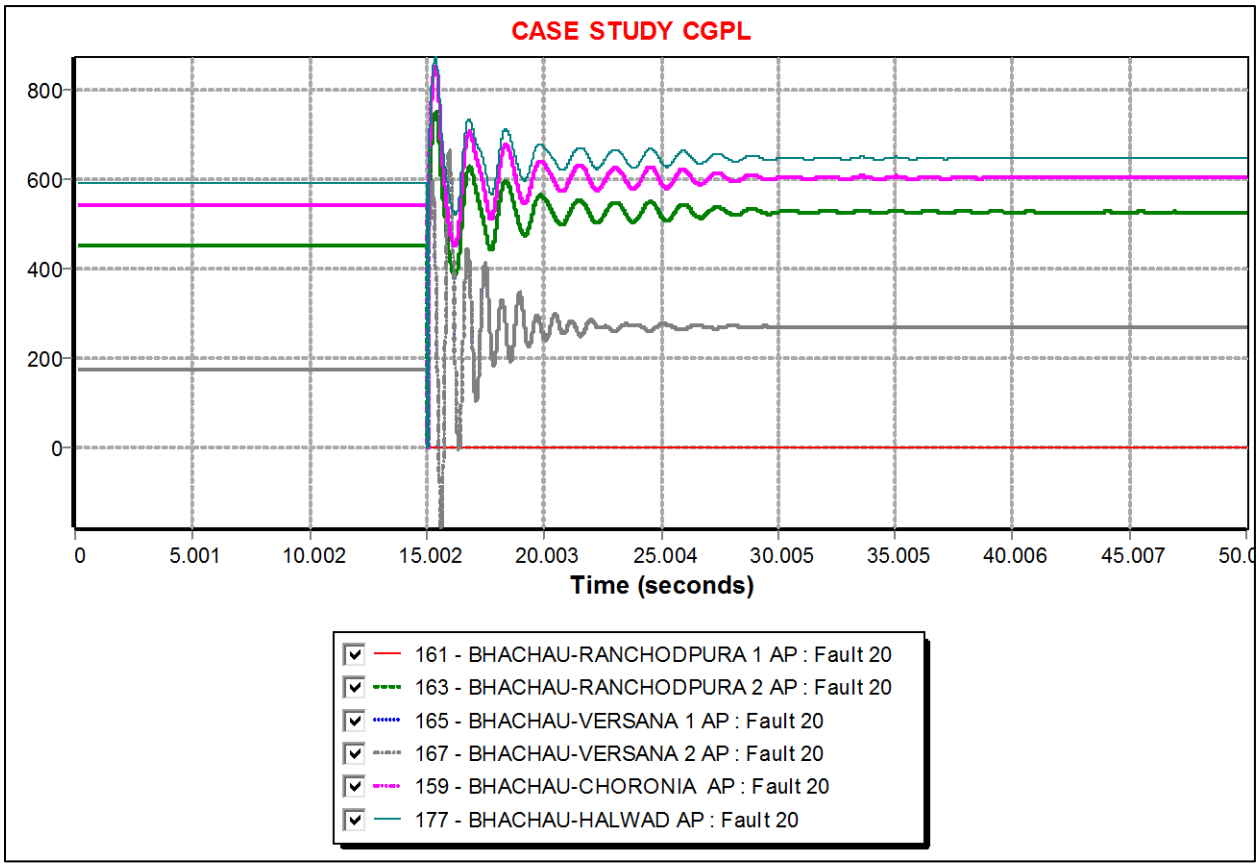

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 19
101 - MUNDRA V : Fault 19
107 - BHACHAU V : Fault 19
109 - VERSANA V : Fault 19
113 - HALVAD V : Fault 19
99 - JETPUR V : Fault 19
103 - RANCHODPURA V : Fault 19
105 - AMRELI V : Fault 19
111 - CGPL V : Fault 19


CASE STUDY CGPL
1,500
1,250
1,000
750
500
250
0
-250
-500
-750
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 19
189 - CGPL-JETPUR 2 AP : Fault 19
191 - CGPL-BHACHAU 1 AP : Fault 19
193 - CGPL-BHACHAU 2 AP : Fault 19
195 - CGPL-BHACHAU 3 AP : Fault 19
197 - CGPL-BHACHAU 4 AP : Fault 19

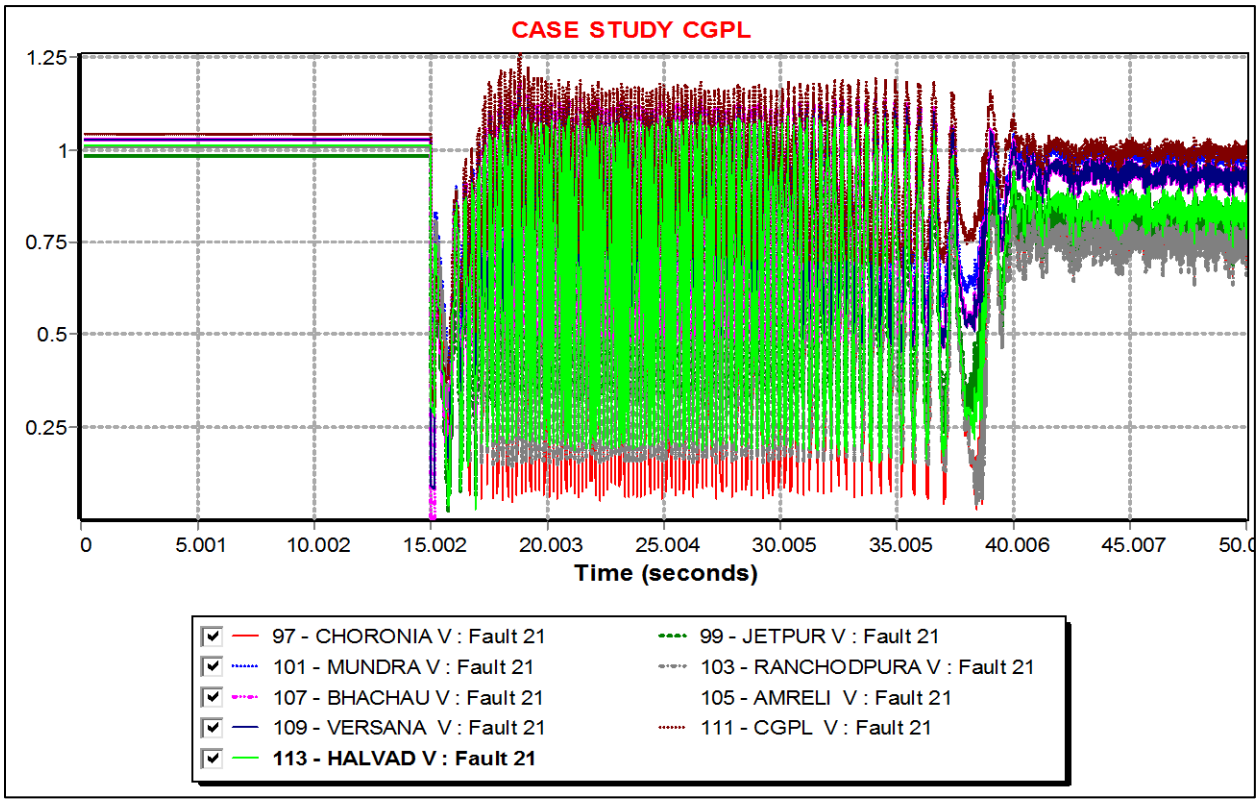
Fault 20:

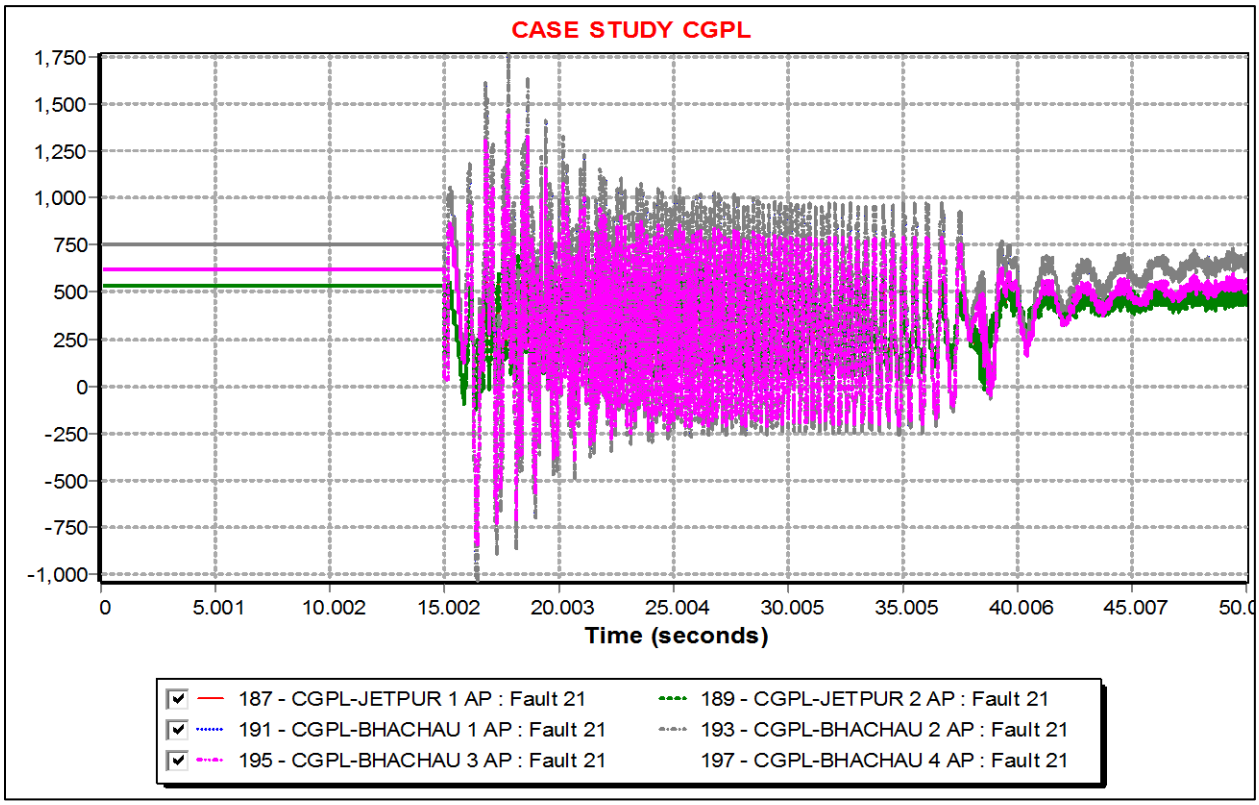

CASE STUDY CGPL
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 20
99 - JETPUR V : Fault 20
101 - MUNDRA V : Fault 20
103 - RANCHODPURA V : Fault 20
107 - BHACHAU V : Fault 20
105 - AMRELI V : Fault 20
109 - VERSANA V : Fault 20
111 - CGPL V : Fault 20
113 - HALVAD V : Fault 20

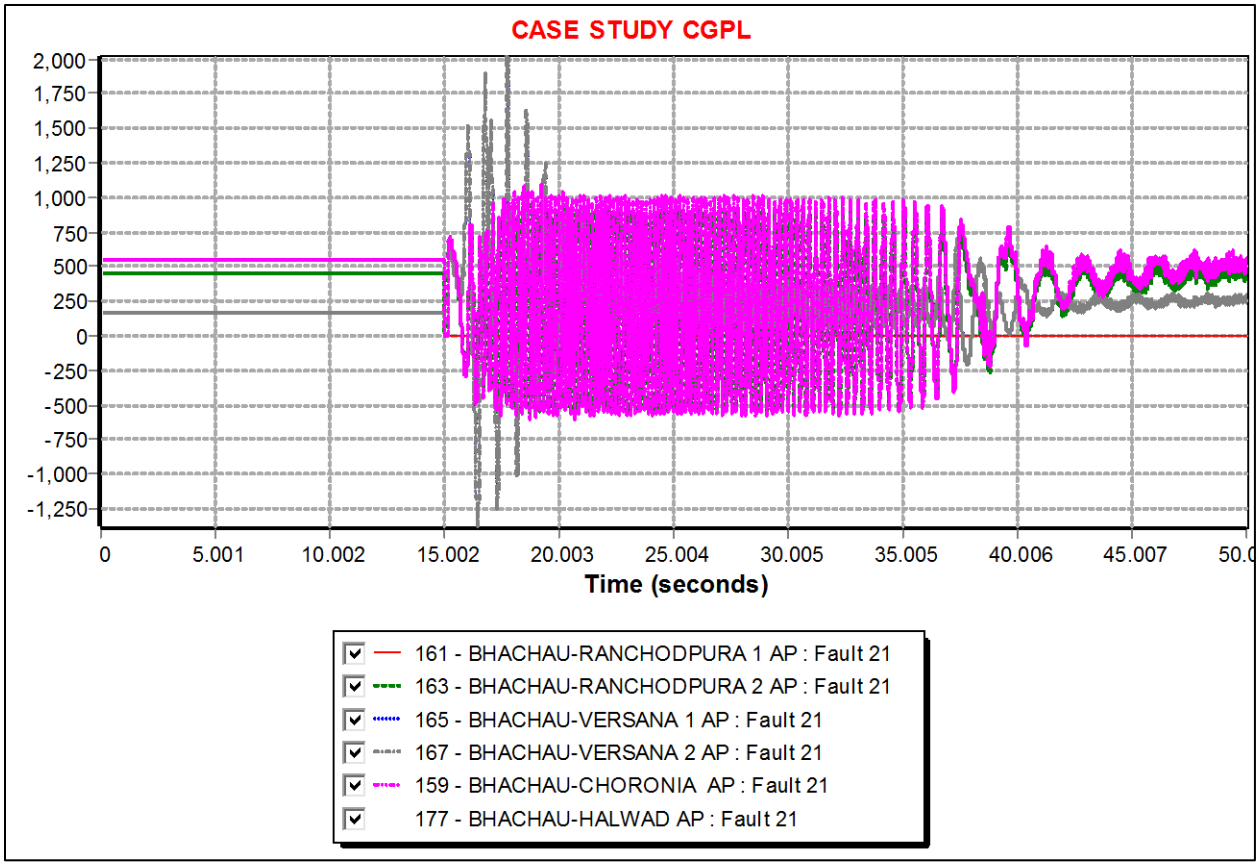

CASE STUDY CGPL
1,100
1,000
900
800
700
600
500
400
300
200
100
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 20
189 - CGPL-JETPUR 2 AP : Fault 20
191 - CGPL-BHACHAU 1 AP : Fault 20
193 - CGPL-BHACHAU 2 AP : Fault 20
195 - CGPL-BHACHAU 3 AP : Fault 20
197 - CGPL-BHACHAU 4 AP : Fault 20


CASE STUDY CGPL
800
600
400
200
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
161 - BHACHAU-RANCHODPURA 1 AP : Fault 20
163 - BHACHAU-RANCHODPURA 2 AP : Fault 20
165 - BHACHAU-VERSANA 1 AP : Fault 20
167 - BHACHAU-VERSANA 2 AP : Fault 20
159 - BHACHAU-CHORONIA AP : Fault 20
177 - BHACHAU-HALWAD AP : Fault 20

Fault 21:


CASE STUDY CGPL
1.25
1
0.75
0.5
0.25
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
97 - CHORONIA V : Fault 21
99 - JETPUR V : Fault 21
101 - MUNDRA V : Fault 21
103 - RANCHODPURA V : Fault 21
107 - BHACHAU V : Fault 21
105 - AMRELI V : Fault 21
109 - VERSANA V : Fault 21
111 - CGPL V : Fault 21
113 - HALVAD V : Fault 21


CASE STUDY CGPL
1,750
1,500
1,250
1,000
750
500
250
0
-250
-500
-750
-1,000
0
5.001
10.002
15.002
20.003
25.004
30.005
35.005
40.006
45.007
Time (seconds)
187 - CGPL-JETPUR 1 AP : Fault 21
189 - CGPL-JETPUR 2 AP : Fault 21
191 - CGPL-BHACHAU 1 AP : Fault 21
193 - CGPL-BHACHAU 2 AP : Fault 21
195 - CGPL-BHACHAU 3 AP : Fault 21
197 - CGPL-BHACHAU 4 AP : Fault 21



Fault 22,24,26 are stable and similar to Fault 20.

Fault 23,25,27 are unstable and similar to Fault 21

Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State System in Western Region

As approved in 34th TCC/WRPC meeting held on 28 July 2017

Contents

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

S.No	Acronym	Definition
1	AMR	Automated Meter Reading
2	ATP	Acceptance Test Plan
3	CDCS	Central Data Collection System
4	CMRI	Common Meter Reading Instrument
5	C&R	Control & Relay
6	CTU	Central Transmission Utility
7	DCD	Data Collection Device
8	DCU	Data Concentrator Unit
9	DSM	Deviation Settlement Mechanism
10	EA	Energy Accounting
11	EHV	Extra High Voltage
12	FAT	Factory Acceptance Test
13	FTE	Full Time Equivalent
14	GPRS	General Packet Radio Service
15	GSM	Global System of Mobile
16	HHU	Hand Held Unit
17	IEC	International Electro-technical Commission
18	IEEE	Institute of Electrical and Electronics Engineers
19	IEM	Interface Energy Meter
20	IP	Ingress Protection
21	IS	Indian Standard
22	ISTS	Inter State Transmission System
23	LAN	Local Area Network
24	MDP	Meter Data Processing
25	NMS	Network Management System
26	OEM	Original Equipment Manufacturer
27	PCB	Printed Circuit Board
28	RDBMS	Relational Database Management System
29	RMS	Root Mean Square
30	SAT	Site Acceptance Test
31	SEM	Special Energy Meter
32	SRS	Software Requirements Specification
33	TOC	Taking Over Certificate
34	VPN	Virtual Private Network
35	WAN	Wide Area Network
36	WRLDC	Western Regional Load Despatch Centre
37	WRPC	Western Regional Power Committee

I. BACKGROUND

Availability Based Tariff and Deviation Settlement Mechanism was implemented in Western Region in 2002 considering the settlement period as 15-min. Presently there are 1409 Special Energy Meters installed at various interface points in Western Region. Meter Data is downloaded by the substation personnel and forwarded (in encrypted format) by email to WRLDC for verification/validation. The processed meter data is forwarded by WRLDC to WRPC secretariat for preparation of weekly/monthly energy accounts.

A large number of SEM's installed in Western Region are more than 5 / 10 years old and are due for testing / replacement. This issue was also discussed in the 73rd and 74th CCM (Commercial Coordination Meeting). During the 33rd TCC/WRPC meeting it was decided to replace the entire fleet of existing SEMs (15-min recording) with Interface Energy Meters (5-min interval) and implement the Automated Meter Reading and Meter Data Processing System. The above is also in line with the recommendations of the Report on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST) that was endorsed by the Forum of Regulators on 15th July 2016. This technical specification was approved in the 34th TCC/WRPC meeting held on 27-28 July 2017 in Mumbai.

II. PROJECT SCOPE

Western region comprises of the states of Gujarat, Maharashtra, Madhya Pradesh, Chhattisgarh, Goa and Union Territories of Daman & Diu and Dadra & Nagar Haveli.

As on 31.03.2017 there are 1409 Special energy meters (SEMs) installed at various interface points in the Inter State Transmission System (ISTS). The existing distribution of energy meters in Western Region (State wise) is as below:

State	No. of SEMs installed
Gujarat	326
Maharashtra	268
MP	375
Chhattisgarh	385
DD	19
DNH	25
GOA	11
TOTAL	**1409**

Table II-1 Distribution of Energy Meters in WR

Station wise bifurcation of installed SEMs are enclosed as Annex-I

The present project envisages to replace the existing fleet of Special Energy Meters (15 min, ABT meters) in the Inter State Transmission System (ISTS) in the Western Region

with Interface Energy Meters (5 min, Interface meters). The project also envisages to put in place a system of Automated Meter Data Reading (AMR)/Meter Data Processing (MDP) software along with the associated hardware for meter data collection, validation and processing at Western Regional Load Despatch Centre (WRLDC) before forwarding the meter data to WRPC Secretariat for regional energy accounting. The successful bidder shall be responsible for supply and installation of hardware and software at respective locations and also for ensuring reliable communication infrastructure between the IEM and WRLDC for seamless transfer of meter data from substation to WRLDC.

This project envisages to deliver an end to end solution for energy metering at the interstate level in the Western Region. It shall involve capital as well as O&M expenditure by the successful bidder. During the warranty and O&M phase, the bidder shall provide web based system for complaint registration, support and maintenance along with one full time equivalent (FTE) competent resident engineer at WRLDC to diagnose and address any software related issues in AMR/MDP/reporting system. The O&M/AMC charges payable to the successful bidder shall be calculated based on the system availability.

The technical specifications are broadly in three parts.

Part-1 - The first part of the specifications covers the design, manufacturing, testing, supply and delivery of AC 3 ph., 4 wire Interface Energy Meter (IEM). The meter shall incorporate suitable communication features to communicate with DCU (Data Concentrator Unit) installed at the substation. The DCU shall communicate with Central Data Collection System for data transfer to WRLDC, Mumbai as per the user defined schedule.

Part-2 -The second part covers the Automated Meter Reading system for data collection in the Inter State Transmission System of Western Region.

Part-3 -The third part covers Meter Data Processing (MDP) and report generation at WRLDC.

The Bill of Quantities shall be developed separately.

The execution of the project shall be planned in such a manner that there is no interruption in the prevailing regional energy accounting system. The IEMs shall record data at 5 minute interval. This data shall be collected and archived at WRLDC. However the settlement period for data processing and energy accounting shall be defined by the user as per the prevailing CERC regulations. For instance, if the user chooses the settlement period to be 15 min, then the archived data of 5 min interval shall be converted to 15 min interval so as to be compatible with the existing software for meter data processing and energy accounting at WRLDC and WRPC. The format of the 15-min processed data reports shall be exactly same as that of the existing 15-min processed data reports in text files for compatibility at WRPC end.

The installation of the IEM at the interface points shall involve shutdown of transmission elements. This shall be coordinated through the existing outage coordination procedure

approved by the WR OCC forum. POWERGRID shall coordinate for administrative approvals from the utility in whose premises the IEM/DCU have to be installed. WRLDC shall coordinate the shutdown as per the OCC approved list subject to real time grid conditions. The bidder shall keep suitable margins for grid related uncertainties while formulating the meter installation plan.

III. INTERFACE ENERGY METERS

1. Basic Features of Interface Energy Meters

a. The energy metering system specified herein shall be used for tariff metering for bulk, inter-utility power flows, in different States of India. Draw out type, Static composite meter shall be installed at interface points as a self-contained device for measurement of Voltage (V), Frequency (f), Active (Wh) and Reactive (VArh) energy exchanged in each successive 5 min time block. All meters shall be compliant to IS 15959 and its latest amendments.

b. Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory. All meters supplied to as per this specification shall have their identification code starting with "IEM", which shall not be used for any other supplies. "IEM" shall be followed by a dash and an eight digit running serial number, further followed by a dash and "A" and "B" for the use with CT secondary of 1A and 5A respectively. This shall be mutually agreed between the buyer and the vendor.

c. The meters shall be suitable for communication with external device like modem, DCU, etc. which shall be able to communicate with CDCS for local/remote data transfer. The meter shall compulsorily have at least 1 optical port for taking reading through Hand Held Unit (HHU).

d. **Auxiliary Supply to IEM-** The meters shall normally operate with the power drawn from DC auxiliary power supply to reduce the Voltage Transformer (VT) burden. In addition, there shall be provision to operate the meter from the Voltage Transformer (VT) secondary circuit having a rated secondary line-to-line voltage of 110V, and current transformers (CTs) having a rated secondary current of 1 A or 5A. Any further transformers/ transactions/ transducers required for their functioning shall be in-built in the meters. Necessary isolation and/or suppression shall also be built-in, for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits of extra high voltage switchyards. The reference frequency shall be 50Hz. Also, the meter shall have suitable tolerance for DC supply.

e. The meters shall safely withstand the usual fluctuations arising during faults etc. In particular, VT secondary voltages 115% of Vref applied continuously and 190% of Vref for 3.0 seconds, and CT secondary current 150% of Iref applied continuously and 30 times of Iref applied for 0.5 seconds shall not cause any damage to or maloperation of the meters.

f. The meters shall continue to function for the remaining healthy phase(s), in case one or two phases of VT supply fails. In case of a complete VT supply failure, the computation of average frequency shall be done only for the period during which the VT supply was

available in the 5-minute block. Any time block contraction or elongation for clock correction shall also be duly accounted for.

g. The total burden imposed by a meter for measurement and operation shall be defined as per IS 14697. An automatic backup for continued operation of the meter's calendar-clock, and for retaining all data stored in its memory, shall be provided through a long-life battery, which shall be capable of supplying the required power for at least 2 years. The meters shall be supplied duly fitted with the batteries, which shall not require to be changed for at least 10 years, as long as total VT supply interruption does not exceed two years. The battery mounting shall be designed to facilitate easy battery replacement without affecting PCB of the meter.

h. The meters shall fully comply with all stipulations in IS 14697 except those specifically modified by this specification. The reference ambient temperature shall be 30° C.

i. Each meter shall have a test output device (visual), as per clause 6.11 of IS 14697.1999, for checking the accuracy of active energy (Wh) measurement. The preferred pulsing rate is twenty (20) per Wh for CT sec-1A and four (4) per Wh for CT sec –5A. It shall be possible to couple this device to suitable testing equipment also.

j. **Exception Management**- The three line-to-neutral voltage shall be continuously monitored and in case any of these falls below defined threshold (70% of Vref), meter shall have suitable indication on LED/ LCD. The meter shall also have provision for low voltage event logging in meter memory in case of any phase voltage going below a defined threshold. The time blocks in which such a voltage failure occurs/persists shall also be recorded in the meter's memory with a symbol"*" If 3 Phase RMS voltage applied to the IEM is in between 5% to 70% of Vref and if Voltage is less than 5% of Vref, meter should record Zero voltage symbol "Z". There shall also be a provision to generate an alarm/SMS (to predefined mobile numbers) in the software at CDCS in case of VT supply failure or to generate error log.

k. **Time Accuracy** - Each meter shall have a built-in calendar and clock, having an accuracy of 10 seconds per month or better. The calendar and clock shall be correctly set at the manufacturer's works. The date (year-month-day) and time (hour-min.-sec.) shall be displayed on the meter front on demand. Meter shall have the intelligence to synchronize the time with GPS (Local GPS/CDCS GPS) signal and from PC using software . Limited time synchronization through meter communication port shall be possible at site. When an advance or retard command is given, twelve subsequent time blocks shall be contracted or elongated by five seconds each. All clock corrections shall be registered in the meter's memory and suitably shown on print out of collected data.

l. A touch key or push button shall be provided on the meter front for switching on the display and for changing from one indication to the next. The display shall switch off automatically about one minute after the last operation of touch key/push button. When the display is switched on, the parameter last displayed shall be displayed again, duly updated.

m. The whole system shall be such as to provide a print out (both from the local PC, and from remote central computer) of the following format:

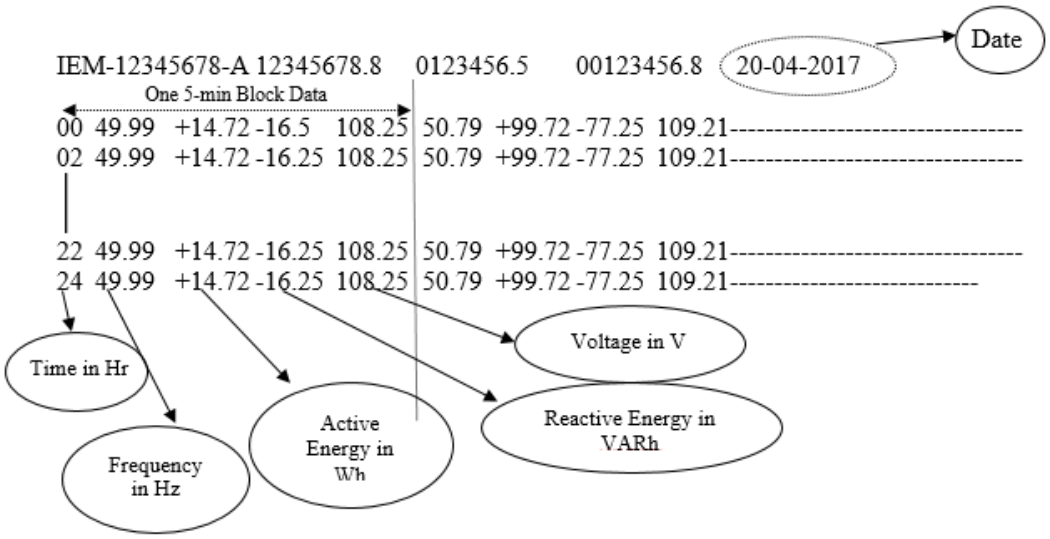


Figure 1 – Standard raw data format for IEM

There are 4 values in one 5 min time block. The first row shall contain the meter data for 2 hours, i.e. 24 time blocks, 00 hrs ton 02:00 hrs. Similarly the 2nd row shall contain the data for the next 2 hours and henceforth.

The above data shall be available in text file format (file extension as per IEEE standard/.txt) exportable to Excel. Indication of time retard or advance to be provided without disturbing the proposed format. Each 5-min block data consists of Frequency (in HZ), Active energy (in Wh), Reactive energy (in VARh) and Voltage (in V)

n. The portable hand held unit (HHU)/ Common meter reading instrument (CMRI)/ Data Collecting Device (DCD) shall be having IS-15959:2011 compatibility for standardized parameters. The optical coupler for tapping data stored in the SEMs memory shall be compatible universally across different make of SEMs.

o. Constructional Features

(i) The meters shall be supplied housed in compact and sturdy, metallic or moulded cases of non-rusting construction and/or finish. The cases shall be designed for simple mounting on a plane, vertical surface such as a control/relay panel front. All terminals for CT and VT connections shall be arranged in a row along the meter's lower side. Terminals shall have a suitable construction with barriers and cover, to provide a secure and safe connection of CTs and VTs leads through stranded copper conductors of 2.5 sq. mm. size.

(ii) All meters of the same model shall be totally identical in all respects except for their unique identification codes. They shall also be properly sealed and tamper evident, with no possibility of any adjustment at site, except for transactions allowed in IS 15959.

(iii) The meters shall safely withstand, without any damage or mal operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. in accordance with IS-14697. They shall have an IP-51 category dust-

tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation.

(iv) Either the meters shall have built-in facility (e.g. test links in their terminals) for in-situ testing, or a separate test block shall be provided for each meter.

2. Measurement

a. The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy as per class **0.2S** (IS 14697).

b. The meter shall compute the net active energy (Wh) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to second decimal with plus sign if there is net Wh export and with a minus sign if there is net Wh import.

c. The meter shall count the number of cycles in VT output during each successive 5 min block, and divide the same by 300 (60 sec/min x 5min) to arrive at the average frequency. The least count of the frequency data shall be 0.01 Hz. The frequency data shall be stored in the meter's memory in Hertz up to second decimal.

d. The meter shall continuously compute the average of the RMS values of the three line-to-neutral VT secondary voltages as a percentage of 63.51 V, and display the same on demand. The accuracy of the voltage measurement/computation shall be at least 0.5%, a better accuracy such as 0.2% in the 95-105% range being desirable.

e. The Reactive energy (VARh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy of 0.5S as specified in IS 14697. The meter shall compute the net Reactive energy (VARh) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to second decimal with plus sign if there is net VARh export and with a minus sign if there is net VARh import. It shall also display on demand the net VARh sent out during the previous 5 min block.

f. The meter shall also integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is above 103.0%, and the other for the period for which the average RMS voltage is below 97.0 %. The current reactive power (VAR), with a minus sign if negative, and cumulative reactive energy (VARh) readings of the two registers (>103% and <97%) shall be displayed on demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. When reactive power is being sent out from substation bus bars, VAR display shall have a plus sign or no sign and VARh registers shall move forward. When reactive power flow is in the reverse direction, VAR display shall have negative sign and VARh registers shall move backwards. Generally, the standard PT ratios are 220 kV /110 V, 400 kV /110 V and 765 kV / 110 V. However, at the time of commissioning the vendor may confirm the same from site and configure the meter accordingly to ensure correct recording of reactive energy.

g. For CT secondary rating of 5A, all computations, displays and memory storage shall be similar except that all figures shall be one fifth of the actual, worked out from CT and VT secondary quantities.

h. Further, the meter shall continuously integrate and display on demand the net cumulative active energy sent out from the substation bus bars up to that time. The cumulative Wh reading at each midnight shall be stored in the meter's memory. The register shall move backwards when active power flows back to substation bus bars.

i. Errors for different power factors shall be as defined in IS14697.

j. For reactive power (VAR) and reactive energy (VARh) measurements, IS14697 shall be complied with. The accuracy of measurement of reactive energy shall be as per class 0.5S.

k. No rounding off to the next higher last decimal shall be done for voltage and frequency displays. All 5 min Wh and VArh figures shall however be rounded off to the nearest last decimal.

l. The harmonics shall be filtered out while measuring Wh, V and VARh, and only fundamental frequency quantities shall be measured/computed.

m. Data security shall be ensured as per IS 15959 (three layers of security).

3. Memory/ Storage

a. Each meter shall have a non-volatile memory in which the following shall be automatically stored:

i. Average frequency for each successive 5 min block, in Hertz up to second decimals.

ii. Net Wh transmittal during each successive 5 min block, up to second decimal, with plus sign if there is net Wh export and with a minus sign if there is net Wh import.

iii. Net VARh transmittal during each successive 5 min block, up to second decimal, with plus sign if there is net VARh export and with a minus sign if there is net MVARh import.

iv. Cumulative Wh transmittal at each midnight, in eight digits including one decimal.

v. Cumulative VARh transmittal for voltage high condition, at each midnight in eight digits including one decimal.

vi. Cumulative VARh transmittal for voltage low condition, at each midnight, in eight digits including one decimal.

vii. Average RMS voltage for each successive 5min block.

viii. Date and time blocks of failure of VT supply on any phase, as a star (*)/ (Z) mark.

b. The meters shall store all the above listed data in their memories for a period of fifteen (15) days. The data older than fifteen (15) days shall be erased automatically.

c. The software provided at CDCS, i.e. WRLDC, will manage all functionalities of collection of data through DCUs, validate the data, store the data in a database, and

manage the complete system. Software will also have a scheduler for scheduling the task of collection of data periodically. The periodicity of data collection shall be user defined.

4. Display

Each meter shall have digital display for indication of the following (one at a time), on demand:

i) Meter serial no. and model : IEM12345678A or IEM12345678B

ii) Date (year month day /yyyy mm dd) : 20160311 d

iii) Time (hour min sec /hh mm ss) : 195527 t

iv) Cumulative Wh reading : 1234567.8 C

v) Average frequency of the previous block : 49.89 F

vi) Net Wh transmittal during the previous block: - 28.75 E

vii) Net VARh transmittal during the previous block: - 18.75 R

viii) Average % Voltage : 99.2 U

ix) Reactive power (VAR) : 106.5 r

x) Voltage - high VARh register reading : 01234567.5 H

xi) Voltage - low VARh register reading : 00123456.4 L

xii) Low battery indication

xiii) The three line-to-neutral voltages shall be continuously monitored and in case any of these falls below 70 %, a normally flashing LED provided on meter's front shall become steady. It shall go off if all three voltages fall below 70 %. The LED shall automatically resume flashing when all VT secondary voltages are healthy again.

xiv) The two VARh registers (xv and xvi) shall remain stay-put while VT supply is unhealthy.

Any other better or more informative mechanism to display the above shall be preferred. The above shall be mutually agreed between the meter buyer and vendor.

Navigation keys to be provided at the meter front plate to navigate the display menu.

5. Communication

a. Each meter must have an optical port on its front for tapping all data stored in its memory through HHU. In addition to the above each meter shall also be provided with a RS-485, Ethernet and USB port on one of its sides, from where all the data stored in the meter's memory can also be transferred to CDCS (through DCU), local computer and external storage. The overall intention is to tap the data stored in the meter's memories at a scheduled time from any of the above mentioned ports or any other means

and transmit the same to a remote central computer using suitable means of communication. It shall be possible to securely download the IEM data through an USB port via external storage thereby removing the requirement of a MRI (Meter Reading Instrument). It shall be ensured that data transfer through USB shall be unidirectional only i.e. from Meter to external storage device. Meter data shall be tamper-proof.

b. All meters shall be compatible with Optical port, RS-485 port, Ethernet port and USB all together at a time and communicate independently. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters, using the local PC. Data collection from any local laptop/PC shall be possible by installing data collection software.

c. Entire project has to be based on Optic Fibre/GSM/4G/3G. Bidder should quote considering availability of Optic Fibre at 80% of locations and availability of PLCC/4G at 20 % of locations. This is for bringing all the bids on common platform. However the selected agency will have to conduct detailed survey regarding availability of the particular service for all locations.

d. The bidder may design appropriate architecture for providing end to end metering solution. He is free to decide upon the best solution out of all the available options to ensure that data from all IEMs in WR are available at Western Regional Load Despatch Centre by the scheduled time. However, the entire responsibility of fully functional end to end metering system shall rest with the bidder in order to meet the performance levels as given in this document. The communication provider may adopt Optical Fibre/ GSM/3G/4G communication technology or a combination of these technologies as per the site requirement adopting best available technology in the proposed area of implementation. The successful bidder shall be responsible for proper data exchange among IEM, DCU, CDCS, MDP and other operational/requisite software as part of fully functional metering system.

e. The bidder shall adhere to the appropriate security algorithm for encryption and decryption.

f. The bidder shall design a reliable, interference free & robust communication network keeping in view the site conditions. It shall be flexible in terms of providing communication in variable terrain & urban density. The bidder shall design the network architecture keeping in view the existing and planned infrastructure of the utility. During designing, suitable consideration shall be kept for future expansion as per requirement of Utility. Before designing the communication network, the bidder shall do the site survey and would provide the most efficient communication infrastructure. The entire infrastructure & associated civil works required for installation & commissioning of equipment/devices like DCUs, repeaters, routers & access points etc. shall be in the scope of bidder. The operational testing of all the network elements has to be demonstrated by the bidder to the satisfaction of the utility.

g. The Bidder shall provide the necessary software which would enable a local PC/ CDCS to:

i) Accept the data from the Optical/Ethernet/WAN and store it in its memory in user defined formats (text, csv, xls, etc.) in a user-defined file name (file name format must be ddmmyysubstation name-utility name).

ii) Polling feature along with a task scheduler to run the data downloading software at a pre-designated date and time repeatedly or by manually selecting a meter. File naming for such downloaded data should also be in user-defined format**.** A detailed activity log shall also be available for each downloading operation.

iii) Upload/Import meter data (binary files) in the software for further processing. While uploading, there shall be provision to upload all selected files with single key-stroke.

iv) Convert the binary file(s) to text file(s).There should be provision to select multiple files based on filename, convert all selected files with single key-stroke and store the text files in the same location where binary files are stored.

v) Display the collected data on PC's screen in text format, with forward/backward rolling.

vi) Print out in text format the data collected from one or more meters, starting from a certain date and time, as per operator's instructions.

vii) Transmit the collected data, in binary format, through an appropriate communication link to the central computer, starting from a certain date and time, as per operator's instructions.

viii) Store the collected data in binary format, on a CD/Pen Device. In addition to above, in general the software shall be able to convert IEMs data to existing format as well as in tabular (.csv) format as applicable.

h. The above software shall further ensure that absolutely no tampering (except erasing of complete data with password protection) of the collected metering data is possible during its handling by the PC. The software shall be suitable for the commonly available PCs, (Windows) and shall be supplied to Owner in a compatible form to enable its easy loading into the PCs available (or to be installed by the Owner/others) at the various substations.

i. The bidder shall ensure data integrity checks on all metered data received from data collection systems.

j. The quality of installation of the various equipment & power supply wiring to all field equipment shall be as per standards/ regulations/prevailing practices of the utility. The supply of electricity needed for operation and maintenance of entire Metering system shall be provided free of cost by the respective owners of the premises.

6. Quality Assurance

The quality control procedure to be adopted during manufacturing of the specified equipment shall be mutually discussed and finalized in due course, generally based on

the established and proven practices of the manufacturer. The software shall be user friendly which can be easily installed in any PC/Laptop irrespective of operating system of the PC/Laptop, and shall be certified for ensuring data handling capabilities. The same shall be demonstrated by the party during technical evaluation. During demonstration party shall bring standard meter. Thereafter software shall be offered for technical compatibility before taking up further necessary action in the procurement process.

7. Testing

a. All equipment, after final assembly and before dispatch from manufacturer's works, shall be duly tested to verify that is suitable for supply to the Owner. Routine and acceptance tests shall be carried out on the meters in line with IS 14697.

b. Any meter which fails to fully comply with the specification requirements shall be liable to be rejected by the Owner. However, the Owner may purchase such meters at a reduced price in case of marginal non-compliance, at his sole discretion.

c. Acceptance Tests for PC Software and data down loading using meter communication ports-

All IEMs after final assembly and before despatch from Bidder's/Manufacturer's works shall be duly tested to verify that they are suitable for downloading data using meter communication ports shall be subjected to the following acceptance test.

i) Downloading Meter Data from the Meter(s) to PC via optical port.

ii) Downloading meter data through USB port.

iii) Downloading meter data to DCU/CDCS through Ethernet port.

iv) Compatibility with PC Software.

v) Functioning of Time synchronisation, advance and retard time commands.

vi) Per meter downloading time verification.

d. Copy of Test certificate shall be submitted to WRLDC.

8. Type Tests

a. One (1) out of every hundred (100) meters shall be subjected to the complete range of type tests as per IS14697 and IS15959, after final assembly. In case of any failure to pass all specified tests, the bidder shall arrange to carry out the requisite modifications/replacements in the entire lot of meters at his own cost. After any such modifications and final assembly, two (2) meters selected out of the lot by the Owner's representative shall be subjected to the full range of type tests. The lot shall be accepted by the Owner only after successful type testing.

b. The meters used for type testing shall be separately identified, duly marked, and supplied to the Owner in case they are fully functional and as good as other (new) meters, after necessary touching up/refurbishing. In case this is not possible, the bidder shall provide their replacements at no extra cost to Owner.

c. The Bidder shall arrange all type testing specified above, and bear all expenses for the same.

d. Copy of Test certificate shall be submitted to WRLDC.

9. Installation and Commissioning

The static energy meters specified above shall be installed at various EHV substations owned by the Owner, ISTS licensee, Inter State Generating Stations, DISCOMs and other agencies, throughout India. The tentative list of substations along with the existing number of meters is enclosed as Annex-I. The exact location for installation shall be provided by the Owner.

a. The Bidder shall be responsible for total installation and commissioning of the meters (along with test blocks, if supplied separately) as per Owner's advice, including unpacking and inspection on receipt at site, mounting the meters on existing control and relay panels at an appropriate viewing height, connection of CT and VT circuits including any required rewiring, functional testing, commissioning and handing over. The Bidder's personnel shall procure/carry the necessary tools, equipment, materials and consumables (including insulated wires, lugs, ferrules, hardware etc.)

b. As part of commissioning of DCDs the Bidder shall load the software specified in clause 6(F) into the PCs at the respective substations, and fully commission the total meter reading scheme. He shall also impart the necessary instructions to substation engineers. At least 2-hour training session shall be arranged for substation staff. Also, an operating manual (pdf as well as hard copy) of the meter containing all details the meter, various data downloading features, etc. shall be made available at site and WRLDC.

c. Bidders to check the dimensions of the existing SEM's. IEMs shall fit in the same location in the panel.

d. Following technical information shall be furnished by the Bidders in their offers:

i) Foreseen dimensions of proposed meter.

ii) Expected weight of proposed meter.

iii) Dimensions and weight of the test block, if supplied separately.

e. At the time of commissioning, the meters lying in stores shall be time synchronized through GPS signal before installation in the panel to avoid the large time mismatch.

10. General

a. The meter shall be supplied with latest/compatible software (shall be compatible with old & new meters data download handling). Any new software as required to be installed within warranty period are to be done by party or through remote support to client.

b. The total arrangement shall be such that one (1) operation (click on "data down load from meter" button on software) can carry out the whole operation in about five (5) minutes per meter or preferably faster.

c. The layout of software front end/user interface has to be approved by WRLDC during technical evaluation/demonstration. However a standard template sheet will be provided along with bid for reference.

d. Software for windows/office/antivirus to be supplied. Antivirus should not slow down processes and same will be demonstrated during technical demonstration.

e. Above specification is minimum only, any higher standard required for the purpose intended (meter data handling) would be assessed by vendor and would be supplied accordingly. The detailed architecture shall be approved during drawing approval stage.

f. Meter shall accommodate in existing C&R panel of standard size (Alstom/ ER/ABB/Siemens) in kiosk or C&R panel with door closed. If required before bidding, bidder may collect necessary data or else the scope is deemed to be included.

g. Step by Step procedure (on screen shot type and desktop video capture) shall be provided for

i. Installation/Re-installation of Database handling software in to Laptop / PC

ii. Meter maintenance/site-testing procedure as per relevant IS/IEC standard.

iii. Procedure for data downloading from Meter by Laptop/Desktop PC.

h. As on date of delivery, the supplied meters shall comply with all statutory regulation as required under CERC/CEA/IEGC as applicable and the same should be declared by the vendor during delivery along with warranty certificate.

i. Bidder is responsible for dismantling of old special energy meters and to purchase on buy back basis on successful installation of interface energy meters.

11. Dismantling / Buy-Back of Existing SEM

Dismantling of existing SEMs and taking it away shall also be in the scope of bidder.

IV. AUTOMATED METER DATA READING (AMR) SYSTEM

This section describes the envisaged system architecture of Automated Meter-data Reading in Western Region.

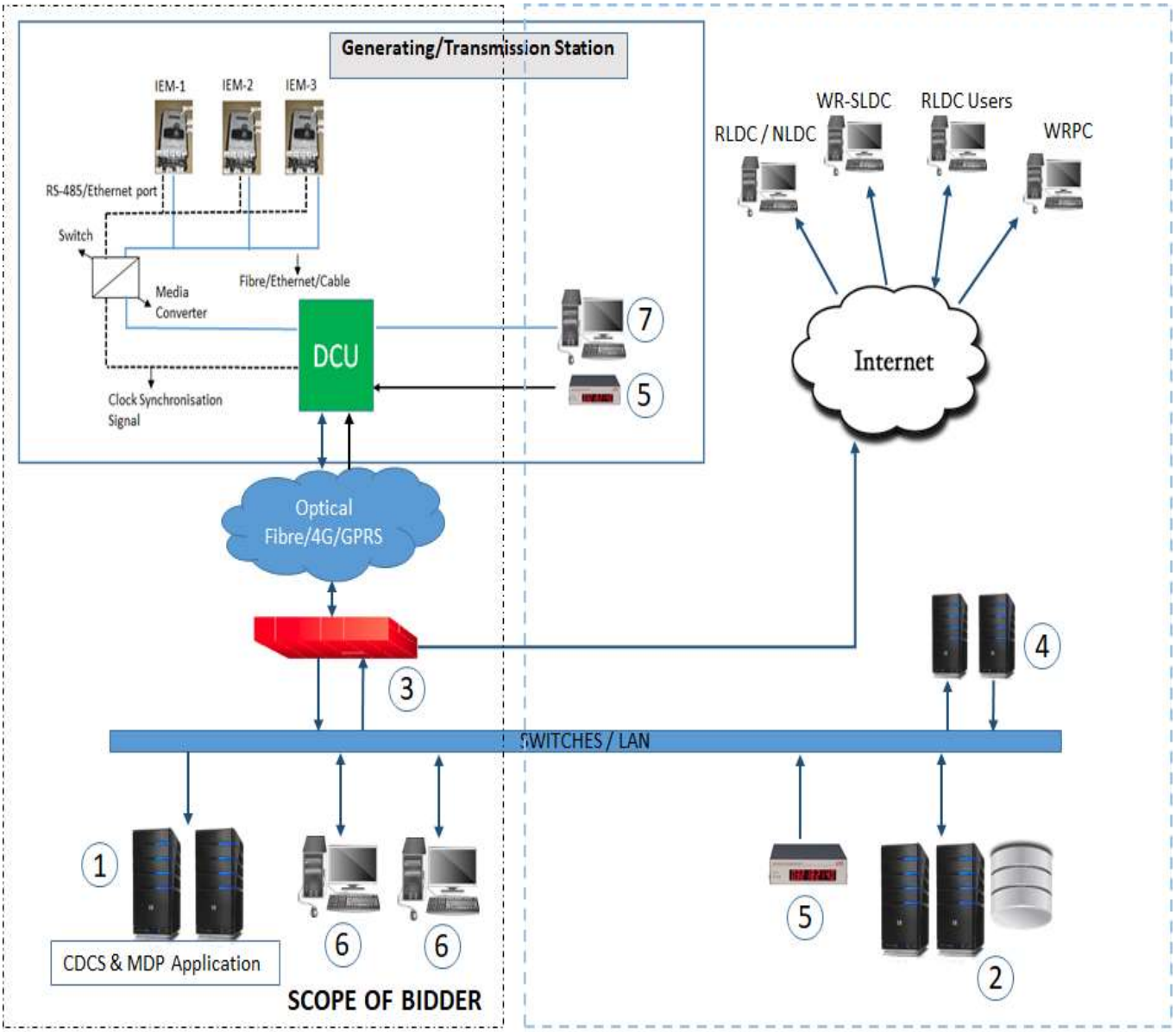
1. Intent of AMR

The intent of AMR scheme proposed in this document is to automate the task of data collection from each meter/location to the Central Data Collection System (CDCS) followed by validation, processing and generation of customized reports. The data shall be stored in ORACLE database located at Western Regional Load Despatch Centre, Mumbai.

The communication system for data transfer from IEM to WRLDC shall also be in the scope of the bidder. Concept diagram of the envisaged AMR system is given in Fig-2:-

1.1 Energy Meters

Energy Meters to be covered under proposed AMR system are Interface Energy Meters (IEMs) manufactured as per Technical Specification illustrated in this document.



Sr. No.	Description
1	Application Server - Main & Standby
2	Oracle Database Server (Not in scope of bidder)
3	Firewall
4	Web Servers (not in scope of bidder)
5	GPS clock (not in scope of bidder)
6	Client PCs
7	Local PC at site (not in scope of bidder)

Figure 2 – AMR concept diagram

1.2 Data Concentrator Unit

A Data Concentrator Unit (DCU) installed at each location will act as interface between Central Data Collection System (CDCS) at WRLDC and IEMs installed at that location. DCU shall collect data from energy meters and sent the same to CDCS at WRLDC. DCU shall also report diagnostic information of the energy meters to CDCS. DCU shall have following functions:-

- Acquiring energy data and status from energy meters.
- Providing energy data and status to CDCS.
- Providing energy data and status to local computer.
- Intelligence to synchronise IEMs clock with GPS clock located at Station/CDCS.

Each meter has a unique identification number and each meter location has unique identification code. DCU shall collect data from a single or group of meters based on meter number or meter location code. DCUs shall collect data from energy meters and transfer the same to CDCS. DCUs should provide a RS-485/LAN/USB port for communication with local personal computer or terminal.

1.3 Central Data Collection System

A Central Data Collecting System provided at WRLDC will manage all functionalities of collection of data through DCUs, validation and verification of the data, storage of the data in ORACLE database and management of the complete AMR system. CDCS shall have a scheduler for scheduling the task of collection of data periodically up to the last time block. Provision of extracting data from the database in the text files as per existing format for all or selected meters for further processing by Energy Accounting software is also to be built in data collection software. The responsibility of providing data up to CDCS (including all the hardware in between) shall be the responsibility of the bidder.

1.4 Communication System

Communication system to be used for transfer of data from DCU to CDCS may be Optic Fibre /GSM/3G/4G. Bidder is free to suggest alternative communication media if it is more efficient and cost effective.

2. Scope of Work

This section provides detailed scope of work included in the bidder's scope, excluded from the bidder's scope, facilities to be arranged by bidder and facilities to be provided by station owner.

2.1 Bidder's Scope of Work

The scope of work in complete conformity with subsequent sections of the specification shall include site survey, planning, design, engineering, manufacturing/integration, testing, supply, transportation & insurance, delivery at site, storage, installation, commissioning, demonstration for acceptance, training and documentation of AMR system including:

- Design Document for complete AMR System.
- Software Requirements Specifications for CDCS and DCU.
- Application Server Database System and Central Data Collection System (CDCS) at WRLDC.
- Making data available up to CDCS system at WRLDC.
- Data Collection Unit (DCU).
- Connection and interfacing of meters with DCU.
- Supply and laying of optical fibre at the stations for connection of IEM to DCU.
- GSM/GPRS/ Modems, Media converter, Switch
- Communication channels between each DCU and CDCS.
- All cabling, wiring, terminations and interconnections of the equipment.
- Database development, Displays and Reports.
- Archival and retrieval of data through Oracle database at WRLDC.
- Decoded text files in existing format at WRLDC.
- Periphery segregation shall be in line with established cyber security standards.
- Training of personnel (Substation, SLDC, RLDC and RPC)
- Warranty for 5 years and support and maintenance during 5 years extended period after expiry of warranty period.
- To maintain extra 20% quantity of AMR equipment as backup and future requirement.

2.2 Exclusions from Bidder's Scope of Work

Followings are not included in the scope of the bidder and shall be provided by local station without any extra cost to bidder:-

- Space for installation of IEMs, DCU, CDCS at respective locations
- Auxiliary Power Supply for IEMs, DCU at each location and server system at CDCS.
- Standard database (RDMS) for storage of data at WRLDC.
- Provision of static IP and internet connection at WRLDC
- Building, air conditioning systems and other infrastructures.
- PC required for data downloading at each location with connector. Local site shall arrange for the same.

Any other work which is not identified in 2.1 & 2.2 or in the specification but is required for completion of the project within the intent of this specification shall also be in the scope of the Bidder without any extra cost.

3. Functional Requirements

Major components of the AMR System to be implemented under the scope of this specification document are Data Concentrator Unit, Central Data Collection System and communication channel. This section enumerates the functional requirements of each component.

3.1 Data Concentrator Unit (DCU)

DCU is to function as a gateway between Central Data Collection System (CDCS) and energy meters installed at DCU location. DCU shall have following functions:-

- Acquiring energy data and status from energy meters.
- Providing energy data and status to CDCS.
- Providing energy data and status to local computer.
- Time synchronization of IEM's, either through GPS installed at site or through CDCS.

3.1.1 Acquiring energy and status data from energy meters

DCUs shall be connected with local energy meters through optical fibre with suitable media converter/ switch in between. Connection to the local energy meters shall be firm and secure from any unintended disconnection. DCU should implement IEM protocols. It shall be possible to change/update the energy meter protocol driver from CDCS. DCUs shall not send any command other than the command to read the energy data, status data and GPS clock synchronization of IEM clock.

3.1.2 Providing Energy Data and Status to CDCS

DCUs shall be provided with suitable SIM/modem etc. in order to have connectivity over Optic Fibre/GSM/3G/4G with WRLDC. All communication between DCU and CDCS shall be on secure VPN.

DCU shall accept following commands from CDCS/GPS Clock and shall function as per the command:

- Energy data collection from energy meters.
- Acquiring status and alarm from energy meters.
- Modification of DCU Configuration
- IEM clock synchronization with GPS clock.

3.1.2.1 Energy Data Collection

DCUs shall query energy data and transfer the same to CDCS based on the command received from CDCS. Command may be for one time demand of data or it may be on cyclic basis. DCU

shall be able to query data from all or selected energy meters for the selected period based on the command from CDCS. DCUs shall be able to read energy data from all make of energy meters available in the market like L&T, Secure and Elster etc.

Each meter has a unique identification number and each meter location has unique identification code. DCU shall collect data from a single or group of meters based on meter number or meter location code. DCUs shall collect data from energy meters and transfer the same to CDCS. As DCU functions on read and forward philosophy for energy meter data, no storage is envisaged in the DCUs for energy data. However, if vendor thinks that provision of storage in DCUs may be required to meet the requirements of the AMR system, storage may be provided. However, such storage shall take care of currency of data while responding to commands from CDCS.

3.1.2.2 Status Data Collection

DCUs shall query periodically all energy meters connected to it for status or any alarm etc. Any change in status or alarm shall be reported to CDCS immediately.

DCUs shall acquire connected energy meter details like meter identification number, make, Low Voltage flag etc. periodically as well as whenever it's powered on. Any meter change activity like meter number, Low Voltage flag etc. shall be reported to CDCS immediately.

DCUs shall be self-monitoring for alarm like power failure, communication disconnection, and disconnection from energy meters and report the same to CDCS immediately.

DCUs shall have non-volatile memory for storing status data of energy meters duly time stamped, details of connected meters like make, meter number, status change. Non-volatile memory should be able to store such data for at least one month in round FIFO buffer.

3.1.2.3 DCU Configurations change

Each DCU shall have a unique identification number normally not required to alter at site.

DCUs shall accept and respond command for making configuration changes in DCU like periodicity of energy data/status data collection/GPS clock signal for IEM clock synchronization. For each configuration change, DCU shall respond with task successful or failure message to CDCS. Configuration commands from CDCS may be in the form of single command or multiple commands in a command file. DCU shall accept and make changes in configuration through data command on Optic Fibre/GSM/3G/4G. DCU shall receive the configuration command from CDCS on same channel used for transfer of data to CDCS.

DCUs shall store all configuration data locally in a separate non-volatile memory. All changes to configuration shall take place first to this memory. Only after receiving a specific command from CDCS, the saved configurations should come into effect. However, any other functionality should not get affected during accepting and responding to configuration commands from CDCS. DCUs are not required to store history of configuration changes as all history shall be maintained in CDCS.

3.1.2.4 IEM clock synchronization with GPS clock

DCU shall have the intelligence to synchronize the IEM clock time with local GPS clock time. Input GPS clock signal to DCU shall be from station GPS clock. If GPS clock is not available at station level, DCU will get GPS clock reference from CDCS (at WRLDC).

3.1.3 Providing energy data to local computer

DCUs shall provide a RS-485/LAN/USB port for communication with local personal computer or terminal. DCU shall provide meter status, alarm etc. and energy data to local personal computer, if required. Local PC shall be able to query energy data from selected or all energy meter by using web browser and institutive user interface. The web browser shall be same as CDCS web browser to access the IEMs installed at local station. No special software should be required to be installed at local computer for this communication. All communication with local computer shall be password protected. PC for data downloading at each DCU location shall be arranged by respective site/ utility.

3.2 Central Data Collection System (CDCS)

A central data collection system (CDCS) shall be provided at WRLDC for collection and processing of data from DCUs installed at remote locations. CDCS shall perform following functions:-

- Communication with DCUs.
- Collection of energy data from DCUs.
- Collection of status data form DCUs
- Remote Configuration of DCUs
- GPS clock signal to DCU
- Processing of energy data.
- Storing of data.
- Providing data to energy accounting software.
- Reporting functions.
- Monitoring and Alarming.
- Audit trail and logging.
- Meter management.
- Shall have user Interface for
  - Data/Report uploading on website.
  - Data/Report access for predefine list of meters to SLDCs with secure user name and password for intrastate energy accounting.

- Data/Report for WRPC.

- CDCS shall include a web based application for utilities/stations to manually upload the data in case of AMR communication system failure due to any reasons. The following shall be taken care of in this regard:
  - The web application link shall be made accessible to all stations through WRLDC website.
  - The downloaded data shall be in encrypted format.
  - Each utility shall be given User name and Password for login the web application.
  - Browser shall have the list of all Utilities and its station names.
  - Each station shall upload the encrypted data by selecting their Utility name and Station name.
  - Web Application shall generate the confirmation message to the station on successful uploading of data.
  - Web application shall generate the popup message at CDCS with Utility name and Station name on receipt of data.
  - All the encrypted data received at CDCS via web application shall be stored in predefined path.
  - CDCS shall have the provision to decrypt the data and store in the database for the further processing.

3.2.1 Communication with DCUs

The CDCS shall have a dedicated Communication Server – This shall manage the VPN Connections, DCU Communication, Alarm management, Logging, DCU Configurations as well as GPS clock signal to DCU. The Interface of the Communication Server shall be standards based such that, up gradation of either Communication System or Application Server will not need a commensurate replacement of the other. The CDCS shall have a Network Management Interface that provides a Dash Board of the DCU's and their status / Alarms and Meter's that are not communicating.

3.2.2 Collection of energy data from DCUs

CDCS shall collect data from energy meters through DCU for selected/configured meter location periodically or on demand at any time. CDCS shall have a scheduler software, which shall issue command to the concerned DCU and collect the required energy meter data. It shall be possible to schedule data downloading on hourly basis.

3.2.3 Collection of status data form DCUs

CDCS shall have a DCU monitoring module. This module shall monitor each DCU for its working status, parameters and any alarm etc. The monitoring data shall be collected periodically or on demand at any time from all or selected DCUs. Possible periodicity of data collection would be once in a day.

3.2.4 Remote Configuration of DCUs

CDCS shall be provided with software module for remote configuration of selected or batch of DCUs. Remote DCU configuration module should be able to configure each parameter of DCU individually or in batch mode. It shall be possible to download the following changes to the remote device in addition to other required changes:

- Poll cycle for collection of energy data.
- Fixed public IP of CDCS server of the Control Centre
- Changes in meter protocol driver.

3.2.5 GPS clock signal to DCU

DCUs get GPS clock reference signal from station GPS itself. If GPS clock is not available in any station, CDCS shall send time sync signal to DCU to time synchronize the IEMs connected to that DCU.

3.2.6 Processing of energy data

Collected energy meter data (5-min) shall be provided to the data processing module. The time block period of the raw output from CDCS shall be used defined (5/15-min). This module shall check the data for completeness, error etc. and if any error is found, the same shall be displayed as an alarm.

3.2.7 Storing of data

If collected data is error free, it shall be provided to a data storage module. Data storage module shall load the collected energy data in to the database as per its structure. Archival of data shall be through Oracle data base.

3.2.8 Providing data to energy accounting software

CDCS should have software module for providing energy meter data from the database to the energy accounting software. The data output shall be in the form of text file (as per WRLDC standard text file format) or as query based output.

3.2.9 Reporting

CDCS shall have data reporting capability implemented through a separate dedicated module. Reporting module should be able to give report output on screen, in pdf or in XLS/csv form. Reports may be based on pre-configured criteria or based on adhoc query.

3.2.10 Monitoring and Alarm

CDCS at WRLD shall provide DCU monitoring and self-monitoring functions to monitor the operating conditions and the performance of the system.

A suitable network management system (NMS) shall be provided at CDCS to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration & parameterization of

the networking devices and the nodes.

Any detected problems shall be reported through local display, built-in event logging and to remote console or printer. Severe problems, such as loss of communication, shall generate alarms locally and e-mail notifications to configured e-mail address. User shall be able to enable and disable alarms individually.

CDCS shall generate an alarm whenever "data not received" occurs for one or more times for one or more DCU/IEM data. The alarm shall indicate which DCU/IEM has the problem.

All Alarms (such as loss of supply to IEM, DCU failure, Communication failure, AMR failure etc.) to be generated in CDCS within 5 min. of the event.

3.2.11 Performance levels for AMR and CDCS

Data from all the installed IEMs shall be received at CDCS within 8 hours after the scheduled hour. Report for missing data if any shall be generated instantly on demand.

Issues observed in data collection, processing, report generation etc. shall be flagged by WRLDC to the vendor for redressal in line with the Emergency Support Response/Resolution time as per table XI-4.

3.2.12 Audit trail and logging

CDCS should have audit and logging function for each and every activities either completed successfully or failed should be logged.

The system shall provide audit trail of user and system activities that enables data changes to be tracked and reported, including changes made by the system administrator.

For editing of energy meter data, the system shall record the following information in a log and store it for a minimum of 12 months:

- User ID
- Date and Time of Change

User shall be prompted to input a reason for editing using either a standard reason code or a freeform text field. In addition to data stored in the edit log, each interval containing edited data shall be marked with a status to indicate that the data has been edited. The pre-edited value shall be stored in the database as a previous version, which can be retrieved using "as-off" date functionality.

Changes to configuration data by users shall be logged by Date, time, and user ID and such logs shall be stored for a minimum of 12 months.

Critical changes relating to measuring parameters (pulse multipliers, transformer ratios, etc.) and formulae change shall be stored indefinitely as a previous version. The database for these is to be maintained in CDCS.

For regular system tasks, such as meter communication, task processing, validation, etc. the information will be kept for minimum one month.

Full data and system audit ability such as version controls and data retrieval according to the date and time. Additionally, all versions of meter data shall be stored such that they may be retrieved by "as-off" date for user to inspect.

4. General Requirements

Components of AMR system shall meet following physical requirements:

4.1 Data Concentrator Unit (DCU)

4.1.1 General Construction

- DCU shall be a self-contained, stand-alone, tamper proof sealed box with necessary ports for external connection. It shall be flush mounted or surface mounted without requirement of a separate panel.
- DCU shall not have any moving parts such as a hard disk, to ensure smooth and reliable operation for long term.
- All components inside DCU shall be easily accessible for testing. The plug in units, whose removal or insertion, when in operation might endanger the reliability or performance of the unit, shall have suitable protection.
- Each sub-assembly inside DCU shall be clearly marked to show its function, schematic reference so that they are identifiable from the component layout diagram in the handbook.
- All external connections to DCU should be secure so as to avoid accidental disconnection.
- The DCU shall be powered from the station battery backup supply rated at 220V DC supply or normal AC supply.
- DCU shall have protection against entry of dust, lizards etc.
- DCU shall be able to operate in environment with temperature up to 50ºC and humidity up to 90% without any significant effect on its performance.
- The mechanical design and construction of each unit sub-assembly shall be inherently robust and rigid under various conditions of operation, adjustment, replacement, storage and transport.
- DCUs shall also withstand, without any damage or mal-operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. They shall have an IP-51 category dust-tight construction and shall be capable of satisfactory operation in an indoor, non-air conditioned installation.

4.1.2 Local Display

A local display for status like power on, communication activity etc. and alarms like power failure communication fault etc. shall be provided on the face of DCU.

A web based display of DCU dashboard displaying all status; logs of activities, logs of alarm etc.

shall be provided which shall be accessible from local PC as well as on CDCS.

4.2 CDCS

- Dot NET or equivalent architecture such as Java based technologies shall be used for development of CDCS software.
- System shall support entry / modification of data manually by an authenticated user.
- Uploading meter data files manually to the AMR system by an authenticated user shall also be supported.
- System under this project shall be complete in all respects including software, hardware, servers, LAN equipment's, cabling, modems, server racks etc.
- The servers or computer system shall be in redundant mode in main and standby configuration. In case of failure of main standby should take over the work of data collection.
- Data collection system shall use multi-tier architecture having separate tier for database, application server and client.
- Application tier shall utilize Web based architecture based on Microsoft .NET framework or equivalent architecture.
- Client tier shall be any Internet Explorer like MSIE, Firefox, Chrome etc.
- All human machine interface with software system shall be web-based.
- The Application shall be secured with password-protected access. It shall support multiuser access with role-based security.
- CDCS shall be implemented by using server machines. Two machines shall be used for hosting software and DBMs in main and standby mode. One server shall be used as communication front end for all communication with DCUs as well as clients. Suggested configuration of servers may be :-
  - 2 X Intel Xeon E5-2667 v4 3.2 GHz,25M Cache,9.6GT/s QPI,8C/16T (135W) Max Mem 2400MHz Cache 8MB
  - 128 GB RDIMM, 2400MT/s
  - 1 TB hot pluggable, RAID 1 for Server Internal HDD
  - Remote Management - Shall be able to manage through dedicated 1G remote management port with Remote Access Controller with KVM redirection. Any licence required for KVM redirection should be included with support for 3 years.
  - DVD+/-RW SATA Internal
  - Power Supply and Fans - Dual, Hot-plug, Redundant Power Supply (1+1). Redundant hot swap fans.
  - USB 3.0 ports – 4 nos. (minimum)

- Supported OS - Shall support following Hypervisor VMWare /RHEV/ HyperV/Citrix
- Form Factor - 1U Rack with rack mounting kit
- Management Software - Server management software with power management features and 3 years support should be included
- NIC Port - 4 X 1Gbps NIC card
- Hardware may be desktop based with keyboard, mouse and monitor etc.
- Office 2013 Business (64 bit) or latest
- Operation System: MS windows 2013 Std. Server 64bit
- 23" Wide TFT Monitor
- Makes: HP/DELL/Lenovo

Client PC Specification:

- Processor - Intel 6th Gen Intel Core i7 (6700)
- 16 GB DDR3 RAM (expandable up to 32 GB)
- 500GB 7200rpm or Higher
- Graphics: Intel Integrated Graphics or Higher
- Integrated sound controller; Gigabit Ethernet controller; DVD writer dual layer ; 104 Keys OEM Keyboard and OEM Optical Mouse; all necessary Plug-ins/utilities and driver software, bundled in CD/DVD Media
- 4 USB Port
- 23 " TFT Monitor
- Windows 10 Professional or latest, MS office 2016 or latest

The above-mentioned server specification is minimum requirement, if the vendor ABT application requires higher configuration than vendor has to quote for the same. After supply of material during commissioning or during observation period if any server hardware/software up gradation required than it shall be in vendor scope.

4.3 Communication System

- All modem/SIM installed shall be securely and firmly mounted on DCU itself.
- Mounting or un-mounting of modem/SIM shall be accessible from front of DCU.
- It shall be possible to change modem/SIM without uninstalling DCU.
- Mounting of modem/SIM shall be sealable.
- The Modem shall meet the following environmental specifications, IP55 housing, Storage Temperature: -20 degrees to +70 degree Celsius, Operating Temperature: - 10 degrees to +60 degree Celsius, Humidity: - 95% RH (Non - Condensing).

5. System Sizing and Performance Requirements

AMR System shall meet the following system sizing and performance requirements. The system sizing and performance requirements are specified for main subsystem. Standby subsystem shall have the same sizing and performance requirements. The Acceptance of the product shall be based on the Owner/WRLDC approved test protocols/ schedules to be submitted in advance by the Bidder ahead of factory/site inspection.

5.1 System Sizing

The system sizing for AMR System is only specified for initial sizing. The delivered system shall be expandable as the input and output requirements grow. Vendor is required to demonstrate their system's expandability in FAT.

5.1.1 CDCS

CDCS shall meet following sizing requirements:

5.1.1.1 Population of Energy Meters

CDCS shall be capable to receive data from a minimum 300 DCUs, which is collecting up to 30 energy meters connected per DCU, at the minimum data collection interval. However, CDCS shall have provision to collect and handle data from up to 1000 DCUs and up to 5000 energy meters without any significant degradation of performance.

5.1.1.2 Data Storage

CDCS shall provide online storage for storing a minimum of 10 years of collected, processed and output data.

CDCS event archive data storage historian shall provide a minimum data storage of 10 years, assuming event will not be more than 20% of the total time.

5.1.1.3 Clients

CDCS shall be capable of supporting minimum 100 clients for providing collected data. Each client output shall be individually configurable by users.

5.1.2 DCU

The number of meters at site may vary from 2 no. to 35 nos. Bidder shall decide the DCU requirement accordingly with sufficient future expansion capability. The detailed list of meters installed at substations as on date 31/03/17 is attached in Annex-1

5.2 Data Handling Performance Requirements

CDCS shall meet the following performance requirements for data collection and data processing.

5.2.1 Performance requirements for CDCS

CDCS shall receive process and archive the complete data from all DCUs within specified time as guaranteed by the vendor excluding the waiting time for data arrival. This performance

requirement shall be met under the maximum number of input DCUs and maximum number of SEMs with the maximum number of data points as specified for the delivered as-build or expanded system.

5.2.2 Performance requirements for DCU

DCU shall receive complete data form energy meters and send the same to CDCS within specified time guaranteed by the vendor. This performance requirement shall be met under the maximum number of SEMs as specified for the delivered as-build or expanded system.

5.3 System Availability Requirements

AMR system and its subsystems and system components shall meet the following availability requirements.

The CDCS shall have a measured availability of 99.9% or better during the availability test. The CDCS software shall be considered available when all of the functions described in this specification, except as noted, are operating as specified at their scheduled periodicity and within the execution time parameters and at the same time all hardware is available as specified.

The CDCS shall continue to operate without interruption under any single point of failure condition. That is, there shall be no hardware or software element whose failure renders the CDCS unavailable. This requirement shall specifically include all hardware, the interconnections among hardware, power supplies, and enclosures of the OP or PT subsystems.

V. METER DATA PROCESSING AND REPORTING

This section describes the envisaged system architecture of Meter Data Processing (MDP) and Reporting in Western Region.

1. Intent of MDP and Reporting

The intent is to provide the requirement details of Oracle Database oriented Meter Data Processing Software having compatibility to exchange and share data / information with similar Database systems that may be used by other RLDC / NLDC with a view to meet requirements of Data Warehousing and Business Intelligence systems etc. The Client Interface shall be Browser/console based and report formats shall be in user defined multiple formats like PDF, MS Excel, CSV, Text etc. The software is intended to meet the regional energy accounting requirements for the commercial mechanism adopted in respect of bulk power supplies and inter-State exchanges within and across a Region. The software shall also have a module for importing the interchange schedule of regional entities from an external system and computing the deviation by any regional entity from its interchange schedule. Further the software shall have a module to compute the deviation charges as per the prevailing DSM mechanism approved by CERC. This document describes the details of various functions like meter data - collection, formatting /conversion and facilities of existing software (which is to be replaced with the new proposed Oracle database oriented software) and proposed solution for meter data processing.

2. Collection, Processing and Computation of Meter Data

- As the end-to-end metering system shall be supplied by the single successful bidder and all meters data shall be available at CDCS through AMR system. Database creation in MDP software shall be done by designing a suitable interface between MDP and CDCS at WRLDC.
- While importing data from CDCS to MDP, any discrepancy or missing of data in any particular block or wrong raw data format shall be displayed and downloaded in the form of a report. The output format shall be Station wise, Utility wise and Period wise.
- MDP software shall have the options to generate the list of Meter IDs whose data is not available, List of meter IDs whose data is available for day wise for the required period. The format of non-availability data report shall be as below.

Data Availability Report for the Period "dd-mm-yy to dd-mm-yy"					
Master ID	Day-1(dd-mm)	Day-2(dd-mm)	Day-3(dd-mm)	Day-4(dd-mm)	Day-nn(dd-mm)
KO-001	-	-	-	-	-
KO-002	*	*	-	-	-
KO-003	-	-	-	-	*

"-" Means Data Available & "*" Means Data Not Available

Table V-1 - Data Availability Report

- The Computation (Multiplication of raw data with CT/PT Ratios to arrive at actual values) of meter data in MDP shall be done automatically after activating the import option for data fetching from CDCS.
- All meter data computations (Active energy, Reactive energy and Voltage etc.) in MDP shall be in 5-min block wise only.
- MDP shall have the provision to access and correct the IEMs raw data in database, if required. The corrected raw data shall replace the old data.

- **IEMs Details (Master file) in MDP**:
  - MDP shall keep database (Meter No., Location ID, Utility Name, Station Name, Description, Meter Type, HV Voltage, LV Voltage, HV Current, LV Current etc.) of all IEMs used in accounting.
  - One of the inputs required for computation of energy from raw data is a Master file containing details (CT/PT ratio, location, etc.) of all the available IEM's in the region
  - Whenever master file shall be modified, the old version of the master file shall be stored in database with date stamping. When computation of raw data for old dates is required, the S/W shall fetch the meter details (Meter ID, HV Voltage, LV Voltage, HV Current, LV Current etc.), for the mentioned period, from the required version of the Master file.
  - There shall be provision for updation of existing IEMs database and to add new IEMs to MDP database.

  - The MDP Master File format shall be as mentioned below.

Utility Name	Station Name	Location	Description	Element Type	Meter No	Local Meter ID	HV Voltage (kV)	LV Voltage (V)	HV current (A)	LV current (A)

Table V-2 - Master file format

3. Computation of Injection/Drawal Of Utilities

- Energy data of IEMs shall be used for Computation of Injection/Drawal of utilities, which shall include application of algebraic functions on a set of predefined IEMs. Such injection/drawal of utilities may itself be treated as a fictitious meter data, which can be calculated through application of algebraic functions on real meter data.
- Addition and deletion of new utility shall be user defined. There shall also be provision to update the file with date stamp.
- There shall be two types of database for Fictitious IEMs. One for Fictitious ID details with description and other is for formulae set. All the data formats shall be user configurable.

- The format of Fictitious IEMs shall be as below:

FICTITIOUS ID	FICTITIOUS ID TYPE	DESCRIPTION
KO-901	Main	Korba Stage-1 Injection
KO-902	Check	Korba Stage-1 Injection
KO-902	Standby	Korba Stage-1 Injection
LK-901	Main	Lanco Stage-1 Injection
LK-902	Check	Lanco Stage-1 Injection
LK-902	Standby	Lanco Stage-1 Injection

Table V-3 Fictitious meter Description file format

FICTITIOUS ID	FICTITIOUS ID TYPE	FORMULA
KO-901	Main	(KO-01)+(KO-02)-(KO-03)*98/100
KO-902	Check	(KO-04)+(KO-05)-(KO-06)*98/100
KO-902	Standby	(KO-05)+(KO-06)+(KO-07)
LK-901	Main	(LK-01)+(LK-02)-(LK-03)
LK-902	Check	(LK-04)+(LK-05)-(LK-06)
LK-902	Standby	(LK-05)+(LK-06)+(LK-07)
IN-901	Main	(KO-901)+(LK-901)

Table V-4 Fictitious meter Formulae File Format

- Computation formula of a fictitious meter may involve other fictitious meters in its formula. Therefore, the software shall have the capability to compute the same. The fictitious meters used in the formula have to be computed first before they are used in other formulae.
- S/W shall have the capability to replace any meter used in fictitious formulae with its Check/Standby meter with application of transmission loss in case of non-availability/discrepancy of main meter data. The replacement can be for a block/day/week. The percentage of loss to be applied shall be defined by user in configuration file base on the type and voltage rating. The configuration file format shall be as below.

Type of Element	Voltage Level KV	% of Loss to be applied
Line	765	1.5
Line	765	2
Line	220 and Below	4
ICT	-	0

Table V-5 – Loss configuration file

- All changes in fictitious meter in block wise shall be stored in database for future requirements.

- MDP shall be capable of fetching computed IEM data and fictitious meter data of required date and time block through query.
- If, while computing fictitious formula, any meter data is found missing/invalid, the same shall be shown in an error dialogue box with an option to bypass the same or not.
- MDP shall compute Injection/Drawal of Utilities while incorporating all the changes made in fictitious meter configuration files viz. replacement of main meters with Check/Standby meters due to non-availability/ discrepancy of main meter data.
- Report of all replacements and adjustments done shall be provided/available and downloadable.

4. Validation of IEM and Fictitious Meter Data

- IEMs and Fictitious meters are classified in 3 categories - Main, Check and Standby meters.
- Prior to energy accounting, validation of IEMs and Fictitious meters data is essential for accurate energy accounting.
- Validation of Main meters (IEMs & Fictitious Meters) data is done by pair checking with Check and Standby meters (IEMs & Fictitious Meters) data block wise (5/15 min).
- For validation of data, S/W shall have a Pairs configuration file where all set of pairs can be defined.
- Pair check file shall user configurable for addition/deletion/modification of pairs in accordance with the change in network configuration.
- The Pair Check configuration file format shall be as below.

Station Name-1	Station Name-2	Main Meter ID	Check/Standby Meter ID	Pair Relation	% Tolerance in +ve direction	% Tolerance in -ve direction	Element Details
KSTPS	KSTPS	KO-001	KO-004	M-C	0.5	0.5	400KV Korba Mahan line
KSTPS	MAHAN	KO-001	KO-005	M-S	2	2	400KV Korba Mahan line
KSTPS	KSTPS	KO-901	KO-902	M-C	0.5	0.5	Korba Stage-1 Injection

Table V-6- Pair check configuration file

- When Pair Check option is activated, S/W shall compute the difference between the selected pairs and shall generate the output file which shall consists of actual difference and percentage of difference.
- Generally, the polarity of Main and Check meters is same whereas polarity of Main and Standby meters is reverse. Therefore, S/W shall compute accordingly.
- For calculating percentage difference, the reference energy value shall be the sending end energy value for Main-Standby meter (M-S) set. Since polarity for Main and Check meters is same, the Main meter energy data shall be considered as reference for pair check of Main-Check meter (M-C) set.

- Sending end can be decided based on the polarity of the meter data (Sending end polarity is +ve, while receiving end polarity is –ve).
- S/W shall generate the pair check output file which contains block wise difference and percentage difference values of all pairs whose % difference is greater than tolerance value.
- Tolerance percentage value shall be user defined and it may vary from element to element. The Tolerance value shall be user given in Pair Check configuration file for each pair.
- The format of Pair Check output file to display the exception values (beyond threshold) shall be as below.

Main Meter ID	Check/ Standby Meter ID	Pair Relation	Station-1-Station-2	Date	Time Blk	Main Meter Reading	Check/ Standby Meter reading	Diff. in MWH	% Diff	% Tolerance
KO-001	KO-004	M-C	KSTPS-KSTPS	31-03-2017	25	52	40	12	23.08	0.5
KO-001	KO-005	M-S	KSTPS-MAHAN	31-03-2017	25	52	50	2	3.85	0.5

Table V-7 – Pair check output file

5. Loss Computation

- Loss Computation module shall have the options to compute Western Region Transmission Loss, Line wise transmission loss (220KV, 400KV, 765KV, HVDC etc.), ICT wise loss (765/400KV, 400KV/220KV etc.) and Bus loss (220KV, 400KV & 765KV) for each time block and for user define period.
- **WR Transmission Loss Computation:** Configuration file for WR Transmission loss computation shall be as below.

Injecting Utility	Drawal Utility	Inter Region	WR Loss(D)	% WR Loss
KO-901	CS-901	SR-91	A-B+C	[D/(Sum of {Injecting Utilities with +ve value, Drawl Utilities with -ve value & IR with +ve value})]*100
LK-901	MP-901	ER-91		
AC-901	GU-901	NR-91		
-	-	-		
-	-	-		
-	-	-		
SK-901	DD-901	-		
∑ (Injecting)= A	∑(Drawal)= B	∑(Inter Region)= C		
For Injection/Drawal Utilities +ve means Injection/Drawl & -ve means Drawl/Injection. For IR -ve means drawal from WR & +ve means injection into WR				

Table V-8 – Loss configuration file

- **Format of loss output file shall be as below**:

Name	Date	Time Blk	Injection(A)	Drawl(B)	Loss(A-B) (MWH)	Loss (MW)	WR Loss (%)
	27-03-2017	1	6084.85	5837.30	247.54	990.16	4.07
	27-03-2017	2	6071.78	5845.74	226.03	904.12	3.72
	27-03-2017	3	6075.19	5837.96	237.24	948.96	3.91
	-	-	-	-	-	-	-
	02-04-2017	96	5669.85	5449.95	219.90	879.6	3.88
	02-04-2017	97	5748.77	5520.88	227.90	911.6	3.96
	02-04-2017	96	5780.30	5560.22	220.08	880.32	3.81
			∑ (A)	∑ (B)	∑ (loss MWH)	∑ (loss MW)	

Table V-9 – Loss output file

- S/W shall have the feature to generate loss output files for required period (From "Date and Time block" & To "Date and Time block") through user query.

- **Line Wise Transmission Loss Computation:** Configuration file for line wise transmission computation shall be as below:

Meter ID (A)	Meter ID (B)	Loss (MWH) (C)	Loss (%)
KO-001	KO-005	If A is +ve "A-B" or else "B-A"	If A if +ve "(C/A)*100)" or else "(C/B)*100)"
KO-007	KO-009	"	"
-	-	"	"
-	-	"	"
TR-001	TR-005	"	"
BL-007	BL-009	"	"

Table V-10 – Line wise Transmission loss configuration file

- Format of line wise transmission loss output file shall be as below:

Date	Time Blk	"KO-001"-"KO-005"		-	-	-	"LA-001"-"LA-005"	
		Loss (MWH)	Loss (%)	-	-	-	Loss(MWH)	Loss (%)
27-03-2017	1	-1.12	-3.18	-	-	-	-2.12	-3.18
27-03-2017	2	-0.27	-1.16	-	-	-	-3.27	-1.16
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
02-04-2017	95	-0.27	-1.00	-	-	-	-1.27	-3.00
02-04-2017	96	-0.40	-1.56	-	-	-	-3.40	-3.56

Table V-11- Line wise transmission loss output file

- S/W shall have the feature of browsing the line wise loss configuration files with respect to utility/Station/Voltage level etc. so that the required pair can be easily computed.
- Software shall also have the provision to compute loss for a user specified no. of time blocks for any entity.

- ICT loss computation configuration file and their output file formats shall be same as that of the line wise loss formats.

- **Bus loss Computation:** The bus loss configuration shall be user defined. Configuration file for bus loss computation shall be as below:

BUS ID	Bus Description	Bus Section Formulae (L)	Bus Section Loss (MWH)	Bus Section Loss (%)
KO-025	KSTPS-400KV	L=(KO-001)+(KO-002) -(KO-003)	L	{L/sum of injection into the bus (negative energy recordings)}
-	-	-	-	-

Table V-12- Bus loss configuration file format

Format of bus wise transmission loss output file shall be as below:

Bus ID	Bus Description	Bus Section Loss (MWH)	Bus Section Loss (%)
KO-025	KSTPS-400KV	10.2	1.2
-	-	-	-
-	-	-	-

Table V-13 – Bus loss output file

6. Reports

- S/W shall have the feature to prepare reports (5/15 min) in user-defined Text, PDF, Excel and CSV formats. Different types of Reports to be prepared are as below.

- **Active Energy Reports**:
  - S/W shall have the capability to prepare the day wise active energy reports (in 5/15 min blocks data) of Utilities for submission to WRPC.
  - These reports shall be prepared for each utility. The formats shall be user configurable.
  - The Active energy report shall consist of computed data of all elements which shall be used for computation of drawal/injection of utilities and total value.
  - These configuration files shall be user configurable. There shall be suitable provisions for addition of new columns in the report to incorporate new elements

and there shall also be provision for configuration of new reports to incorporate new utility.

- Typical Active energy output file format (15 min) shall be as below:

Active Energy(MWH) Accounting of "Utility Name" for 31-03-17								
Date	**Time**	**Time Blk**	**Meter ID-1**	**Meter ID-2**	**-**	**-**	**-**	**Total**
31/03/2017	00:00	1	33.163635	33.054546	-	-	-	100.036362
31/03/2017	00:15	2	32.072727	32.072727	-	-	-	100.690903
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
31/03/2017	23:30	95	36.545452	36.436363	-	-	-	100.254555
31/03/2017	23:45	96	36.327271	36.327271	-	-	-	100.254539

Table V-14- Active Energy Output file format

- **Reactive Energy Reports:**
  - Reactive Energy Settlement at ISTS level is being done day wise for Low Voltage (<97% of Rated Voltage) and High Voltage (>103% of Rated Voltage) conditions.
  - S/W shall have the capability to prepare the weekly reactive energy reports of Utilities for submission to WRPC.
  - These reports shall be prepared for each utility. The Reactive energy report shall consist of Cumulative reactive data (LV & HV registers) of all elements which shall be used for computation of drawal/injection of utilities. However, there shall be an option to provide reactive energy reports similar to active energy report with block-wise details of reactive energy consumption/injection.
  - Typical block wise Reactive energy output file format shall be as below:

Reactive Energy (MVARh) Accounting of "Utility Name" for 31-03-17								
Date	**Time**	**Time Blk**	**Meter ID-1**	**Meter ID-2**	**-**	**-**	**-**	**Meter ID-n**
31/03/2017	00:00	1	11.163635	12.054546	-	-	-	100.036362
31/03/2017	00:15	2	12.072727	12.072727	-	-	-	100.690903
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
31/03/2017	23:30	95	16.545442	16.436347	-	-	-	100.254555
31/03/2017	23:45	96	16.327261	16.327252	-	-	-	100.254539

Table V-15 – Reactive energy output file (block wise)

  - The configuration files shall be user configurable. There shall be provision for addition of new columns in the report to incorporate new elements and there shall also be a provision to configure new report to incorporate new utility.
  - Day wise Reactive energy output file format shall be as below:

Reactive Energy(MVArh) Accounting of "Utility Name" for 31-03-17									
Date	Meter ID-1		Meter ID-2		-	-	-	Total Reactive Energy Drawl	
	LV	HV	LV	HV	-	-	-	LV	HV
01/02/2016	2346.20	0.00	2324.70	0.00	-	-	-	6584.25	0.00
02/02/2016	2356.00	0.00	2334.50	0.00	-	-	-	7524.25	125.25
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
06/02/2016	1142.90	0.00	2195.60	0.00	-	-	-	7558.39	25.30
07/02/2016	1718.60	0.00	2339.30	0.00	-	-	-	6548.35	365.20

Table V-16 - Reactive energy output file (day wise)

- **Voltage Reports:**
  - S/W shall have the option for preparation of Voltage reports (5/15 min block wise) for required meters. The configuration files shall be user configurable.
  - The format of 5/15 min block wise Voltage reports are same as that of active energy reports.
  - S/W shall have the option for preparation of Low Voltage Logging report (5/15 min block wise).
  - The S/W shall fetch the details of meter IDs which have recorded the Low Voltage using low voltage logging symbols "*" and "Z".
  - The output format of Low Voltage reports shall be as below:

Meter ID	Low Voltage(*) Logging report for the period "31-03-17" to "02-04-17"										
	Total No. of Blocks (LV Logging)	31-03-2017		-	01-04-2017			-	02-04-2017		
		Blk-1	2	-	-	-	-	-	-	-	96
KO-001	125	*	*	-	-	-	-	-	-	-	*
LA-028	18		*	-	-	-	-	-	-	-	
KS-012	7	*		-	-	-	-	-	-	-	*
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
MB-005	8	*	*	-	-	-	-	-	-	-	-

Table V-17 – Low voltage Log file

Meter ID	Low Voltage(Z) Logging report for the period "31-03-17" to "02-04-17"										
	Total No. of Blocks(LV Logging)	31-03-2017			01-04-2017			-	02-04-2017		
		Blk-1	2	-	-	-	-	-	-	-	96
KO-001	2	Z	Z	-	-	-	-	-	-	-	Z
LA-028	5		Z	-	-	-	-	-	-	-	
KS-012	6	Z		-	-	-	-	-	-	-	Z
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
MB-005	0			-	-	-	-	-	-	-	

Table V-18 – Zero voltage log file

- **Frequency Reports**
  - Frequency data of reference IEM (user defined) shall be used for DSM Accounting. If main reference meter data is not available, first standby meter (user defined) frequency data shall be used for accounting. If both main and first standby meter frequency data are not available for a particular period, second standby meter (user defined) frequency data shall be used for these periods.
  - The S/W shall have a user frequency configuration file for selection of any of the reference IEMs.
  - The output file format of reference IEM frequency data to submit to RPC for DSM accounting shall be as below:

Date	Time	Time Block	Frequency of Main IEM	Frequency of First Standby IEM	Frequency of Second Standby IEM
31-03-2017	00:00	1	49.97		
31-03-2017	00:15	2	49.88		
-	-	-	-		
-	-	-	-		
-	-	-	-		
-	-	-	-		
31-03-2017	23:30	95	50.03		
31-03-2017	23:45	96	50.01		

Table V-19 – Frequency report output file format

  - S/W shall have the module to compare the frequency data recorded by all IEMs with reference IEM frequency data and to generate the report/trend for any required period (Date and Time) through query. The module shall also have the option to define frequency tolerance value. If difference in the frequency data is greater than the tolerance then report shall show the same. The output file format shall be as below.

Frequency Comparison Report for the Period "30/03/17" to "31/03/17"							
Date	**Time**	**Blk No**	**Meter ID-1**	**Meter ID-2**	**-**	**-**	**Meter ID-n**
31-03-2017	00:00	1	0.02	0	-	-	0.02
31-03-2017	00:15	2	0.01	0.01	-	-	0.01
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
06-04-2017	23:30	95	0.06	0	-	-	0.02
06-04-2017	23:45	96	0.01	0	-	-	0.03

Table V-20 – Frequency

7. Issues to be addressed In New MDP to cater WRPC Requirement

- As the input raw data to new MDP S/W is in 5-min blocks , all computations in new data processing software shall be done in 5-min only.
- While reports generation, Data Processing Software shall provide two options to generate processed data reports in 15/5-min depending upon the user requirement.
- The format of the 15-min processed data reports shall be exactly same as that of the existing 15-min processed data reports in text files for compatibility at WRPC end.

8. Issues to be Addressed during Transition Phase

Presently the time period for Scheduling and Settlement at ISTS level is 15-min. Special Energy Meters data is used for computation of injection/drawal of all entities, which are under the jurisdiction of WRLDC. Injection/Drawal computed from SEMs data is used as input data for preparation of following regional accounts.

- Deviation Settlement (Weekly)
- Reactive Energy (Weekly)
- Congestion (Weekly)
- Ancillary Services (Weekly)
- Regional Energy Account (Monthly)
- Transmission Deviation Account (Monthly)

Bidders are encouraged to refer the appropriate regulation to understand the settlement system. They are also encouraged to check the following links on WRLDC website to understand the format of existing output reports.

- Active Energy Reports- http://wrldc.org/dropdown_semdata.aspx
- Reactive Energy Reports- http://wrldc.org/semdata_reactive.aspx

Until the amendments for 5-min Settlement in the appropriate regulations come, the settlement at the interstate level shall continue to be done at 15-min interval. Hence, the data of 5-min interval received from the IEMs shall be converted to 15-min interval at CDCS, so that it is compatible with the existing software for energy accounting at WRLDC and WRPC. After the

entire infrastructure envisaged under this project is in place, the output files generated for energy accounting shall be compatible with the existing software. In a nutshell, the execution of work shall be planned in such a manner that there is no interruption in the existing regional energy accounting system.

Shutdown Coordination for meter installation

The successful bidder shall prepare and submit a schedule for replacement/testing of meters of meters to POWERGRID and WRLDC. If the meter installation requires shutdown of transmission elements, the indent for the same shall be forwarded to WRPC through the respective utilities/POWERGRID 45 days in advance for the approval of the WR Operation Coordination Committee. POWERGRID shall coordinate for gate pass and other administrative approvals from the utility in whose premises the IEM/DCU have to be installed. WRLDC shall coordinate the shutdown as per the OCC approved list subject to real time grid conditions. The bidder shall keep suitable margins for grid related uncertainties while formulating the meter installation plan.

For smooth handling of transition phase, following issues are to be well addressed in AMR and new MDP software.

Compatibility of raw data (text file) with existing software

AMR system shall have the options to generate raw text files of IEMs in 15/5min at CDCS. Format of the raw text file (*.npc) in 15-min shall be exactly same as that of the existing format (Existing format is given in example).

In existing 15-min raw text file, frequency is stored in terms of codes from 00 to 99. This can be addressed in new AMR system by converting frequency to codes at WRLDC end (CDCS) for compatibility with existing MDP S/W (Detailed explanation is given in example-1.

Existing SEMs have 7 character unique serial number where as new IEMs shall have 12 character serial number. This can also be addressed by mapping old meter SEM IDs to IEM IDs in CDCS data base at WRLDC so that new IEMs raw data could be extracted with old SEM IDs for compatibility with existing software.

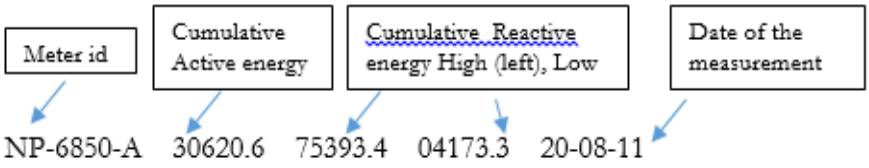
Example

The format of the decoded file (text file) of our existing SEM meter is shown in Fig.3.

Where the first two digit (for e.g. “00”,”04”, etc.) denotes the starting hour i.e. 00 hrs, 04:00 hrs, etc., the next two digits denotes the frequency code for the current block (Freq. = 49.5 + (freq. code)/100) and the next digits denote the active energy measurement (in MWH) of the current time block.

The decoded file of the IEM (with 5 min accounting) is shown in Fig. 4.

WEEK FROM 0000 HRS OF 20-07-17 TO 0937 HRS OF 30-07-17



NP-6850-A 30620.6 75393.4 04173.3 20-08-11

00 44 -11.00 39 -10.84 47 -10.85 50 -10.82 ..... 48 -10.63 52 -10.50
04 54 -10.58 48 -10.51 48 -10.50 43 -10.33 ..... 48 -10.49 48 -08.82
.....
.....
20 21 -12.33 28 -11.74 13 -11.68 24 -11.71 ..... 48 -10.49 48 -08.82

NP-6850-A 29688.2 75353.1 04173.3 21-08-11

Figure 3 – Standard raw data format for SEM

WEEK FROM 0000 HRS OF 20-07-17 TO 0937 HRS OF 30-07-17

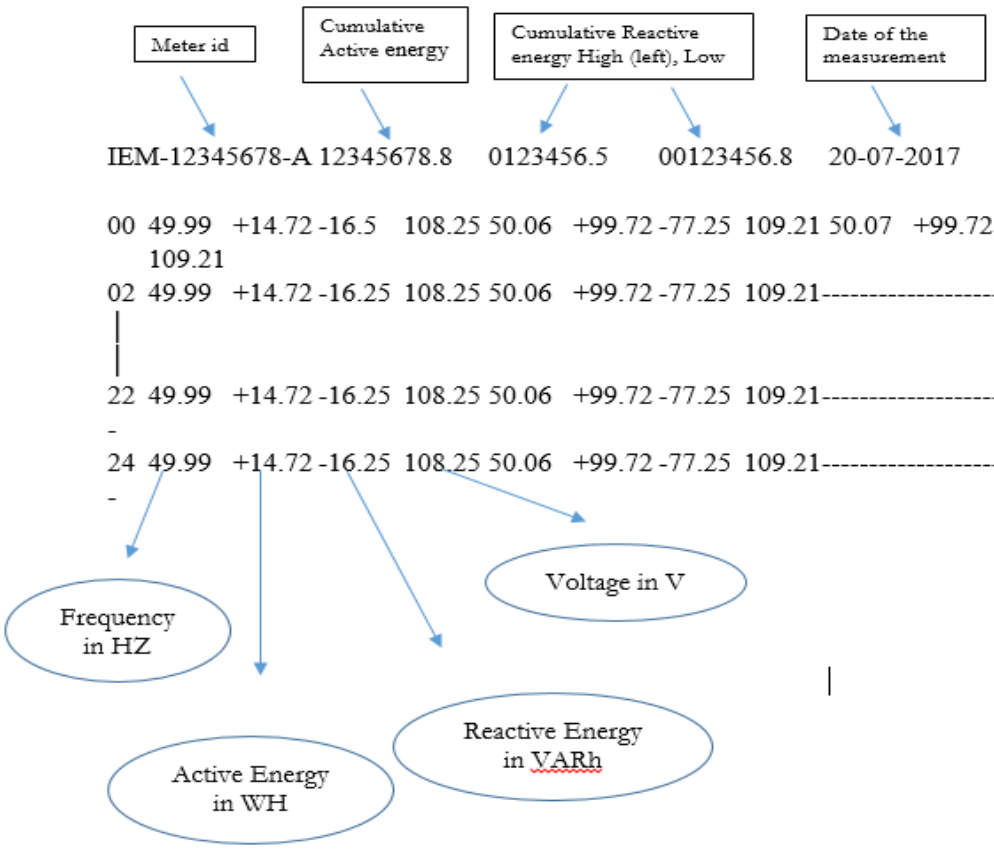


Figure 4 – Standard raw data format for IEM

In the transition phase, above 5 min data shall be converted into 15 min data in the existing format as defined in Fig. 3. For conversion of 5 min data into 15 min data, active energy and frequency data in three consecutive time blocks (5 min.) starting from 00 hrs shall be averaged to arrive at 15 min active energy and frequency data.

For e.g. in Figure-4, the active energy in the first three time blocks (5 min) are +14.72, -77.25 and -77.20. The frequency in the same consecutive time blocks are 49.99, 50.79 and 50.78.

When this file will be converted to the existing format (15 min), the 15 min active energy data (00 hrs) will be calculated as the average of the +14.72,-77.25 and -77.20, i.e. -46.58.

Similarly, the frequency code data will be calculated as = 100*[{Average of (49.99, 50.06, 50.07)}-49.5]

= 100*[50.04 – 49.5]

= 100*[0.54] = 54

9. Deviation and Other Reports

This module shall compute deviation of regional entity by comparing the actual injection/drawal with its interchange schedule. It shall also compute the applicable deviation charges and generate the reports that include time block wise normal deviation charges, additional deviation charges, capped deviation charges, aggregate deviation charges.

The module shall be capable of importing the interchange schedules in .xls/.csv format from the external system. The user shall be able to define the applicable deviation rates (in paisa per unit) in line with the formula notified in the appropriate CERC regulations. There shall be adequate flexibility for the user to configure the methodology for computation of deviation/ deviation charges in line with the prevailing CERC regulations and/or as per the decisions of the regional power committees.

As on date of delivery, the supplied S/W shall comply with all statutory regulation as required under CERC/IEGC as applicable and the same should be declared by the vendor during delivery along with warranty certificate.

The module shall provide interface for generating user defined reports using arithmetic, logical and statistical functions.

10. Graphs/Trends

- S/W shall have the option to display the graphs/trends in user defined standard chart type such as line scatter plot, bar chart etc. of different electrical quantities (Energy, Voltage, Frequency etc.) already stored in database for the required period (Date and Time) through query.
- There shall also be a provision to display the Actual vs Schedule graphs of utilities for user defined period. S/W shall have the provision to upload standard CSV 15/5 min schedule data.
- There shall be provision to download the Graphs/Trends in required formats (JPEG, PDF etc.)
- The X and Y axis parameters of the graphs are user definable.

VI. GENERAL SOFTWARE REQUIREMENTS

AMR System and MDP software shall meet the following general software requirements.

1. Upgradability

All software kernel/OS and application programs supplied shall be fully upgradable through firmware upgrade and/or other software upgrade methods. The firmware/software upgrade may include

- General software upgrade such as kernel/OS upgrade
- Adding new features and functionalities, such as supporting new data format and communication protocols
- Fixing bugs and deficiencies

The Vendor shall keep WRLDC and POWERGRID informed of the latest software updates of revisions available after the system is shipped.

Users shall be able to perform the necessary software upgrade in the field.

2. Software Security Requirements at Delivery

The development of the software for AMR and MDP system shall be done in consultation with WRLDC. Software at delivery shall meet following requirements in accordance with general software security assurance practices.

2.1 Security Tested and Configured

All software and associated application software modules shall be the most secure version of the software available at the time of start of the Factory Acceptance Test. The delivered software shall to be tested to ensure the followings:

- Free of computer viruses, worms, Trojan horses, and other software contaminants
- Unused services are disabled/removed, this includes device drivers for devices not included in the hardware.
- Unused networking protocols.
- Unused administrative utilities, diagnostics, network management, or system management functions.
- Administrative utilities, diagnostics, network management, or system management functions or workstations unused by administrators.
- Backups of files, databases, and programs, used during system installation/upgrade but not needed in the operational system
- Accounts that are not End-User Administrator shall be removed, this include any guest accounts (with and without passwords) or default administrator or maintenance

accounts other than the initial system administrator account for Procurement Entity or any guest accounts or default administrator or maintenance accounts for any third party software.

2.2 Maximum Initial Security Settings

The software shall be shipped with all security settings at their maximum setting. All software shall be delivered with all the latest relevant patches installed.

All security-related parameters and options shall be placed at their most restrictive settings at the delivery, i.e. affording the access and execution privileges to the smallest class of users consistent with meeting the functional specifications, and restricting their rights to the narrowest range of privileges.

2.3 No Automatic Downloading and Execution of Executable Code

It shall not be possible to download any executable code into the CDCS or DCU and execute the downloaded software code automatically without system administrator's (WRLDC) approval. All software shall be removed that would otherwise make it possible to execute a scripting language (such as ActiveX, Java, Java scripts, etc.), including software in the browser and e-mail processor, where applicable.

2.4 File Access Control

The CDCS and DCU software shall support controlled access privileges for files, including at least access, read, write, execute and combinations of these. The access privileges for each user can only be assigned by system administrator of CDCS or DCU as the case may be, and shall be assigned on an individual user account basis.

The default access privileges for each new user account shall be no access to any file on the system at all.

No user, including system administrator, shall be given the privilege of modifying operating system files and other files that are never supposed to change while the system is running.

2.5 Free of "Electronic Self-Help" Enabled Software

It shall be strictly prohibited for delivered software to contain embedded faults or back-door mechanisms that allow the software manufacturer to remotely disable some or all of the functions of the software, or affect their performance, or in any way degrade its operation (so-called "electronic self-help" in the terms of the Uniform Computer Information Transactions Act). The software shall not contain any mechanism that automatically disables some of all of its functions or degrades their operation on a certain date or upon the occurrence of a specific event.

3. Application Software Modification

Modifications in application software to comply with the prevailing CERC regulations for energy accounting and/or to implement the decisions at the RPC level shall be in the scope of the vendor. These modifications shall be considered as a part of O&M/AMC expenses. The modification shall be done in consultation with WRLDC.

4. Source Code

After completion of the project, the final implemented source code shall be handed over to POWERGRID and WRLDC.

VII. GENERAL HARDWARE REQUIREMENTS

AMR System and MDP shall meet the following hardware requirements.

1. Operating Environment

AMR system and MDP hardware shall be supplied that shall be suitable to operate in environment with temp up to 50ºC and humidity up to 90% without any significant effect on its performance.

2. Security Requirements

AMR System and MDP hardware and packaging design shall meet physical security requirements like measures to prevent unauthorized access to certain system hardware components.

VIII. DOCUMENTATION REQUIREMENTS

Documentation of AMR system and MDP shall meet following requirements. All documents shall be supplied in hard copies as well as computer readable soft version:-

1. Design Documents

Before starting the manufacturing of the AMR system components, a design document shall be submitted. The design document must essentially (but not limited to) included:-

- System Overview
- Functional diagram
- Flow diagram
- Functions of each major component
- Physical details of each major component
- Overall networking scheme

- System configurations
- Cyber Security Provisions

Similarly the design document for MDP shall also include (not limited to) the above sections.

2. Software Requirement Specifications Document

After approval of Design document a software requirements specifications (SRS) document for the application software for CDCS and DCU should be prepared and submitted for approval. This SRS should be prepared as per IEEE standard 830 of latest version for recommended practice for software requirements specifications. Software should be designed as per approved SRS.

3. User Manuals

Following user manuals shall be prepared and supplied for the system:-

3.1 User Manual for central site

User manual for central site i.e. location where CDCS shall be installed and where all data collection activities shall be taken up, should contains all user instructions, block diagrams, user screens etc. in order to make itself contain complete document required for operation of complete AMR and MDP system including each and every component of the metering system.

3.2 User Manual for DCU site

Separate user manual shall be provided which shall be used by the users located at DCUs site. This user manual shall contain details of IEMs, external connections to DCU, communication system, block diagram of system at DCU site, instructions of using DCU system, trouble shooting of DCU system etc. This user manual should be self-contained and shall not require any external reference document in order to use and trouble shoot DCU system.

3.3 Training Documents

Training document to be used during training of site personals shall contain major functional details of the overall metering system, its features and major instructions for understanding the overall working of the system.

3.4 Testing Documents

Testing documents shall be prepared and submitted as per Testing Requirements clause of this specification.

IX. TESTING REQUIREMENTS

All equipment, materials and software for AMR and MDP System shall be subject to both Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT). The purpose of Acceptance Testing is to determine compliance to this specification in every respect in regard

to the delivered and installed system.

1. Acceptance Test Plans and Procedures

The Vendor shall develop and document proposed Test Procedures and Test Plans for Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT) of the delivered and commissioned system and its components. Vendor shall finalize the proposed FAT and SAT acceptance test plans and procedures. The final Test Procedures and Test Plans shall be subject to review and approval prior to testing.

The Acceptance Test Plans (ATP) shall enable WRLDC and POWERGRID to verify the ability of the delivered and commissioned system and its components to individually and simultaneously fulfil all functional and performance requirements of the system set forth in the contract through a series of mutually agreed to structured tests.

All system documentations shall be completed, reviewed and approved by the POWERGRID in consultation with WRLDC before any testing.

The ATP shall include, but not be limited to, functional tests that demonstrate compliance of the functional, performance, software, hardware, communication, interface, and operational aspects of the delivered and installed system.

2. Factory Acceptance Test (FAT)

The Vendor shall perform a preliminary FAT (Pre-FAT) prior to the FAT. The pre-FAT shall be a complete dry run of the FAT, following the test plans and procedures. The intent is for the Vendor to detect and correct most design, integration, and database, display, and performance problems prior to the FAT. The representatives of POWERGRID, WRLDC and Registered Users of WRLDC shall have the right to witness all or parts of pre-FAT for which vendor shall intimate WRLDC and POWERGRID in sufficient advance.

Test results (including documentations and certifications) for tests conducted by Vendor or third parties that are not included in the FAT test plan and procedures shall be furnished to POWERGRID prior to FAT for review and evaluation. Vendor and/or third parties conducted tests deemed inadequate shall be repeated until accepted by POWERGRID and WRLDC.

Vendor's project manager shall sign off each test of Pre-FAT. The completed test results shall be sent to POWERGRID and WRLDC for review before their representative's travel to the Vendor facilities for the FAT. All tests shall be conducted using the contract-specified databases unless the POWERGRID and WRLDC authorizes the Vendor to use a test database.

The FAT shall be conducted according to the FAT Test Plan and Test Procedure documents approved by POWERGRID and WRLDC shall cover, as a minimum:

- Visual Inspection – To verify that the system to be delivered has all required components and is properly configured. Visual inspection shall verify acceptable workmanship and that all equipment, including cables and connectors, are appropriately labelled

- Hardware Diagnostic Test – Individual tests of all system hardware. These tests shall consist of running standard hardware diagnostic programs, plus all special diagnostic programs used by the Vendor.
- Communications and Interfacing Test – Verify that all interconnected system components, such as data acquisition, control, monitoring, and data management functions are operating properly when correctly connected.
- Software Development Tools – Verify that all required software development tools, utilities, software diagnostics, and debugging tools for the system, including the UI and database, are included in the system and are functioning correctly.
- Functionality verification – Verify that all system functions are working normally as set forth in the contract.
- Performance Testing – Verify that the system throughput, timing and response time requirements are satisfied. Tests shall include verification of:
  - Data exchange times
  - Local and remote request response times
  - Communication latency
  - User Interface function response time
- Security Testing – Verify that the system meet the software at delivery security requirements and other aspects of secure operation and system access including:
  - Communication error detection capabilities
  - Correct operation of system configuration, control, maintenance, and management procedures
  - Safe system recovery with no erroneous data or control operation generation after system restarts
  - Protection against unauthorized access to the system and control functions
- Environmental Testing – Verify that
  - All system functions shall operate correctly over the specified temperature range
  - The accuracy of the inputs and outputs remain valid over the specified temperature range.

The test schedule shall allow sufficient time for verification and/or additional unstructured testing by the WRLDC/POWERGRID's representative, who shall be able to schedule unstructured testing at any time, including during structured tests.

3. Site Acceptance Test (SAT)

The SAT will be conducted by the POWERGRID and WRLDC with support as required from the vendor after the system has been installed and commissioned. The system will be subjected to a subset of the functional and performance tests. The SAT will also include any type of testing that could not be performed in the factory. Unstructured tests will be employed by the POWERGRID and WRLDC's representative, as necessary, to verify overall system operation under field conditions. Any defects or design errors discovered during the SAT shall be corrected by the Vendor. The SAT includes the commissioning test, the functional and performance test, and the cyber security audit after the installation of the delivered system.

3.1 Commissioning Test

The commissioning tests shall be conducted by the vendor and include:

- The same visual inspection and verification as in FAT
- Loading of the software and starting the system. At the option of the POWERGRID, all software shall be recompiled from the source or distribution media.
- Interface of the AMR and MDP System to communications facilities for all data sources and other systems that interface with the AMR System.
- Initialization and preliminary tuning of application software as needed.

3.2 Site Functional and Performance Test

The site functional and performance test ("site test") shall be comprised of a subset of the functional and performance tests conducted in FAT. The tests to be performed shall be proposed by the Contracto and approved by the POWERGRID and WRLDC. These tests shall be extended as necessary to test functions simulated during the FAT, such as communications with all field devices and all other systems that interface with the CDCS.

3.3 Site Cyber Security Audit

The site cyber security audit shall repeat the audit performed during factory testing.

3.4 Test Approval

The Vendor shall maintain a complete computer record of all test results with variance reporting and processing procedures for approval by POWERGRID and WRLDC. In the event that the AMR/MDP system does not successfully pass any portion of the Acceptance Testing, the Vendor shall notify the POWERGRID and WRLDC of the specific deficiency. The Vendor shall promptly correct the specified deficiency, which will then be re-tested until successful.

X. TRAINING REQUIREMENTS

Comprehensive training programs shall be provided to enable the efficient and effective use and operation of the deployed system by users of the system, and to develop a self-sufficient hardware and software support team within POWERGRID, WRLDC, SLDCs and the registered users of WRLDC.

Training shall include, where appropriate, a combination of formal training classes, workshops, as well as continuous (informal) knowledge transfer from the Vendor's technical specialists to the personnel of WRLDC and its constituents during the deployment process and after the commissioning of the AMR and MDP system. In-person training sessions could be offered at Vendor's location or at the POWERGRID/WRLDC own facilities or any other locations of choice by both parties.

1. Training for personnel at Generating/Transmission substation where IEM is installed

Hands on training program for personnel at Generating Stations/Transmission substation shall cover the following:

- Features of IEM, DCU, Communication Interface
- IS/IEC protocols
- Extension of Auxiliary Supply, CT/PT connection
- Time synchronization through station GPS, Time correction through software
- Data downloading from IEM
- Data uploading through web interface
- Installation of software in local PC/Laptop
- System Diagnostics

Minimum duration of training session shall be 3 hours.

Soft and hard copy of the training manual shall contain Step by Step procedure (on screen shot type and desktop video capture) for

- Installation/Re-installation of software in to Laptop / PC
- Meter maintenance/site-testing procedure as per relevant IS/IEC standard.
- Procedure for data downloading from Meter by Laptop/Desktop PC

2. Training programs for system users

Training program for system users shall include but not restricted to the following:

- System overview including system functionalities and features
- System configuration and operations oriented training
- System alarms handling

- Local/Remote configuration procedures
- Engineering oriented training for development/testing
- Minimum classroom training for a group of system users shall be 18 hours (6 hours x 3 days). Minimum hands-on training for a team of system users shall be 48 hours (6 hours x 8 days). The group shall comprise of representatives from RLDCs, SLDCs, WRPC, NLDC, POWERGRID, Registered Users of WRLDC etc.

3. Training program for system hardware and software support team

Training program for hardware and software support team shall include but not restricted to the following:

- System overview including system design and detailed as-built system configuration information
- System software maintenance
- System hardware maintenance
- Engineering oriented training for development/testing
- System diagnostics and troubleshooting oriented training for engineers and technicians
- Minimum training for hardware and software support team shall be 18 hours (6 hours x 3 days). The software support team shall comprise of representatives from WRLDC.

The bidder shall prepare and provide a description of the proposed training programs with course content, and technical level of the instruction for review and approval by the POWERGRID and WRLDC at the beginning of the deployment, and shall work with the WRLDC to schedule, organize and execute the approved training programs.

Two hard copies and one soft copy of operating manual of the meter and DCU/AMR/MDP containing all details shall be made available to POWERGRID and WRLDC each.

XI. SUPPORT AND MAINTENANCE REQUIREMENTS

Vendor shall provide onsite as well as remote support in order to keep system operational with system functionalities and performance in accordance with the specifications.

1. Scope of Warranty/O&M/AMC

During warranty/O&M/AMC period, vendor would be responsible for repair/ replacement/ modification/ rectification of software, hardware either manufactured or bought out, updation of software used in AMR and MDP scheme all times without any extra charges to POWERGRID/WRLDC.

2. On-Site Support and Maintenance

Vendor shall maintain a team of skilled personals having sufficient knowledge of the system in order to diagnose and set right any problem in AMR and MDP system in minimum time. Since, the locations of DCUs under this AMR system is geographically spread across entire Western Region, the vendor shall locate its supporting personals so as any problem may be attended within next working day of reporting.

Vendor shall maintain an online web based help desk system on its own website for logging complaints and checking the resolution status round the clock on all days of the year. Web based help desk shall be accessible to the user through browser via Internet. Separate username and password shall be provided with separate privileges for users of central site as well as DCUs site. DCUs site user shall be able view logs of complaints and status logged by that user only. However, WRLDC/POWERGRID shall be able to view logged complaints and their status irrespective the initiator of compliant. Any complaint shall remain open until and unless approved its closure by WRLDC/POWERGRID. All logs shall be suitably time stamped. The severity level of the complaint shall be assigned by WRLDC/POWERGRID.

Vendor shall post one Full Time Equivalent (FTE) resident engineer to central site (WRLDC, Mumbai) throughout the warranty/O&M/ AMC period in order to diagnose and set right any problem in AMR/MDP/reporting system in minimum time. He/she shall coordinate with the substation personnel and the back end team of the vendor for complaint resolution. Resident engineer shall be provided with mobile phone for communication for escalation of complaint. Vendor shall maintain this mobile phone live and shall maintain same number throughout the contract period.

3. Remote Support and Maintenance

No remote login shall be permitted.

4. Upgradation and Patches

Vendor shall keep updated all supplied software kernel/OS and application software with all latest patch and upgrade. There shall be no separate liability for Licence renewable on the system user.

5. Maintenance and Support Of Brought Out Items

Vendor shall take back-to-back support from manufactures of bought out items like servers, printers and like items. However, vendor shall be responsible for all coordination work from OEM for all types of support and maintenance.

6. Maintenance and Support for Communication Channels

Vendor shall be responsible for all coordination with communication channel service provider like availability of channels, utilisation, data volume certification etc. Bidder shall provide web based access to Network Management System and make it to WRLDC and POWERGRID. Billing and payment of monthly and/or yearly bills will also be settled by the vendor to

communication services provider. Channel utilisation charges and rental charges of communication channels as billed by communication service provider shall be reimbursable to the vendor by POWERGRID against original documents. Bidder should estimate the optimum plan of service provider for each location & submit to POWERGRID before taking any connection.

7. Charges for support services

All recurring expenditure for support services shall be borne by the vendor.

8. Problem/Defect Escalation Order

The successful bidder shall submit their organization's escalation order for this project in the following format:

Vendor Executive Details	Description	Escalation Order
Name Designation Email ID Mobile number	Overall accountability	4th level
Name Designation Email ID Mobile number	WRLDC Department head to interact if there is any change in business requirement or some change request need to be implemented within the existing contract or any other issue that need to have a mutual consent to move forward and if the problem/defect in the existing software is not resolved within the specified resolution time.	3rd level
Name Designation Email ID Mobile number	WRLDC Team Lead to report if any concerns and some items within the scope need to be fixed in priority	2nd level
Name Designation Email ID Mobile number	Interaction with WRLDC Team, to provide support, resolve the defects and work together for seamless operation.	1st level

Table XI-1- Escalation Matrix

9. System Availability and Recovery of Charges

The nature of maintenance support required for systems and components are described in the Table XI-2 below:

Sl. no.	System	Scope	System Availability
1	AMR system (Data collection and storage in database)	Hardware and software	99.9 %
2	Meter Data Processing, Energy Accounting and DSM accounting software	Hardware and software	99.9 %

Table XI-2- System availability requirement

Bidder shall be responsible for coordination with the OEM for all matter related to that equipment. The bidder shall also be responsible for meeting the overall response times and availability requirements as specified in the specification.

The maintenance of the System shall be comprehensive and shall comprise of the following category of works which is further elaborated for each of the different subsystems:

(a) Preventive Maintenance Activity (performance monitoring, system backup, patch management, updates, emergency response and troubleshooting)

(b) Maintaining a minimum no. of specified spares.

(c) Integration of new module etc.

9.1 Preventive Maintenance Activity

The preventive maintenance activity to be performed by the Vendor to keep the system running at optimum level by diagnosis and rectification of all hardware and software failures would broadly include:

- Repair / replacement of defective equipment -The bidder shall be responsible for repair/replacement of all the hardware including consumables required for the various systems.
- Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.
- Providing all necessary assistance to Owner for addition and modification of database, Database sizing activities including Backup and restore of the system.
- Restoration of the systems upon its failure and to restore the functioning of the various systems.

9.2 Hours of Cover

The vendor shall provide engineers who have an experience and skill to maintain the AMR/MDP system to the desired level of availability. The vendor's on-site support for Control centre shall be standard hours of service i.e. Monday to Friday- 9:00 am to 5:30 pm local time (IST) throughout a year.

One expert Engineer on FTE basis having expertise in metering system shall be available during the standard hours of service at WRLDC. The timings for Emergency Support shall be 24 hours a day, 7 days a week throughout the year.

Vendor and its personal have to follow all rules and regulations of owner's office premises in view of owner's certifications of ISO-9001, ISO-14001, OHSAS-18001 and ISO-27001 including any other future certification.

9.3 Problem/Defect Reporting

The bidder shall submit an appropriate problem/defect reporting procedure to meet the requirement of all severity level cases to get the approval of the same from POWERGRID/WRLDC.

The problems will be categorized as follows:

Severity 4 – Emergency	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability. For e.g. system crash/both servers are not working.
Severity 3 – Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost. For e.g. meter data of a whole station is not available/both main & standby meter data not available/Main server not working, system shifted on standby server.
Severity 2 – Minor	Any other system defect, failure, or unexpected operation. For e.g. Main meter data is not available, however standby/check meter data is available.
Severity 1 – General	Request for information, technical configuration assistance, "how to" guidance, and enhancement requests.

Table XI-3- Severity Levels

9.4 Response and Resolution Time

This section describes the target times within which the bidder shall respond to support requests for each category of severity. The Initial Response Time is defined as the period from the initial receipt of the support request (email/telephone/fax or any other communication channels) and the acknowledgment of the vendor subject to the Maximum time defined in Table XI-4. The Action Resolution Time shall be computed after the expiry of the ideal initial response time subject to the Maximum time defined in Table XI-4.

This period includes investigation time and consideration of alternative courses of action to remedy the situation. The Action is defined as a direct solution or a workaround.

Except for Severity Level 4 all response and resolution times (hours and days) specified below are working hours only:

Severity	Ideal Initial Response Time	Action Resolution Time (to be commenced after end of ideal initial response time)	Action
4	1 hour	6 hours	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.
3	3 Hours	12 Hours	Attempt to find a solution acceptable to Owner (dependent on reproducibility) as quickly as practical.
2	8 hours	2 days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and Owner's prioritisation. Resolution may be by workaround.
1	1 day	4 days	Report on the problem/query is to be furnished.

Table XI-4 - Emergency Support Response/Resolution Time

The bidder shall submit the detailed format and procedure for all the activities such as Reporting time, Resolution time, Downtime etc. along with the bid proposal.

9.5 Availability and Payment charges Calculation

It is the endeavour of both the bidder and owner to maximize system availability to the extent possible. The bidder shall provide guaranteed availability for various types of Systems as specified in Table XI-2. The non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time. The web based help desk software application shall have features for complaint reporting, severity level assignment, initial response time stamping, remarks of the resident engineer regarding actions taken, complaint resolution time stamp and statistics for computing duration of system outage under different severity level categories. There shall be separate login for WRLDC and POWERGRID for certification of the complaint resolution time. The complaint resolution time stamp shall be generated only after endorsement/acknowledgement by WRLDC engineer in-charge.

Duration of outages over and above the Action Resolution time, as defined in Table XI-4 in each of the Severity levels shall be counted for the non- availability computation and shall be clearly brought out in the web based help desk. The resolution may be accomplished by a work around, and such solution shall mark the end of non-availability.

In the event of frequent failures at a site, due to a common cause, the first FPR (Field Problem Report) logged shall be used for the purpose of availability calculation. However, simultaneous multiple outages due to unrelated cause would be counted separately.

9.6 Availability computation for AMR/MDP System

Availability shall be computed on weekly basis. The formula to be used for availability computation would be as under:

$$\text{Availability per week} = \frac{\{THQ - (S4 + S3 + S2 + S1)\} \times 100\%}{THQ}$$

Where THQ is total hours in the week

S1 is the total non-available hours in Severity Level-1 in the week.

S2 is the total non-available hours in Severity Level-2 in the week.

S3 is the total non-available hours in Severity Level -3 in the week.

S4 is the total non-available hours in Severity Level -4 in the week.

The target availability would be 99.9 % or better.

9.7 Payment of maintenance charges (based on the total System availability)

In the event of availability below a certain level, the maintenance charges would be proportionately reduced as follows:

Availability of the system per week	**Deduction in the AMC/O&M charges for the week**
More than or equal to 99.9%	NIL
Less than 99.9%	Deduction of 1% of the apportioned weekly AMC/O&M charges for every 0.1 % or part there of decrease in availability from Target Availability

Table XI-5- Deduction against less availability

The computation of Availability / Non-availability would be rounded up to 2 decimal places at Control Centre on weekly basis and any deduction in the maintenance charges thereof would be calculated as stated above on pro-rata basis.

9.8 Reliability Indices

The following reliability indices shall also be automatically generated on weekly basis from CDCS and archived for download on demand.

9.8.1 System Average Interruption Duration Index

The System Average Interruption Duration Index (SAIDI) shall measure the average duration for which the meter data was unavailable during a week. An Interruption shall be defined as the non-availability of meter data at WRLDC end at the scheduled hour (for e.g. at 09:00 hrs everyday)

To calculate SAIDI, each interruption during a week shall be multiplied by the duration of the interruption to find the interruption time during which meter data was not available at

WRLDC. The time duration of all such interruptions would then be summed up to determine the total unavailability minutes. To find the SAIDI value, the total unavailability minutes would be divided by the total no. of meters. The formula is

SAIDI = Σ(ri * Ni) / NT

Where,

SAIDI = System Average Interruption Duration Index in minutes.

Σ = Summation function.

ri = Restoration time, in minutes.

Ni = Total number of meters interrupted.

NT = Total number of meters in the system.

For example the SAIDI for a sample week having three cases of interruptions is computed in the table below. It is assumed that the interruption and restoration in each case occurred simultaneously. It is further assumed that the system has a total of 1,500 meters.

Date of Interruption	No. of meters whose data was unavailable at WRLDC	Interruption Duration (minutes)	Unavailability minutes
Date-1	50	120	6000
Date-2	25	240	6000
Date-3	100	30	3000
Total			**15000**

Table XI-2 – Calculation of unavailability minutes

The SAIDI for the above case would be

SAIDI = 15000/1500 = 10 minutes.

This implies that on an average, each meter was out for 10 minutes in the above week.

9.8.2 Average Service Availability Index (ASAI)

The Average Service Availability Index (ASAI) would be the ratio of the total number of minutes that meter data was available during a week to the total minutes in the week (7 x 24 x 60 = 10080). This is sometimes called the service reliability index. The ASAI shall be computed as

ASAI = [1 – (Σ (ri * Ni) / (NT * T))] * 100

Where,

ASAI = Average System Availability Index, percent.

Σ = Summation function.

T = Time period under study, minutes.

ri = Restoration time,minutes.

Ni = Total number of meter data interrupted.

NT = Total number of meters installed in the system.

The ASAI value for the sample week based on the interruption data reported in Table XI-2 would be as under

The meter data unavailability minutes = 15000.

Study period = 7 x 24 x 60 = 10080

ASAI = [1 – (15000 / (1500 x 10080)] * 100

ASAI = 99.90%

XII. WARRANTY

Part-A (Meter)

a. The IEM shall be under warranty for 60 months from the date of installation. The bidder shall be responsible for meter testing as per CEA metering regulations. Support and maintenance during 5 years extended period after expiry of warranty period.

b. The warranty would include repair, replacement, part material replacement cost and one way (return) transportation cost (including insurance of transit).

c. Meter software, if upgraded by OEM should be supplied free of cost with initiation taken from party. Remote service person name to be indicated during bidding.

d. Meters which are found defective/inoperative at the time of installation or become inoperative/defective within the warranty period, these defective/inoperative meters shall be replaced within one week of receipt of report for such defective/inoperative meters.

e. Copy of warranty certificate shall be submitted to WRLDC.

Part-B (AMR system and MDP software)

a. The AMR system and MDP software shall be under warranty for a period of 3 years from the date of successful commissioning.

b. The warranty shall include repair, replacement, part material replacement and both way (return) transportation cost (including transit insurance) of the hardware items in the AMR system and MDP software.

c. The software developed shall be kept under warranty for a period of 3 years from completion of SAT (site acceptance test) and issuance of TOC. Necessary support towards un-interrupted operation of the software along with support for integration with third party software shall be ensured during warranty period. For the warranty period, bidder shall provide on-site, web and telephonic support for application support, as & when required, on all days of the week. In case site visit is necessary for the software system restoration/ upgradation, all such required visits shall be free and without any additional financial implication.

d. During the warranty period, the bidder shall implement the modifications in the software to implement amendment in CERC Regulations regarding metering and energy accounting.

XIII. ANNUAL MAINTENANCE CONTRACT

After successful completion of warranty period, POWERGRID and WRLDC, at their sole discretion, may decide to avail annual maintenance service from the successful bidder for providing technical/hardware support for the AMR system and the software system under the Annual Maintenance Contract (AMC). In such event, POWERGRID/WRLDC shall issue separate award of contract for the AMC.

XIV. SPARES/FUTURE REQUIREMENT

Bidder shall maintain sufficient number of IEMs as spares/future requirement at each substation/Generating station.

XV. STANDARDS TO BE COMPILED WITH

S.No	Reference Detail	Reference Title
1	IS-15959:2011	Data Exchange for Electricity Meter Reading Tariff & Load Control – Companion Specification
2	IS-14697:1999	Specifications for AC Static Transformer operated Watt Hour & VAR-Hour meters, class of 0.2S and 0.5S
3	IEEE 830-1998	IEEE Recommended Practice for Software Requirements Specifications

Table XV-1- IS Standards

XVI. REFERENCES

1. CEA (Installation & Operation of Meters) Regulations 2006 available at http://www.cea.nic.in/meteringreg.html
2. Functional Requirement of AMI – CEA report available at http://www.cea.nic.in/reports/others/god/dpd/ami_func_req.pdf
3. CERC Regulations on IEGC, DSM, Congestion Alleviation, Ancillary Services, Sharing of Transmission Charges as available at http://www.cercind.gov.in/updated_consolidated_reg1.html
4. Report on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity "SAMAST", http://www.forumofregulators.gov.in/Data/WhatsNew/SAMAST.pdf

Annex-I

Station wise bifurcation of SEMs in WR

TS-Transmission Station, GS-Generating Station

S.No	GS/ Substation name	Utility Name	No. of meters	Location type	State/UT
1	Korba	NTPC	39	GS	Chhattisgarh
2	Vindhyachal (NTPC)	NTPC	70	GS	MP
3	Kawas	NTPC	24	GS	Gujarat
4	Gandhar	NTPC	22	GS	Gujarat
5	Sipat	NTPC	27	GS	Chhattisgarh
6	LANCO	LANCO	10	GS	Chhattisgarh
7	Jindal	JPL	29	GS	Chhattisgarh
8	KAPS	NPCIL	16	GS	Gujarat
9	TAPS 1 &2	NPCIL	20	GS	Maharashtra
10	TAPS 3 &4	NPCIL	16	GS	Maharashtra
11	Pench	MPGCL	8	GS	MP
12	SSP	SSP	15	GS	Gujarat
13	Rajgarh	PGCIL	12	TS	MP
14	Raipur	PGCIL	27	TS	Chhattisgarh
15	Bhatapara	PGCIL	6	TS	Chhattisgarh
16	Raigarh	PGCIL	10	TS	Chhattisgarh
17	Bhilai	CSPTCL	17	TS	Chhattisgarh
18	Korba (W)	CSPTCL	2	TS	Chhattisgarh
19	Korba E	CSPTCL	2	TS	Chhattisgarh
20	Kotmikala	CSPTCL	2	TS	Chhattisgarh
21	Raigarh(CSEB)	CSPTCL	1	TS	Chhattisgarh
22	Dongargarh	CSPTCL	1	TS	Chhattisgarh
23	Vapi	PGCIL	18	TS	Gujarat
24	Asoj	GETCO	4	TS	Gujarat
25	GPEC	GETCO	1	TS	Gujarat
26	Kasor	GETCO	3	TS	Gujarat
27	Dehgam	PGCIL	8	TS	Gujarat
28	Haldarwa	GETCO	6	TS	Gujarat
29	Icchapur	GETCO	2	TS	Gujarat
30	Navsari (PG)	PGCIL	10	TS	Gujarat
31	Navsari (Getco)	GETCO	4	TS	Gujarat
32	Vapi (GETCO)	GETCO	8	TS	Gujarat
33	Vav	GETCO	4	TS	Gujarat
34	Bhilad	GETCO	7	TS	Gujarat

S.No	GS/ Substation name	Utility Name	No. of meters	Location type	State/UT
35	Una, Diu	DD	1	TS	DD
36	Dhokadwa, Diu	DD	1	TS	DD
37	Zerda	GETCO	4	TS	Gujarat
38	Magarwada (DD)	DD	2	TS	DD
39	Dabhel, Daman	DD	2	TS	DD
40	Dalwada	DD	1	TS	DD
41	Kharadpada, DNH	DNH	4	TS	DNH
42	Kharadpada (new), DNH	DNH	2	TS	DNH
43	Jabalpur	PGCIL	6	TS	MP
44	Satna	PGCIL	9	TS	MP
45	Khandwa	PGCIL	14	TS	MP
46	Itarsi	PGCIL	13	TS	MP
47	Indore	MPPTCL	4	TS	MP
48	Bina (MP)	MPPTCL	2	TS	MP
49	Satpura	MPPTCL	3	TS	MP
50	Bhopal	MPPTCL	4	TS	MP
51	Nagda	MPPTCL	6	TS	MP
52	Bina (PGCIL)	PGCIL	21	TS	MP
53	Gwalior	PGCIL	18	TS	MP
54	Seoni	PGCIL	17	TS	MP
55	Pandurna	MPPTCL	1	TS	MP
56	Malanpur	MPPTCL	1	TS	MP
57	Mehgaon	MPPTCL	1	TS	MP
58	Ujjain	MPPTCL	2	TS	MP
59	Amarkantak	MPPTCL	3	TS	MP
60	Balaghat	MPPTCL	1	TS	MP
61	Damoh	PGCIL	12	TS	MP
62	Chandrapur	MSETCL	4	TS	Maharashtra
63	Bhadravathi	PGCIL	6	TS	Maharashtra
64	Wardha	PGCIL	26	TS	Maharashtra
65	Akola	MSETCL	4	TS	Maharashtra
66	Aurangabad (MSEB)	MSETCL	2	TS	Maharashtra
67	Bhadravathi	PGCIL	15	TS	Maharashtra
68	Dhule	MSETCL	6	TS	Maharashtra
69	Koradi	MSETCL	2	TS	Maharashtra
70	Padghe	MSETCL	4	TS	Maharashtra
71	Kolhapur (Telangada)	MSETCL	2	TS	Maharashtra
72	Nasik	MSETCL	2	TS	Maharashtra

S.No	GS/ Substation name	Utility Name	No. of meters	Location type	State/UT
73	Kalmeshwar	MSETCL	1	TS	Maharashtra
74	Boisar	PGCIL	8	TS	Maharashtra
75	Mapusa, Goa	PGCIL	6	TS	Goa
76	Amona, Goa	Goa	2	TS	Goa
77	Sugen	GETCO	33	TS	Gujarat
78	Rajghat (MP)	MPPTCL	1	TS	MP
79	Khadoli	DNH	3	TS	DNH
80	Sayali	DNH	2	TS	DNH
81	Pirana (PG)	PGCIL	13	TS	Gujarat
82	NSPCL	NSPCL	20	GS	Chhattisgarh
83	Parli (MSETCL)	MSETCL	2	TS	Maharashtra
84	Shujalpur (PG)	PGCIL	8	TS	MP
85	RGPPL	RGPPL	19	GS	Maharashtra
86	Solapur	PGCIL	16	TS	Maharashtra
87	ACBIL	ACBIL	19	GS	Chhattisgarh
88	Bhachau	GETCO	12	TS	Gujarat
89	BALCO	BALCO	11	GS	Chhattisgarh
90	CGPL Mundra	CGPL	17	GS	Gujarat
91	DCPP	JPL	4	GS	Chhattisgarh
92	Tamnar	PGCIL	1	TS	Chhattisgarh
93	Ranchhodpura	GETCO	6	TS	Gujarat
94	Limbdi	GETCO	5	TS	Gujarat
95	Essar Mahan	ESSAR	6	GS	MP
97	Birsingpur	MPPTCL	4	TS	MP
98	Mouda (NTPC)	NTPC	18	GS	Maharashtra
99	KSK Mahanadi	KSK	9	GS	Chhattisgarh
100	Jetpur	GETCO	2	TS	Gujarat
101	Sasan	SASAN POWER	25	GS	MP
102	Vindhyachal (PS)	PGCIL	9	TS	MP
103	Bilaspur	PGCIL	12	TS	Chhattisgarh
104	Vandana	VANDANA	7	GS	Chhattisgarh
105	GMR Warora	GMR EMCO	6	GS	Maharashtra
106	KWPCL	KWPCL	6	GS	Chhattisgarh
107	Jaypee Nigrie	JAYPEE NIGRIE	8	GS	MP
108	DB Power	DB POWER	8	GS	Chhattisgarh
109	Raigarh(Kotra)	PGCIL	2	TS	Chhattisgarh

S.No	GS/ Substation name	Utility Name	No. of meters	Location type	State/UT
110	Essar Hazira	ESSAR HAZIRA	6	TS	Gujarat
111	Indore (PG)	PGCIL	5	TS	MP
112	Pune (PG)	PGCIL	28	TS	Maharashtra
113	Solapur	PGCIL	12	TS	Maharashtra
114	Aurangabad (PG)	PGCIL	15	TS	Maharashtra
115	APL Mundra	APL	27	GS	Gujarat
116	Raipur (PS)	PGCIL	8	TS	Chhattisgarh
117	Tamnar (PS)	PGCIL	14	TS	Chhattisgarh
118	Dharamjaygarh	PGCIL	12	TS	Chhattisgarh
119	Dhariwal	DIL	6	GS	Maharashtra
120	GMR Raipur	GMR CHHATTISGARH	8	GS	Chhattisgarh
121	BDTCL Bhopal	BDTCL	10	TS	MP
122	Jabalpur (PS)	PGCIL	2	TS	MP
123	Bhopal (MP)	MPPTCL	2	TS	MP
124	DGEN	DGEN	13	GS	Gujarat
125	Diu(DD)	DD	2	TS	DD
126	Dadra	DNH	2	TS	DD
127	Silvassa	DNH	2	TS	DNH
128	Pithampura	MPPTCL	3	TS	MP
129	Mahalakshmi	GOA	2	TS	GOA
130	Tillari	GOA	1	TS	GOA
131	Pirana (TPL)	GETCO	2	TS	Gujarat
132	RKM Power	RKM	7	GS	Chhattisgarh
133	Kotra PS	PGCIL	23	TS	Chhattisgarh
134	Satna (PG)	PGCIL	15	TS	MP
135	Parli (PG)	PGCIL	10	TS	Maharashtra
136	Kala (PG)	PGCIL	12	TS	DNH
137	Jabalpur (PS)	PGCIL	14	TS	MP
139	Jaypee Bina TPP	MPPTCL	6	GS	MP
140	CGPL Mundra	CGPL	16	GS	Gujarat
141	Indore (PG)	PGCIL	8	TS	MP
142	Magarwada (PG)	PGCIL	8	TS	DD
143	Varsana (GETCO)	GETCO	2	TS	Gujarat
144	Dhule (BDTCL)	BDTCL	8	TS	Maharashtra
145	Mansar (GETCO)	GETCO	2	TS	Gujarat
146	MB Power	MB POWER	7	GS	MP
147	MCCPL	ACBIL	6	GS	Chhattisgarh

S.No	GS/ Substation name	Utility Name	No. of meters	Location type	State/UT
148	Jhabua Power	JHABUA POWER	6	GS	MP
149	SKS Power	SKS	6	GS	Chhattisgarh
151	Vadodara (PG)	PGCIL	12	TS	Gujarat
152	TRN Energy	TRN	7	GS	Chhattisgarh
153	Kolhapur (PG)	PGCIL	10	TS	Maharashtra
154	Bhanpura	MPPTCL	1	TS	MP
155	Kosamba	GETCO	1	TS	Gujarat
156	Ukai	GETCO	1	TS	Gujarat
157	Champa (PG)	PGCIL	17	TS	Chhattisgarh
158	Lara	NTPC	5	GS	Chhattisgarh
159	Betul GIS	PGCIL	6	TS	MP
	Total		1409		

Station type	No. of meters
Transmission Station	810
Generating Station	599
TOTAL	1409

Station owner wise bifurcation of SEMs in WR

S.No	Station owner	No. of meters	S.No	Station owner	No. of meters
1	PGCIL	555	20	LANCO	10
2	NTPC	205	21	DD	9
3	GETCO	109	22	KSK	9
4	MPPTCL	53	23	DB POWER	8
5	NPCIL	52	24	GMR CHHATTISGARH	8
6	CGPL	33	25	JAYPEE NIGRIE	8
7	JPL	33	26	MB POWER	7
8	MSETCL	29	27	RKM POWER	7
9	APL	27	28	TRN ENERGY	7
10	ACBIL	25	29	VANDANA	7
11	CSPTCL	25	30	DIL	6
12	SASAN	25	31	ESSAR MAHAN	6
13	NSPCL	20	32	ESSAR HAZIRA	6
14	RGPPL	19	33	GMR EMCO	6
15	BDTCL	18	34	JHABUA	6
16	DNH	15	35	KWPCL	6
17	SSP	15	36	SKS	6
18	DGEN	13	37	GOA	5
19	BALCO	11		**TOTAL**	**1409**

Make wise bifurcation of SEMs in WR

S.No	SEM Make	No. of meters
1	SML	642
2	L&T	577
3	ELSTER	190
	TOTAL	**1409**

Annexure-11

1.0 Progress of downstream network whose terminating bays are under construction by POWERGRID

The following assets were planned under various transmission schemes & under implementation. However, implementation of downstream 220kV system needs to be commissioned for utilization of the system

1.1 Status of unutilized 220kV line bays at Existing Substations in WR

Sl	ISTS Substation	Voltage ratio in use	Status of Bays	220kV Lines emanating from Substation	No of ckt	Status of 220kV lines
1	Raipur (PG)	3x315MVA, 400/220 kV	2no Bays ready since 01.07.2011 (WRSS-6)	Raipur (PG) – Doma 220 kV D/c	2	CSPTCL may update
2	Mapusa (PG)	3x315MVA, 400/220kV	2 nos Bays ready since : 01.11.2013	Mapusa – Cuncolin 220 kV D/c	2	GED may update
3	Pirana	2x315MVA, 400/220kV	2nos Bays ready since 19.03.15 (WRSS-6)	Pirana – Barjadi 220 kV D/c	2	GETCO may update
4	Boisar	2x315 +500MVA, 400/220kV	1no Bays ready since 30.05.15	Boisar – STU line S/c	1	MSETCL may update
5	Magarwada	2x315MVA, 400/220kV	2nos Bays ready since 03/11/14	Magarwada – Ringanwada 220 kV D/c	2	D&D may update
6	Wardha	2x315MVA, 400/220kV	2 nos Bays ready since 01.02.2011	Wardha – Yavatmal 220kV D/C	2	MSETCL may update
7	Solapur	2x315 +1x500MVA, 400/220kV	2 nos Bays ready since 01.04.2011 & 2 nos Bays ready since 02.11.2015	Solapur – Bhale (MS) 220kV D/c Solapur – Narangwadi (MS) 220kV D/c	2 & 2	MSETCL may update
				Solapur – Bhalwane (MS) 220 kV D/c	2	MSETCL may update

Sl	ISTS Substation	Voltage ratio in use	Status of Bays	220kV Lines emanating from Substation	No of ckt	Status of 220kV lines
8	Damoh	1 x 500 MVA 400/220 kV	2 Nos of Bays ready since Nov '16	LILO of 2nd 220 kV Circuit of Damoh(MPPTCL) – Sagar 220 kV line at Damoh (PGCIL) 400 kV S/S (1km)	1	MPPTCL may update
9	Vadodara GIS	2 x 500 MVA, 400/220 kV	Bays Ready since May 2017	220 kV Venkatpura-Vadodara D/C Line 220 KV Jambua – Vadodara D/C Line	4	GETCO may update
10	Betul GIS	2x315 MVA, 400/220 kV	Bays Ready since July 2017	Betul (PG) - Betul D/C 220 kV line (3 Km) LILO of Sarni - Pandhurna 220kV line at Betul GIS(PGCIL) 400 kV S/s (41 Km)	4	MPPTCL may update
11	Itarsi (PG)	1x500 MVA, 400/220 kV	Bays Ready since July 2017	LILO of 2nd 220kV circuit of Itarsi (MPPTCL) - Hoshangabad 220 kV line at Itarsi (PGCIL) 400kV S/s (Existing)	2	MPPTCL may update

2.0 Status of Under Construction 220 kV line bays at New Substations / Substation Extensions in WR

S. No.	ISTS Substation	Proposed Bays	Commissioning Schedule	220kV Lines emanating from Substation	No of ckt	Status of 220kV lines	Remarks
1	Morena (TBCB) 2 x 315, 400/220 kV	4	May'18 (Chhattisgarh & WR SS)	i) LILO of one circuit of Malanpur – Mehgaon 220kV line at Morena (TBCB) 400kV S/s (8Km from Loc. No.12). ii) Morena(TBCB)400 - Sabalgarh 220kV DCDS line (92Km) with LILO of one circuit of Morena(TBCB)400 - Sabalgarh 220kV line at Morena 220kV S/s of MPPTCL (0.5Km)	4	Planned	MPPTCL may update
2	NaviMumbai 2 x 315, 400/220 kV	4	Bays ready since Mar'14 (WRSS-V)	STU line	4	Planned	MSETCL may update
3	Indore (PG) 2x500 MVA, 400/220 kV	6	Jul'18 (WRSS-14)	Indore (PG) – Indore (MP) 220 kV D/c	2	UC	MPPTCL may update
				Indore (PG) – Ujjain (MP) 220 kV D/c	2	UC	
				Future	2	To be planned by MP	
4	Parli (PG) 2x500 MVA, 400/220 kV	6	Jun/Jul'18 (WRSS-16)	Parli (PG) - Harngul 220 kV D/c	2	UC	MSETCL may update
5	Parli (PG) 2x500 MVA, 400/220 kV	6	Jun/Jul'18 (WRSS-16)	Parli (PG) - Parli (MS) 220 kV D/c	2	UC	MSETCL may update
				Parli (PG) - Parli (MS) 220 kV S/c	1	UC	
				Osmanabad (MS) - Parli (PG) 220 kV S/c	1	UC	
6	Mapusa (PG) 3X315 MVA, 400/220	2	Jun/Jul'18 (WRSS-16)	Mapusa - Tuem 220kV D/c	2	UC	GED may update

S. No.	ISTS Substation	Proposed Bays	Commissioning Schedule	220kV Lines emanating from Substation	No of ckt	Status of 220kV lines	Remarks
7	Satna (PG) 1x500MVA, 400/220kV	2	Oct-17/Nov-17 (WRSS-16)	LILO of one circuit of Satna (MPPTCL) - Chhatarpur 220 kV line at Satna (PGCIL) 400 kV S/s (3Km)	2	To be planned by MP	MPPTCL may update
8	Bijawar (TBCB) 2 x 500 MVA, 400/220 kV	4	RfQ stage	LILO of Tikamgarh – Chhattarpur 220kV D/c line at Bijawar	4	Planned	MPPTCL may update
9	Navsari 2x315MVA + 1x500MVA, 400/220kV	2	May'18	Navsari – Bhestan 220kV D/c line	-	Planned	GETCO may update
10	Rewa PS 2x500MVA, 400/220kV	6	Nov '17	Rewa UMSPP – Rewa PS 220kV 3xD/c line	-	UC	MPPTCL may update
11	Khandwa S/S 500MVA, 400/220kV	2	Sept '19 (WRSS-17)	STU Line	-	UC	MPPTCL may update

****

ANNEXURE-12

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
पश्चिम क्षेत्रीय विद्युत समिति
Western Regional Power Committee
एफ -3, एमआयडीसी क्षेत्र, अंधेरी (पूर्व), मुंबई - 400 093
F-3, MIDC Area, Andheri (East), Mumbai -93
दूरभाष Phone: 022- 28221681; 28200194/95/96; फैक्स Fax : 022 – 28370193
Website : www.wrpc.gov.in E-mail : opc-wrpc@nic.in

आई एस ओ ः 9001-2008
IS/ISO : 9001-2008

संख्या : पक्षेविस / टीआरएम / कार्यवृत्त /2012-11523 8 दिनांक :
No.:WRPC/ TRM/ /Min/2017- Date 18 अक्टूबर OCT 2017

सेवा में /To,

(सूची के अनुसार
As per list enclosed)

विषय: दिनांक **09** अक्टोबर **2017** को पक्षेविस मुम्बई में आयोजित पश्चिम क्षेत्र में कार्यरत पारेषण परियोजनाओं की स्थिति की समीक्षा की बैठक के रिकार्ड नोटस।

Sub: Record Notes of meeting held on 9th October 2017 at WRPC Mumbai to review status of ongoing transmission projects in Western Region

महोदय / Sir,

इस पत्र के साथ पश्चिम क्षेत्र में कार्यरत पारेषण परियोजनाओं की स्थिति की समीक्षा हेतु दिनांक **09** अक्टोबर **2017** को पक्षेविस मुम्बई में आयोजित बैठक के रिकार्ड नोटस आपकी सूचना एवं आवश्यक कार्रवाई हेतु संलग्न हैं।

Please find enclosed herewith Record Notes of the meeting held on 9th October 2017 at WRPC Mumbai to review status of ongoing transmission projects in Western Region for your information and necessary action.

भवदीय / Yours faithfully,

संलग्न :- उपरोक्तानुसार /As above

(जे के राठोड / J K RATHOD)
अधीक्षण अभियंता
Superintending Engineer

Mailing List

1) Managing Director, MPPTCL Jabalpur (Fax 0761-2664141)
2) Chairman & Managing Director, MSETCL, Mumbai (Fax 26595401)
3) Managing Director, GETCO, Vadodara (Fax 0265-2337918)
4) Managing Director, CSPTCL, Raipur (Fax 0771-2241141)
5) Executive Director,(SEF&CE), PGCIL, Gurgaon (0124-2571760)
6) Executive Director, WRTS-I, PGCIL, Nagpur (Fax 0712-2641471)
7) Executive Director, WRTS-II, PGCIL, Vadodara (Fax 0265-2487544)
8) General Manager, POSOCO,WRLDC, Mumbai (Fax 28202630)
9) Chief Engineer (Trans. Projects), GETCO, Vadodara (Fax 0265- 2339066)
10) Chief Engineer (Trans.), CSPTCL, Raipur (Fax 0771-2574246)
11) Executive Director (Trans. & Project), MPPTCL, Jabalpur (Fax 0761-2665593)
12) Chief Engineer (Trans. Project), MSETCL, Mumbai (Fax 26598587)
13) General Manager (Projects), PGCIL, WRTS-I, Nagpur (Fax 0712- 2646585)
14) General Manager (Projects), PGCIL, WRTS-II, Vadodara (Fax 0265- 2487544)
15) Head Sterlite Transmission Bhopal.
16) CEO(RPTL), WR Transmission (Gujarat), Pvt. Ltd., Gurgaon (Fax 0124-3917982)
17) Head Adani Transmission India Ltd. Ahmedabad.
18) Chief Electrical Engineer, Elect. Deptt., Goa (Fax 0832-2222354)
19) Executive Engineer(Projects), Electricity Deptt., UT of DNH, Silvasa (Fax 0260-2642338)
20) Executive Engineer, Electricity Deptt., UT of DD, Daman (Fax 0260-2250889)
21) Regional Executive Director(W), NTPC, Mumbai (Fax 28259364, 28257769)

Minutes of the meeting
Transmission scheme progress Review Meeting (TRM)
held on 9th October, 2017 at WRPC, Mumbai

The meeting to review ongoing transmission projects in Western Region was held on 9th October 2017 at WRPC, Mumbai, list of participants is placed at **Annex-1.**

Member Secretary, WRPC welcomed the participants in the Transmission scheme progress review meeting (TRM). He stated that in line with the decision taken in 34th TCC/WRPC meeting, the TRM meeting is being conveyed on regular basis to closely monitoring & reviewing of progress of ongoing transmission projects in WR. He stated that this group will monitor the progress status of Transmission lines, Sub-stations, ICTs, Reactors etc. He further stated that apart from the reviewing the status of ongoing projects other associated issues like Railway crossing works, ROW related issues, other constraints etc. shall also be discussed & matter will be addressed at appropriate forum to resolve the issues. He informed that CEA is also monitoring the ongoing transmission projects nation-wide. The list of ongoing transmission projects is available at CEA website (http://cea.nic.in/monthlytrans.html). He raised the concern about the poor participation in the meeting. He told that the issues during construction of transmission elements can't be addressed properly as no beneficiaries states were present.

He requested Superintending Engineer, WRPC to take up the agenda items.

The status of progress of ongoing transmission schemes/lines:

Superintending Engineer (Opn.), WRPC stated that the progress of ongoing transmission schemes under construction executed by GETCO, MPPTCL, CSPTCL, MSETCL, PGCIL, Adani transmission, Sterlite transmission & Essar Transmission shall be reviewed regularly under following categories:-

a) Progress of transmission schemes associated with evacuation and system strengthening scheme for CTU connected Generating Station including IPP.

b) Progress of interconnected transmission schemes associated (downstream network) with PGCIL Sub-station and other transmission agencies.

c) Progress of transmission schemes and system strengthening schemes set up through TBCB projects.

d) Progress of Intra-state transmission schemes.

e) Review of progress of ongoing transmission schemes/lines planned in Standing Committee meeting.

f) Review of progress of ongoing transmission schemes/lines under green corridor projects.

EPTCL

SE (Opn), WRPC requested EPTCL to update the present status of 400 kV Mahan-Bilaspur line.

Representative from EPTCL informed that progress of 400 kV Mahan-Bilaspur line is in line with the plan submitted during the 34th WRPC meeting. All the resources required have been mobilized. However he informed that they are facing ROW issues for which local administration support has been taken. Two towers out of four are under full swing of construction stages, parallelly adequate gangs for string work are already going on. Member Secretary, WRPC suggested/advised EPTCL to stick as per plan submitted.

ATIL

Representative from Adani Power (ATIL), informed that 765 kV Raipur - Rajnandgaon D/C has already completed in May 2017, however gantry connection at Raipur Bay (PGCIL) is pending due to non-readiness of gantry, (anticipated completion of Raipur bay (PGCIL) is Nov'18). He also informed that 400 kV Gwalior - Morena D/C has ready & likely to be commissioned shortly, however 220 kV Malanpur-Mehgaon D/C line of MPPTCL is required to be

ready for onward evacuation. SE (Opn), WRPC suggested that ATIL shall write a request letter to Member Secretary, WRPC regarding issues i.e. readiness of bays, downstream network etc.

POWRGRID, WRTS-I

Representative from POWRGRID, WRTS-I intimated that there is severe ROW problem near Wasim area for commissioning of 765 kV Wardha-Aurangabad line. He raised the concern about the slow progress of downstream 220kV system of MSETCL at Parli (POWERGRID) & 220kV system of GOA at Mapusa S/S. He updated the present status of all PGCIL, WRTS-I projects. SE(Opn), WRPC suggested that PGCIL(WRTS-I & WRTS-II) shall write a request letter to Member Secretary, WRPC regarding issues of readiness of downstream network so that matter can be taken up with appropriate authority from WRPC Secretariat.

POWRGRID, WRTS-II

Representative from POWRGRID, WRTS-II intimated that there is issues of readiness of downstream network at 220 kV Betul, Satna & Ujjain. He requested WRPC to take up the matter with MPPTCL.

Others Transmission agencies

Though there were no representation from Gujarat, Maharashtra, Madhya Pradesh, Chhatishgarh & Sterlite Transmission, they submitted present status of progress of ongoing schemes.

Summary

Member Secretary, WRPC summarized the meeting with following points:

1. WRPC Secretariat will take up the matter of poor participation with all concerned authorities & also inform WRPC forum.
2. He suggested that monitoring of ongoing schemes shall be with respect to actual target date fixed during the award of tender itself & any deviation shall also be with respect that only. Accordingly, the column for target date

shall contain the actual target date and the revised target date shall be shown in the Remark column with revision number.

3. In the list of ongoing transmission lines associated bays at both ends shall also be monitored.
4. Month-wise progress of ongoing transmission schemes shall be monitored.
5. Readiness of downstream network is serious concern & based on request from transmission agencies, WRPC will take up the matter with appropriate concerned authority on target-priority basis.
6. He suggested that green corridor shall separately be monitored.
7. In the next TRM meeting, CEA's transmission report available on (http://cea.nic.in/monthlytrans.html) would also be taken into account while reviewing the progress of ongoing schemes of WR transmission agencies. He requested all the participants to reconcile their list with the CEA's list so that the discussion in next TRM meeting would become more fruitfull.

The status of progress of ongoing transmission schemes/lines is attached in **Annexure–A**.

Date and venue of next meeting:

The date and venue of the next meeting will be communicated separately.

Meeting ended with thanks to the Chair.

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ANNEXURE -I

TRM MEETING PARTICIPANTS LIST HELD AT WRPC, MUMBAI ON 09.10.17

Sl.No.	Name, Designation & Organisation	Mobile No.	E-mail Address
1	Shri A. Balan, M.S., WRPC	9483540528	ms-wrpc@nic.in
2	Shri J.K. Rathod, S.E., WRPC	9987910799	opc-wrpc@nic.in
3	Shri L.K.S. Rathore, E.E., WRPC	9833371844	lksr_ies@nic.in
4	Shri Ratnesh Yadaw		
5	Shri Ashish K. , EPTCL	9687668725	ashish.kakroo@essar.com
6	Shri Munank Bhatt, Adani Power Ltd.	9825805203	munankb.bhatt@adani.com
7	Shri Hitesh Vaghasiya, Adani Power Ltd.	9099002535	hitesh.vaghasiya@adani.com
8	Shri Labhesh Kumar Bansod, POWERGRID, WR-2	9428520316	labhesh@powergridindia.com
9	Shri Pradeep Kumar Sanodiya, Sr. Eng. POSOCO	8452045338	psanodiya@posoco.in
10	Shri Chetan K. Mendhe, POWERGRID, WR-I	9422108592	chetankmendhe@powergridindia.com

STERLITE

ANNEXURE-A

A) Status of Progress of Ongoing Transmission Schemes undertaken by Transmission Utility as on 20.09.2017

Sr.No	Name of Transmission line	Length in Ckt Km	Total Location	Foundation Completed	Tower Erected	Stringing completed	Anticipated completion Target	Remark
A	**Odisha Generation Phase-II Transmission Limited**							
1	Jharsuguda – Raipur 765 kV D/C (hexa) line	608	780	589	427	71.4*2=142.8	May-18	a) RoW issue: Yes (Facing Severe RoW issues in multiple locations. A)Forest/Wildlife clearance issue c) Check survey of 2.9 km held due to tribaes resistance d) PTCC Clearance pending
B	**Khargone Transmission Limited**							
1	765KV D/C Khandwa(KTL)-Indore(PGCIL) Hexa AAAC Zebra Line	180	245	79	37	NIL	Jul-18	A) Check survey 62 KM completed B) forest- working permission expected by 20th October 17 C)PTCC clearnce under process at New Delhi D) Early commissioning before COD(July'19) is expected
2	765KV D/C Khandwa(KTL)-Dhule (BDCIL) Hexa AAAC Zebra Line	378	485	115	51	NIL	Jul-18	A) Check survey 181 KM completed B) forest- for MP portion working permission expected by 20th October 17,for MH portion by Decmber '17 C)PTCC clearnce under process at New Delhi D) Early commissioning before COD(July'19) is expected
3	LILO of one CKT of 400KV D/C Khandwa-Rajgarh at NTPC,Khargone(TWIN ACSR MOOSE)	13.6	21	15	5	NIL	Feb-18	Actual COD Feb-18

STERLITE

ANNEXURE-A

STATUS OF CONSTRUCTION ON ONGOING/UNDER IMPLEMENTATIONS SUBSTATIONS

NAME OF ORGANISATION : Khargone Transmission Limited

Sl. NO.	Name of Substation	Voltage Ratio	Capacity in MVA	Cummulative Progress till date				Expected date of completion	Issues in detail if any	
				Land Acquisition (%)	Civil works completion (%)	Sturcture Transformer & S/s equipments Recevied (%)	Structure Transformer substation equipments Erected (%)			
1	2	3	4	5	6	7	8	9	10	
1	765KV Khandwa 1&2 Line Bays with 3X80MVAR Line Reactors at BDTCL ,Dhule	765KV		100%	30%	0%	3%	Jun'18	Work under Progress.	
2	765/400KV 2X1500MVA Substation at Khandwa	765/400KV	2x1500MVA	100%	0%	0%	0%	March'19	Work under Progress	early commissioning expected (4 momnth before COD)

Status of Ongoing Transmission Projects in Gujarat (September-2017)								
Sr. No.	Name of Transmission lines	Length in Ckt. Km.	Total Locations	PRESENT STATUS (As on 01.10.2017)			Anticipated Completion Target	Remarks
				Stub (Nos.)	Tower (Nos.)	Stringing (Ckm)		
(A)	**Transmission Schemes associated with State Generating Stations**							
1	**Utran CCPP (374 MW)**							
i	220kV D/C Gavasad - Salejada line	194.00	313	268	152	13.482	Mar-18	WIP (Severe RoW problems)
2	**Sikka Unit 3 & 4 (2 x 250= 500 MW)**							
i	LILO to Sikka from 220kV Jamnagar – Jetpur ckt. No.2	120.00	189	187	185	66.684	Dec-17	WIP
(B)	**Transmission Schemes associated with IPP**							
3	**Adani Power, Mundra (Bid-02)**							
i	400kV D/C Mundra-Zerda Line No. 1 **(Package-I)**	160.00	260	163	123	0.000	Mar-18	WIP (Severe RoW problems)
	400kV D/C Mundra-Zerda Line No. 1 **(Package-II)**	190.00	284	103	65	0.000	Mar-18	WIP (Severe RoW problems)
	400kV D/C Mundra-Zerda Line No. 1 **(Package-III)**	314.00	453	187	87	0.000	Mar-18	WIP (Severe RoW problems)
	Total	**664.00**	**997**	**453**	**275**	**0.000**		
4	**Essar Power, Vadinar (Bid-3) (2011-12)**							
i	400kV D/C Vadinar - Amreli line **(Package-I)**	116.85	168	168	168	116.850	--	400kV Hadala-Jetpur made
	400kV D/C Vadinar - Amreli line **(Package-II)**	118.26	173	173	173	118.260	--	Line charged on 66kV voltage
	400kV D/C Vadinar - Amreli line **(Package-III)**	120.94	192	136	94	0.000	--	Tender cancelled and Fresh
	Total	**356.05**	**533.00**	**477**	**435**	**235.110**		
5	**GSEG Extension Phase-I (350 MW)**							
i	220kV D/C GSEG - Mota line	111.06	182	107	94	19.940	Jan-19	LOA given on 24.07.2017.
6	**Bhavnagar Energy Co.Ltd. (BECL)**							
i	220kV D/C BECL - Botad line	190.00	292	182	142	33.798	Mar-18	WIP (Severe RoW problems)
(C)	**Transmission Schemes associated with PGCIL Substation**							
i	400kV LILO to Dehgam from Wanakbori - Soja line No.2	12.000	23	12	0	0.000	April-18	WIP
ii	220kV D/C Vyankatpura-Waghodia (765kV PGCIL) line	29.000	60	47	32	0.000	Nov-17	WIP
iii	220kV D/C Pirana - Barejadi Line	44.96	92	0	0	0.000	June-18	WIP
iv	220kV D/C Jambuva - Vadodara (765kV PGCIL) line	67.96	131	2	0	0.000	Jan-19	WIP
(D)	**Transmission schemes through IPTC route - NIL**							
(E)	**Intrastate transmission schemes**							
i	400kV Mundra - Hadala LILO to Halvad	89.40	136	124	77	1.100	Mar-18	WIP
ii	400kV D/C Amreli - Kasor line (Part-1)	160.95	238	211	180	0.000	Mar-18	WIP (Severe RoW problems)
iii	400kV D/C Amreli - Kasor line (Part-2)	164.34	235	235	219	89.380	Mar-18	WIP (Severe RoW problems)
iv	400kV D/C Amreli - Kasor line (Part-3)	145.26	206	175	158	47.752	Mar-18	WIP (Severe RoW problems)
	Total	**470.55**	**679**	**621**	**557**	**137.132**		
v	400kV D/C Vadavi - Halvad Line (Package-I) (From Vadavi to AP-	146.40	215	206	203	132.982	Mar-18	WIP
vi	400kV D/C Vadavi - Halvad Line (Package-II) (From Halvad to AP-	144.42	196	36	1	0.000	Mar-18	WIP
vii	400kV D/C Varsana - Halvad Line (Package-I) (From Varsana to AP-	143.39	224	179	157	0.000	Mar-18	WIP
viii	400kV D/C Varsana - Halvad Line (Package-II) (From AP-44 to	93.80	154	29	5	0.000	Mar-18	WIP
ix	LILO of one ckt. of 400kV D/C Vadavi-Zerda line at Veloda	29.30	45	45	43	18.554	Dec-17	WIP
x	LILO of one ckt. of 400kV D/C Kosamba-Chorania line at 400kV Sanand-II GIDC S/s.	90.00	132	117	114	68.102	Mar-18	WIP
xi	LILO of 400kV D/C Vadinar-Hadala Line No.1 at 400kV Kalawad S/s	7.76	13	13	12	6.742	Dec-17	WIP
xii	LILO of 400kV D/C Vadinar-Hadala Line No.2 at 400kV Kalawad S/s	7.63	13	12	11	6.830	Dec-17	WIP
xiii	LILO of one ckt. Of 400kV D/C Kosamba-Chorania line at 400kV Pachchham S/s	46.00	66	38	36	0.000	Mar-18	WIP
xiv	400kV D/C Wanakbori TPS (Existing Switchyard) - Wanakbori Unit No. 8 Line (Tie Line)	2.42	5	5	5	2.332	May-18	WIP
xv	400kV D/C Wanakbori-Soja line (Pkg-1)	121.76	186	166	163	56.196	May-18	WIP
xvi	400kV D/C Wanakbori-Soja line (Pkg-2)	91.41	157	65	64	0.000	May-18	WIP
xvii	400kV D/C Soja-Zerda line (Pkg-1)	133.66	223	159	146	0.000	May-18	WIP
xviii	400kV D/C Soja-Zerda line (Pkg-2)	135.26	224	147	132	0.000	Nov-18	WIP
xix	LILO of one ckt. of 400kV D/C Ukai-Kosamba line at 400kV Vav S/s	62.00	106	48	41	0.000	Mar-18	WIP
xx	LILO of one ckt. of 400kV D/C Jhanor-Navsari line at 400kV Vav S/s	20.00	34	1	0	0.000	Mar-18	WIP
xxi	400kV D/C Hadala-Shapar line	124.34	198	42	29	0.000	Mar-19	WIP
xxii	400kV D/C Bhogat-Kalawad line	260.57	444	32	0	0.000	Mar-20	WIP

Sr. No.	Name of Transmission lines	Length in Ckt. Km.	Total Locations	PRESENT STATUS (As on 01.10.2017)			Anticipated Completion Target	Remarks
				Stub (Nos.)	Tower (Nos.)	Stringing (Ckm)		
(A)	**Transmission Schemes associated with State Generating Stations**							
xxiii	400kV D/C Bhachunda - Varsana Line	276.16	499	0	0	0.000	June-20	WIP
xxiv	LILO of both ckt. of 400kV D/C Mundra - Zerda line at 400kV Charanka S/s	25.76	43	0	0	0.000	July-18	LOA given on 24.07.2017.
xxv	220kV LILO at Kukma S/S from one Ckt. of Shivlakha -	34.00	54	46	45	17.740	Mar-18	WIP
xxvi	220KV D/C Halvad - Sadla line	76.00	124	101	101	59.100	Mar-18	WIP (Severe RoW problems)
xxvii	220KV D/C Bhatiya - Kalawad line	238.00	373	176	127	10.514	Mar-18	WIP (Severe RoW problems)
xxviii	220KV D/C Kalawad - Kangasiyali line	111.88	191	173	156	63.700	Mar-18	WIP (Severe RoW problems)
xxix	Termination of one D/C line of 220KV Achhaliya-Jambuva line at	68.39	128+2G	120	117	24.156	Dec-17	WIP
xxx	220kV Vadavi-Chhatral line LILO at 220kV Santej S/s (Work for	7.40	14	14	14	0.600	Mar-18	WIP
xxxi	220kV Vadavi-Chhatral line LILO at 220kV Santej S/s	43.26	74	55	46	0.000	Mar-18	WIP
	Total	**50.66**	**88.00**	**69**	**60**	**0.600**		
xxxii	220kV D/C Vadavi-Sanand DFCC line	61.08	108	48	32	0.000	Mar-18	WIP
xxxiii	220kV D/C Botad-Chorania line	103.24	196	68	12	0.000	Mar-18	WIP
xxxiv	220kV D/C Jamnagar-Hadala line	139.36	238	238	238	139.192	Sept-17	Line charged from Hadala S/s to
xxxv	220kV Amreli-Dhasa line LILO at 220kV Botad S/s	99.98	186	148	120	0.000	Dec-17	WIP
xxxvi	LILO of 220kV Sankhari-Jangral line at Veloda (Sankhari) S/s	4x14.206 +	42-M/C +	54	54	60.488	Sept-17	Line charged on 23.09.2017.
xxxvii	220kV D/C Kheralu-Dharewada (DFCC) line	53.36	97	65	52	0.000	Dec-17	Tender to be invited at Risk &
xxxviii	220kV D/C Soja-Journang (DFCC) line	43.42	75	51	33	0.000	Dec-17	Tender to be invited at Risk &
xxxix	220kV D/C Palanpur-Amrigadh DFCC Line	80.00	144	87	60	0.000	Mar-18	WIP
xxxx	220kV D/C Gavasad-Bhayali DFCC Line	46.42	91	83	83	41.704	Dec-17	WIP
xxxxi	220kV LILO to Jhanor S/s from 220kV Haldarwa-Zadhadia Line	14.00	26	23	23	13.458	Dec-17	WIP
xxxxii	LILO of 220kV S/C Kasor-Vartej line and 220kV S/C Karamsad-	38.620	29-M/C +	29	26	0.000	Dec-17	WIP
xxxxiii	LILO of both circuit of 220kV D/C Nyara-Thebda line at Kalawad S/s	20.800	17	17	16	16.776	Oct-17	WIP
xxxxiv	LILO of one circuit of 220kV D/C Achhaliya-Vyankatpura line at	167.640	296+8 (G)	274	272	102.460	Oct-18	WIP
xxxxv	LILO of one circuit of 220kV D/C Kadana-Godhara line at 220kV	124.000	248	144	105	0.000	June-18	WIP
xxxxvi	LILO of one circuit of 220kV D/C Akrimota-Nakhatrana line at 400kV	51.700	83	77	71	12.388	Jan-18	WIP
xxxxvii	LILO of one circuit of 220kV D/C Hadala-Sartanpar line at 220kV	12.880	16	12	10	0.000	Mar-18	WIP
xxxxviii	220kV D/C Radhanpur-Sankhari line	95.640	170	135	102	22.094	Aug-18	WIP
xxxxix	LILO of 220kV D/C Nyara-Thebda line at Moti Gop S/s on M/C tower	59.360	59	25	17	0.000	Mar-18	WIP
xxxxx	220kV D/C Bhogat-Moti Gop line	138.960	251	16	11	0.000	Sep-19	WIP
xxxxxi	220kV D/C Chorania-Salejada line	134.540	240	48	7	0.000	Mar-19	WIP
xxxxxii	LILO of 220kV S/C Tappar-Hadala Line at 220kV Vondh S/s	3.540	7	7	7	3.540	Dec-17	Line charged on 06.07.2017.
xxxxxiii	220kV D/C Bhogat - Bhatiya Line	26.000	53	18	12	0.000	Dec-17	WIP
xxxxxiv	220kV D/C Bhogat - Ranavav Line	140.000	248	15	0	0.000	Dec-18	WIP
xxxxxv	LILO of 220kV S/C Chorania - Salejada line at 220KV Bagodara S/s	3.520	9	9	9	3.520	June-17	Line charged on 01.06.2017.
xxxxxv	220kV LILO of both ckt. of 220kV D/C Mobha - Mangrol line at 220kV Amod S/s	57.000	66	0	0	0.000	April-18	A/T issued on 23.05.2017.
xxxxxvi	LILO of 220kV Lalpar - Sartanpar line at 220kV Wankaner S/s	37.000	72	0	0	0.000	Jan-19	LOA given on 24.07.2017.
xxxxxvii	220kV D/C Bhilad - Sarigam line and LILO of 220kV Vapi - Tarapur	25.600	33	0	0	0.000	Jul-18	A/T issued on 15.09.2017.
xxxxxviii	LILO of one circuit of 220kV D/C Gandhinagar – Chhatral line at 400kV Vadavi S/s	24.720	52	0	0	0.000	Mar-19	LOA given on 04.09.2017.
xxxxxix	Hot line stringing of 132KV LILO to Bhomiyavadar from Sikka - Ranavav ckt.1	100.00	NA	NA	NA	97.000	Dec-17	WIP / RoW issue.
xxxxxx	132kV D/C Haldarwa-Trasla (DFCC) line	24.05	48	23	5	0.000	Dec-17	WIP
xxxxxxi	132kV D/C Ode-Manjusar line	55.37	103	103	103	55.374	Jul-17	Line charged on 30.05.2017.
xxxxxxii	132kV D/C Tilakwada-Chotaudepur line	140.00	237	237	237	140.000	Jul-17	Line charged on 06.07.2017.
xxxxxxiii	LILO of One circuit of 132kV D/C Dhuvaran-Vatva line at	25.84	52	50	48	21.736	Dec-17	WIP
xxxxxxiv	LILO of both circuit of 132kV D/C Wankaner-Varsamedi line at Mota-	8.000	12	7	5	0.000	Dec-17	WIP
xxxxxxx	LILO of one circuit of 132kV D/C Wankaner-Jamnagar line at	3.400	7	7	7	3.400	Sept-17	Line charged on 27.09.2017.
xxxxxxxi	LILO of one ckt of 132kV D/C Tilakwada-Chhotaudepur line at	57.72	118	0	0	0.000	Nov-18	LOA issued on 15.05.2017.
xxxxxxxii	LILO of 132kV S/C Junagadh-Talala line at 220kV Shapur S/s	23.90	46	0	0	0.000	Feb-18	LOA issued on 02.05.2017.
xxxxxxxiii	LILO of 132kV S/C Gondal-Haripur line at 220kV Visavadar S/s	37.92	70	0	0	0.000	May-18	LOA issued on 01.06.2017.
xxxxxxxiv	LILO of 132kV S/C Ranasan - Vijapur line at 220kV Chiloda S/s	7.82	15	0	0	0.000		

Status of ongoing transmission projects under MSETCL

MSETCL

SN	Name of transmission line	Length in CKM	Total locations	Present status as on August 2017			Anticipated completion target	Remarks
				Stub setting completed	Tower erected	Stringing completed		
1	2	3	4	5	6	7	8	9
	A) 400 kV Projects							
1	400KV Babhaleshwar-Kudus line.(Naneghat to Padgha-II)	150	226	136	109	0	Dec-18	
2	400KV LILO on Padghe-Tarapur for 400KV Kudus s/s	3	13	3	0	0	Mar-18	
3	400 KV D/C Jejuri-Hinjewadi Line(Jejuri-Wainjhar) Package-I.	101	146	105	95	28	Dec-18	
4	400 KV D/C Jejuri-Hinjewadi Line (Wainjhar- Hinjewadi) Package-II.	92.67	130	98	87	40.61	Dec-18	
5	400 KV DCQ BBLR-Kudus line (upto Naneghat)	297.4	482	418	376	172.4	Dec-18	
	B) 220 kV Projects							
6	220 KV DC Chandrapur MIDC to Ballarshah line **(IInd Circuit)**	41.16	66	66	66	41.16	Mar-17	CKT-I commissioned on 28.09.16. and CKT-II on 12.03.2017
7	220 kV Ch'pur -II - Ch'pur MIDC (Tadali)	81.89	89	82	74	40	Dec-17	
8	220kV DC Balapur- Malegaon line, Part-I	31.86	55	55	55	31.86		Commissioned on 14.08.2017
	220kV DC Balapur- Malegaon line, Part-II	37.96	59	59	59	37.96		
	220kV DC Balapur- Malegaon line, Part-III	32.78	55	55	55	32.78		
	220kV DC Balapur- Malegaon line, Part-IV	38.09	59	59	59	38.09		
9	220 KV DCDC Akola - Anjangaon line, Part-I	30.6	57	50	38	0		
	220 KV DCDC Akola - Anjangaon line, Part-II	39.01	57	57	57	0	Dec-17	
	220 KV DCDC Akola - Anjangaon line, Part-III	33.94	58	51	48	16.3		
10	220KV DC Kalmeshwar-Warud line (B.C substation source line)	171.4	303	187	101	0	Mar-18	
11	220KV Partur-Nagewadi DC line	126.7	215	199	190	89.4	Dec-17	
12	220 kV Kumbhargoan Krishnoor line (foundation & ETC)	-	54	54	26	-	Dec-17	
	220 kV Kumbhargoan Krishnoor line (Stringing)	28.26	-	-	-	0	Dec-17	
13	220KV DC Malegaon-Kalwan line (B.C substation source line)	98.19	170	169	167	77.79	Dec-17	
14	220KV D/C Pimpalgaon -Eklahare line for Pimpalgaon SS (B.C substation source line)	87.59	158	149	127	12.61	Mar-18	
15	220KV LILO on Bhigwan-Walchandnagar for Loni Deokar SS	37.64	64	64	64	37.64		Commissioned on 31.03.2017
16	220KV Lamboti-Vairag line	31.9	107	107	107	31.9		Commissioned on 30.03.2017
17	220kV DC Warora-Wardha II (Bhugaon)	165.17	289	289	289	165.17		Commissioned on 16.05.2017
18	LILO on 220KV Bhugaon to Warora–I line for 400KV Warora Ss	20.45	42	40	34	3.82	Mar-18	
19	220kV DC line from Deoli (PGCIL)- Ghatodi **(upto Yavatmal)**	326	556	390	213	0	Sept.-2018	
20	220KV MC LILO on both circuits of Waluj-Jalna at 400KV Taptitanda SS	31.86	41	36	31	13.92	Dec.2017	
21	220KV Dc Nagewadi-Taptitanda line	79.37	134	126	105	0	Mar-18	
22	220kV MC Kopargaon tap- Babhaleshwar	144	117	90	2	0		
23	220KV D/C cable feeder for by passing 400/220KV Kalwa substation	1.7	-	-	-	1.7	Feb-17	Commissioned on 09.03.2017
24	220KV Borivali - Boisar M/C line	331.4	261	261	261	331.4	Jan-17	Commissioned on 29.04.2017
25	220kV SCDC Kandalgaon-Dasturi line	75	240	92	0	0	Dec-18	
26	220kV DC line from 220kV Phaltan s/s to Walchandnagar s/s	100	178	170	170	78	Nov.2017	Commissioned on 12.08.2017 except MC portion from loc.1-7.
27	220 kV D/C line from 400 kV PGCIL (Kumbhari) S/Stn to Bale S/Stn	107.4	135	127	86	30.71	Mar-18	
28	220KV LILO on Pandharpur -Malinagar for 220KV Bhalwani SS	26.56	64	59	47	0	Dec-17	
29	LILO on 220kV Chinchwad- Apta for 400kV Talegaon s/s up to point near Urse Ss.	10.54	39	0	0	0	Dec-17	
30	Conversion of existing S/C Chinchwad - Apta line in to M/C line for portion between Chinchwad substation to prop. 220 kV PGCIL Talegaon line LILO point (Loc. No. 50)	3.07	62	57	27	32.62	Dec-17	
31	220kV SCDC Karad- Koyna line	49	170	154	143	39.914	Nov-17	

A) Status of Progress of Ongoing Transmission Schemes undertaken by Transmission Utility as on September 2017

NAME OF ORGANISATION- M.P. POWER TRANSMISSION Co. LTD.

Sl. No.	Name of Transmission Line	length in Ckt. Km	Total Location	Present status as on 20.12.2016			Anticipated completion Target	Remarks
				Stub setting Completed	Tower Erected	Stringing completed		
1	2	3	4	5	6	7	8	9
	400KV LINE							
1	400 KV DCDS (Quad moose) line from Shri Singa Ji TPS (Stage-II) to Pithampur	2x160	362	130	44	NIL		Work in progress
2	400 KV DCDS (Quad moose) line from Pithampur to Badnawar	2x70	203	40	2	NIL		Work in progress
	220KV LINE							
1	220kV DCDS line from Gwalior(Malanpur) - Morena	2x29.765	101	101	101	2x29.765	Mar'17	LINE CHARGED ON 16-02-17
2	2nd Cirkuiting of 220 Kv Satna - Chhatarpur Double Circuit line	160	NA	NA	NA	15.3	Mar'17	Original Contract terminated and Retendered. Work to be commenced
3	Upgradation of 132KV D/C Indore-II (Jaitpura) - Indore(N/Z) line on composite multi circuit monopole	2x0.50	38	38	38	2x0.50	2017-18	LINE CHARGED ON 22-02-17
4	LILO of one Ckt of 220kv Indore-II (Jaitpura) - Indore(400KV) line at 220kv S/S Indore(N/Z)	2x10.163				2x10.163		CHARGED ON 31-03-17
5	LILO of one Ckt of 220kv DCDS Ashta - Dewas line at 220kv S/S Chapda	2x32.782	104	18	0	0	2018-19	Work stopped. 32.782 Kms. Profile approved. M/s B.S. Ltd. 01.03.2014/01.05.2014.
6	220Kv DCDS line from Pithampur-Depalpur line	2x35.583	129	120	63	0	2017-18	Work stopped. M/s B.S. Ltd. 01.03.2014/ 01.05.2014.
7	220Kv FCFS line for LILO of both Ckt. Of Badnagar -Ratlam D/C line at 400Kv S/s Badnawar	2x1+4x5.6	20	4	0	0	2018-19	Work stopped. M/s B.S. Ltd. 01.03.2014/ 01.05.2014.
8	220Kv DCDS Julwaniya- Kukshi	2x62.9	200	108	34	0	2017-18	Work stopped. M/s B.S. Ltd. 01.03.2014/ 01.05.2014.

A) Status of Progress of Ongoing Transmission Schemes undertaken by Transmission Utility as on September 2017

NAME OF ORGANISATION- M.P. POWER TRANSMISSION Co. LTD.

Sl. No.	Name of Transmission Line	length in Ckt. Km	Total Location	Present status as on 20.12.2016			Anticipated completion Target	Remarks
				Stub setting Completed	Tower Erected	Stringing completed		
9	220Kv DCSS Shujalpur- Narsinghgarh line	1x44.575	144	69	24	0	2018-19	Work stopped. M/s B.S. Ltd. 01.03.2014/
10	220Kv DCDS Morena(400KV S/s CWRTL Adani Group) - Sabalgarh DCDS line	2x94.42	294	220	131	0	2018-19	Work in progress. M/s L& T Chennai/dt. 29.03.2016
11	LILO of one ckt. Malanpur - Mehgaon at 400 KV S/s Morena(Adani)	2x7.396	26	24	24	2X2.975		Work in progress
12	LILO of Morena 400 KV S/s Adani - Sabalgarh at Morena 220 S/s	2x0.50	1	NIL	NIL	NIL		
13	LILO of 2nd ckt. Of Bansagar - Satna 220Kv line at Kotar 220 KV S/s.	4x3.231+2X2.462	21	21	19	0	2017-18	Work in progress. Under ADB-Saving. M/s Vikran Engineering & Exim, Mumbai/dt. 17.03.2016.
14	LILO of both circuit of Indore-II (Jaitpura)) - Ujjain 220Kv line at Indore (PGCIL) 765KV Substation	4x6.012	25	NIL	NIL	NIL		Survey in progress
15	LILO of 2nd circuit of Damoh (MPPTCL) - Sagar 220KV line at Damoh (PGCIL)400KV Substation	2x0.592	3	3	3	2x0.592		CHARGED ON 28-08-17
16	LILO of 2nd circuit of Itarsi (MPPTCL) - Hoshangabad 220KV line at Itarsi (PGCIL) 400KV Substation	2x0.06	NA	NA	NA	2x0.06		CHARGED ON 09-08-18
17	LILO of one circuit of Satna (MPPTCL) - Chhatarpur 220KV line at Satna(PGCIL) 400KV Substation	2x1.96	10	10	10	2X1.929		M/s NKR Projects Hyderabad/ dated 19.11.2016
18	LILO of 400KV Seoni-Bhilai SC line at 400KV Substation Balaghat/Kirnapur	2x3.37	10	NIL	NIL	NIL		Under ADB--III Scheme. M/s BHEL 28.02.2014/01.05.2014. Work to be commenced
19	LILO of both circuit of 400KV Nagda-Rajgarh line at 400KV Substation Badnawar	4x8.163	22	7	NIL	NIL		Work in progress

A) Status of Progress of Ongoing Transmission Schemes undertaken by Transmission Utility as on September 2017

NAME OF ORGANISATION- M.P. POWER TRANSMISSION Co. LTD.

Sl. No.	Name of Transmission Line	length in Ckt. Km	Total Location	Present status as on 20.12.2016			Anticipated completion Target	Remarks
				Stub setting Completed	Tower Erected	Stringing completed		
20	LILO of One Ckt. Of Bhopal - Hoshangabad at 220 KV S/s Adampur	2X2.868	13	NIL	NIL	NIL		Under ADB-III scheme. Work to be commenced.
21	220 KV DCDS line for LILO of One Ckt. Of 220 KV DCDS Indore - Indore-II (Jaitpura) line at Mangaliya.	2x0.198	3	3	3	NIL		Work in progress
22	220 KV DCDS Malwa TPS - Chhanera line	2x39.322	130	6	NIL	NIL		Work in progress
23	LILO of both Ckt. Of Badod - Kota/Modak 220 KV Line at 220 KV S/s Suwasara	4x4.382	16	12	NIL	NIL		Work in progress
24	LILO of 2nd Ckt. Of Badod - Kota/Modak 220 KV Line at 220 KV S/s Bhanpura	2x0.5	2	NIL	NIL	NIL		Under ADB- saving. M/s Kalpataru Power Trans. Ltd. Noida/dated 03.02.2016
25	LILO of 2nd Ckt. Of Nagda - Neemach 220 KV Line at 220 KV S/s Daloda	2x12.2	37	24	NIL	NIL		Under ADB- saving. M/s Kalpataru Power Trans. Ltd. Noida/dated 03.02.2016
26	220 KV DCDS line for Interconnection of 400 KV S/s Betul with 220 KV S/s Betul	2x1.88	7	7	7	2X1.88		CHARGED ON 21-07-17
27	LILO of 220 kV Sarni - Pandhurna at 220 Kv S/s Betul	2x38.868	135	39	18	NIL		Under ADB-Saving. M/s Punj Lioyd Ltd. Gurgaon/dated 30.03.2016/date of advance 14.07.2016.
28	LILO of 2nd Ckt. Of Birsinghpur -	4x5.6+2X0.084	24	19	5	NIL		Under ADB-Saving. M/s
29	220KV DCDS BARSITADESH(220KV	2X0.917	7	6	NIL	NIL		WORK STOPPED (OPGW)
30	220KV DCDS (RAMNAGAR) 220KV	2X0.917	7	6	NIL	NIL		WORK STOPPED (OPGW)
31	220KV DCDS FROM 220KV POOLING S/S	2X43.426	136	100	63	2X8.813		

STATUS OF CONSTRUCTION OF ONGOING/UNDER IMPLEMENTATIONS SUBSTATIONS

NAME OF ORGANISATION- M.P. POWER TRANSMISSION Co. LTD. **Status as on : : SEPTEMBER 2017**

Sl. No.	Name of Sub-Station	Voltage Ratio	Capacity in MVA	Cummulative Progress till date				Expected date of Completion	Issue in detail if any
				Land Acquisition (%)	civil works completion (%)	structure Transformer & substation equipment Recevied (%)	structure, Transformer substation equipment Erected (%)		
1	2	3	4	5	6	7	8	9	10
1	400 KV S/s Balaghat/Kirnapur	400/132/33	2x100	100	97	89	53		Work under progress. M/s Bharat Heavy Electrical, Noida/dt. 28.02.2014 & 01.05.2014
2	400 KV S/s Badnawar	400/220/132	2x315	100	100	99	74		Work under progress. M/s Bharat Heavy Electrical, Noida/dt. 28.02.2014 & 01.05.2014
3	Installation of 315 MVA 400/220 KV Addl. X-mer at 400 KV S/s Bhopal (Sukhi Sevaniya)	400/220	1x315	100	92	80	31		Work under progress
4	Installation of 315 MVA 400/220 KV Addl. X-mer at 400 KV S/s Chhegaon	400/220	1x315	100	100	100	100		Work under progress
5	Upgradation of 132 KV North Zone S/s at Indore - 220 KV	220/132 KV	2x160	NIL	NIL	NIL	NIL	NIL	
6	220/33 KV pooling S/s at Badwar (RUMS-I)	220/33 KV	3x100	NIL	NIL	NIL	NIL	NIL	Layout issued.
7	220/33 KV pooling S/s at Barsita Desh (RUMS-I)	220/33 KV	3x100	NIL	87	56	17	NIL	Work under progress
8	220/33 KV pooling S/s at Ramnagar (RUMS-I)	220/33 KV	3x100	NIL	51	30	11	NIL	Work under progress
9	220/33 KV pooling S/s at Suwasara (Goojarkhedi RUMS-II)	220/33 KV	3x100	NIL	100	98	98	NIL	2X100 MVA TR. CHARGED 1X100 MVA IS TO BE CHARGED
10	Upgradation of Chapda S/s from 132 Kv - 220 KV	220/132 KV	1x160	100	12	NIL	NIL	NIL	Work Stopped. M/s B.S. Ltd, Hyderabad/dt. 01.03.2014.

STATUS OF CONSTRUCTION OF ONGOING/UNDER IMPLEMENTATIONS SUBSTATIONS

NAME OF ORGANISATION- M.P. POWER TRANSMISSION Co. LTD. **Status as on : : SEPTEMBER 2017**

Sl. No.	Name of Sub-Station	Voltage Ratio	Capacity in MVA	Cummulative Progress till date				Expected date of Completion	Issue in detail if any
				Land Acquisition (%)	civil works completion (%)	structure Transformer & substation equipment Recevied (%)	structure, Transformer substation equipment Erected (%)		
11	Upgradation of Depalpur S/s from 132 Kv - 220 KV	220/132 KV	1x160	100	46	NIL	NIL	NIL	Under Progress. M/s B.S. Ltd, Hyderabad/dt. 01.03.2014.
12	220 KV S/s Adampur	220/33 KV	2x50	100	43	NIL	NIL	NIL	Work Stopped. M/s B.S. Ltd, Hyderabad/dt. 01.03.2014.
13	Upgradation of Kukshi S/s from 132 Kv - 220 KV	220/132 KV	1x160	100	56	NIL	NIL	NIL	Work Stopped. M/s B.S. Ltd, Hyderabad/dt. 01.03.2014.
14	220 KV Morena	220/132 KV	1x160	100	100	100	100		CHARGED ON 18-03-17
15	220 KV S/s Mangliya	220/132 KV	1x160	100	100	97	80	NIL	WORK IN PROGRESS
16	220 KV S/s Chhanera (Upgradation of 132KV)	220/132 KV	2x160	100	85	24	0	0	WORK IN PROGRESS
17	220/132 KV S/s Suwasara	220/132 KV	2x160	100	67	42	13	0	WORK IN PROGRESS
18	220 KV S/s Shahdol(Upgradation of 132KV)	220/132 KV	1x160	100	85	77	48	0	WORK IN PROGRESS
19	Installation of 160 MVA 220/132 KV Addl. X-mer at 220 KV S/s Betul	220/132 KV	1x160	100	91	31	NIL		Work stopped.
20	Installation of 160 MVA 220/132 KV Addl. X-mer at 220 KV S/s Sidhi	220/132 KV	1x160	100	100	100	100		CHARGED ON 31-01-17

Status of Ongoing Transmission Progress in Chhattisgarh (September 2017)

S. No	NAME OF TRANSMISSION LINE	Length in Circuit Km	Total Loc. [Nos.]	Present Status			Anticipated Completion Target		REMARKS
				Stubs	Tower	Stinging	As per order	REVISED	
(A)	**Transmission schemes associated with evacuation and system strengthening scheme for own Generating Station.**						NIL		
(B)	**Transmission schemes associated with evacuation and system strengthening scheme for Generating Station set up by IPP**						NIL		
(C)	**Interconnected Transmission schemes associated with PGCIL sub-station**						NIL		
(D)	**Transmission schemes and system strengthening schemes set up through IPTC route**						NIL		
(E)	**Intra State transmission Schemes**								
1	**400kV line**								
1.1	400kV DCDS Raipur(Raita) - Jagdalpur(DCDS)	657	903	903	903	657	May'14	Dec'16	Work completed
1.2	LILO of 400kV Raita-Jagdalpur at Dhamtari	5							Tender in process
2	**220kV line**								
2.1	2nd circuiting of 220 KV Korba-Bishrampur line(DCSS)	155				126.30	June'15	June'17	Work in progress
2	LILO of 220kV Urla-Khedamara(Bhilai) line on Multicircuit tower at Borjhara	1	6	3	2			Dec'17	Work in progress.
2.3	Mungeli-Kawardha	77	135	58	30			Mar'18	Work in progress.
2	LILO of 220 KV Mopka-Bhatapara Circuit & 220 KV Mopka-Siltara Circuit on multicircuit tower at proposed 220/132 KV S/s at Dherdehi (Bilaspur)	64	120+8					Mar'18	Work in progress.
2.5	LILO of Gurur-Barsoor at Narayanpur	2							Tender in process
3	Barsoor-Jagdalpur	175	290	5				June'18	Work in progress.

PGCIL WR-1

S.N	Name of Transmission Line	Length in Ckt Km	Total Location	Present Status as on September 2017			Actual/ Anticipated completion	Remark	Status
				Stub Setting completed	Tower Erected	Stringing Completed			
1	LILO of Lonikhand-Kalwa at Navi Mumbai GIS-JSL/LS Cable	16	25	25	25	15.60	Mar'18	Balance is in Underground Cable portion. Downstream 220kV system of MSETCL at Navi Mumbai is yet to be finalized.	
2	400 KV Mauda Betul Line(MH Portion)	220	312	312	312	220.00	Jul'17	Commissioned in Jul'17	
3	765 kV Raipur-Wardha Line-2	714	963	963	963	714.00	Mar'17	Commissioned in Mar'17	
4	400 KV Wardha-Aurangabad Line (Upgradable to 1200 kV Voltage	696	956	954	917	518.00	Mar'18	Severe RoW problems	2 towers balance
5	765 KV Aurangabad-Padghe Tr. Line	570	773	772	762	546	Oct'17	Work in progress.	1 tower balance
6	400 kV Padghe (PGCIL)-Padghe 2 MSETCL (Kudus) Tr. Line	33.4	46	46	46	33.4	Oct'17	Line is ready. Will be commissioned along with 765kV D/C Aurangabad-Padghe TL subject to readiness of 400kV Kudus (MSETCL).	
7	400 KV Solapur(NTPC)-Solapur(PG) Line-2	24	40	40	40	24.00	Sep'17	Commissioned on 29th Sep'17	
8	765 KV Wardha-Nizamabad line(MH portion)	236	322	322	322	236.00	Mar'17	Commissioned in Mar'17	
9	400 KV Aurangabad-Boisar Line(WR-I portion)	340	458	458	458	340.00	Oct'17	Commissioned on 3rd Oct'17	
10	765 kV D/C Jharsuguda-Dharamjaygarh	210	286	220	212	91.24	Feb'18	Forest Stage-I received & Compliance under submission.	
11	400 kV D/C LARA-Champa Tr.Line	226	306	306	306	226.00	Jul'17	Commissioned on 21st July17	
12	800kV Raigarh-Pugalur(Western Region Portion)	1160	1541	32	4	0.00	Dec'18	Work in progress.	
13	2x500MVA, 400/220kV ICT at Parli (POWERGRID) SS							Downstream 220kV system of MSETCL at Parli (POWERGRID) is critical.	
14	2nos 220kV bays at Mpausa SS							Downstream 220kV system of GED at Mapusa SS is critical.	

POWERGRID WARORA TRANSMISSION LTD (TBCB Project)

13	765 kV D/C Gadarwada-Warora TL	173.42	237	208	195	51.486	*Nov'17	Severe Row Problems in Nagpur district	

14	LILO of both Ckts. Of 400 kV Wardha-Parli at Warora	193.734	269	261	249	138.718	Nov'17	Severe Row Problems	

POWERGRID PARLI TRANSMISSION LTD (TBCB Project)

15	765 kV D/C Warora-Parli Line	695.48	919	764	667	271.064	*Jan'18	Severe Row Problems
16	765 KV D/C Parli - Solapur TL	236	311	268	219	68.19	Jan'18	Severe Row Problems
17	400 KV D/C Parli - Parli TL	36.64	52	32	29	0	Jan'18	Severe Row Problems

* Agreement date

B) Completed Transmission projects in year 2017-18 so Far - POWERGRID (WESTERN REGION-I)

S.N	Name of Transmission Line	Length in Ckt Km	Date of Completion/
1	765 kV Raipur-Wardha Line-2	714	31.03.2017
2	765 KV Wardha-Hyderabad line(MH portion)	236	24.04.2017
3	400 kV D/C LARA-Champa Tr.Line	226	21.07.2017
4	400 KV Mauda Betul Line(MH Portion)	220	24.08.2017
5	400 KV Solapur(NTPC)-Solapur(PG) Line-2	24	Charged on 29.09.17
6	400 KV Aurangabad-Boisar Line(WR-I portion)	340	Charged on 03.10.17

(A) Status of Progress of On-going Transmission schemes undertaken by Transmission Utility as on 10th October 2017

WR-2

Sr. No.	Name of Transmission Line	Length in Ckt. Km.	Total Location	Present Status as on 10th			Progress During August 2017			Progress During			Progress During October			Anticipated Completion	Remarks
				Stub setting Completed	Tower Erected	Stringing Completed	Stub setting Completed	Tower Erected	Stringing Completed	Stub setting Comple	Tower Erected	Stringing Comple	Stub setting Comple	Tower Erected	Stringing Comple		
1	765kV D/C Jabalpur Pool - Orai (Part-I) T/L.	165.1	226	226	226	165.1	0	0	0.0	0	0	0.0	0	0	0.0	Oct-17	
2	765kV D/C Jabalpur Pool - Orai (Part-II) T/L.	192.7	259	259	259	192.7	0	0	0.0	0	0	0.0	0	0	0.0	Oct-17	Antitheft Charged.
3	765kV D/C Jabalpur Pool - Orai (Part-III) T/L.	184.2	243	243	243	184.2	0	0	0.0	0	0	0.0	0	0	0.0	Oct-17	
4	765kV D/C Jabalpur Pool - Orai (Part-IV) T/L.	179.1	241	241	241	179.1	0	0	11.5	0	0	0.0	0	0	0.0	Oct-17	
5	LILO of 765kV S/C Satna - Gwalior T/L at Orai S/S.	36.7	104	104	104	36.7	0	0	0.3	0	0	0.4	0	0	0.0	Oct-17	
6	400kV D/C Aurangabad - Boiser (Part-II) T/L.	338.1	444	444	444	338.1	0	1	7.7	1	0	3.0	0	1	3.6	Oct-17	Commis
7	LILO of 400kV D/C Mundra UMPP - Limbdi T/L at Bhachau	45.3	72	72	70	40.4	0	8	5.6	0	2	18.4	0	0	0.4	Oct-17	Shut
8	400kV D/C Mundra UMPP - Bhuj T/L.	190.0	257	91	51	0.0	9	4	0.0	12	12	0.0	14	10	0.0	Jun-18	
9	400kV D/C Kala - Kudus T/L	36.9	58	53	49	23.0	1	4	6.1	1	2	6.0	2	3	8.5	Nov-17	Status of
	Under Consultancy																
10	220kV D/C Magarwada - Ringanwada T/L.	12.3	23	23	23	12.3	2	2	0.8	0	0	0.0	0	2	1.9	Oct-17	Line
	Under TBCB Route																
11	765kV D/C Vindhyachal - Jabalpur (Part-I) T/L.	183.7	253	169	108	24.4	0	3	3.7	2	20	4.8	3	11	1.5	Mar-18	
12	765kV D/C Vindhyachal - Jabalpur (Part-II) T/L.	191.2	253	185	126	14.0	1	6	0.2	3	22	0.0	2	13	2.6	Mar-18	
13	765kV D/C Vindhyachal - Jabalpur (Part-III) T/L.	188.3	251	172	89	15.5	0	2	0.0	0	13	9.5	3	4	6.0	Mar-18	
14	765kV D/C Vindhyachal - Jabalpur (Part-IV) T/L.	184.6	251	204	120	0.0	0	8	0.0	3	30	0.0	2	8	0.0	Mar-18	
15	765kV D/C Gadarwara STPP - Warora (Part-I) T/L.	219.3	287	256	217	96.7	8	6	0.3	13	16	14.4	4	13	13.2	Nov-17	
16	765kV D/C Gadarwara STPP - Warora (Part-II) T/L.	234.1	312	251	214	111.0	8	12	7.7	2	9	10.5	3	9	3.8	Nov-17	

1.1 Status of unutilized 220kV Line Bays at Existing Substation in WR

Sl. No.	*ISTS Substation*	*Voltage Ratio in Use*	*Status of Bays*	*220kV Lines emanating from Substation*	*No. of Ckt.*	*Status of 220kV Lines*
1	Pirana	2x315M	2 nos. Bays	Pirana -	2	GETCO may
2	Boisar	2x315 + 500MVA, 400/220 kV	1 no. Bay ready since 30/05/2015	Boisar - STU line S/c	1	MSETCL may update
3	Magarwada	2x315M	2 nos. Bays	Magarwada -	2	D&D may
4	Damoh	1x500M	2 nos. Bays	LILO of 2nd	1	MPPTCL may
5	Vadodara GIS	2x500M	Bays ready	220kV	4	GETCO may

1.2 Status of Under Construction 220kV Line Bays at New Substation / Substation Extension

Sl. No.	*ISTS Substation*	*Propos*	*Commiss*	*220kV*	*No. of*	*Status of*	*Remarks*
1	Betul GIS 2x315MVA, 400/220kV	4	August '17 (Mauda-II)	Betul (PG) -	2	UC	MPPTCL may update
				LILO of	2	UC	
2	Indore (PG) 2x500MVA, 400/220kV	6	July '18 (WRSS-14)	Indore (PG) -	2	UC	MPPTCL may update
				Indore (PG) -	2	UC	
				Future	2	To be planned	
3	Itarsi (PG) 1x500MVA, 400/220kV	2	July '18	LILO of 2nd	2	To be planned	MPPTCL
4	Satna (PG) 1x500MVA, 400/220kV	2	Jun / July	LILO of one	2	To be planned	MPPTCL
5	Navsari GIS 2x315MVA + 1x500MVA, 400/220kV	2	May '18	Navsari -	_	Planned	GETCO may
6	Rewa PS 2x500MVA, 400/220kV	6	August '17	Rewa	_	UC	MPPTCL
7	Khandwa S/s 1x500MVA, 400/220kV	2	September	STU Line	_	UC	MPPTCL

1.3 Status of Under Construction 400kV Line Bays at New Substation / Substation Extension

Sl. No.	*ISTS Substation*	*Propos*	*Commiss*	*400kV*	*No. of*	*Status of*	*Remarks*
1	Indore (PG) 400kV	2	July '18 (WRSS-16)	Indore (PG) - Ujjain (MP)	2	UC	MPPTCL may update
2	Vadodara GIS 400kV	2	May '18	DGEN TPS	2	Planned	DGEN may
3	Vindhyachal Pool 400kV	2	January '18		2	UC	Adani may
4	Gwalior GIS 400kV	2	January '18	Gwalior -	2	UC	Adani may
5	Rajgarh 400kV	1	May '18	Khargone	1	UC	Sterlite may

1.4 Status of Under Construction 765kV Line Bays at New Substation / Substation Extension

Sl. No.	*ISTS Substation*	*Propos*	*Commiss*	*765kV*	*No. of*	*Status of*	*Remarks*
1	Vindhyachal Pool 765kV	1	March '18	Sasan UMPP	1	UC	Adani may
2	Indore (PG) 765kV	2	May '18	Khandwa PS	2	UC	Sterlite may

(A) Status of Progress of On-going Transmission schemes undertaken by Transmission Utility as on 10th October 2017

WR-2

Sr. No.	Name of Transmission Line	Length in Ckt. Km.	Total Location	Present Status as on 10th			Progress During August 2017			Progress During			Progress During October			Anticipated Completion Target	Remarks
				Stub setting Completed	Tower Erected	Stringing Completed	Stub setting Completed	Tower Erected	Stringing Comple	Stub setting Comple	Tower Erected	Stringing Comple	Stub setting Comple	Tower Erected	Stringing Comple		
1	765kV D/C Banaskantha - Chittorgarh (Part-I) T/L.	148.3	200	197	169	70.9	1	2	17.0	3	10	1.4	2	6	1.3	Mar-18	
2	765kV D/C Banaskantha - Chittorgarh (Part-II) T/L.	145.0	201	197	188	56.5	1	0	2.4	2	2	0.0	0	3	13.2	Mar-18	
3	400kV D/C Banaskantha - Sankheri (GETCO) T/L.	43.4	59	59	59	20.9	1	7	4.1	3	5	10.7	1	7	6.1	Dec-17	
4	765kV D/C Bhuj - Banaskantha (Part-I) T/L.	120.8	157	134	68	0.3	11	7	0.0	9	10	0.0	0	14	0.3	Jul-18	
5	765kV D/C Bhuj - Banaskantha (Part-II) T/L.	122.0	159	105	69	8.8	6	11	0.0	6	8	0.0	1	2	8.8	Jul-18	
6	765kV D/C Bhuj - Banaskantha (Part-III) T/L.	126.0	165	100	62	0.0	3	0	0.0	3	8	0.0	4	7	0.0	Jul-18	
7	765kV D/C Bhuj - Banaskantha (Part-IV) T/L.	126.0	160	62	49	0.0	1	7	0.0	1	7	0.0	3	10	0.0	Jul-18	
8	765kV D/C Bhuj - Banaskantha (Part-V) T/L.	87.9	119	82	39	0.0	6	10	0.0	6	6	0.0	6	3	0.0	Jul-18	
9	LILO of 400kV D/C Vindhyachal - Jabalpur (2nd Circuit 3&4)	115.7	169	163	163	102.8	0	3	0.6	1	1	6.1	0	2	0.0	Dec-17	
10	400kV D/C Banaskantha (Radhanesda) - Banaskantha (PG)	95.0	252	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	Sep-18	

A Status of Progress of Ongoing Transmission lines undertaken by Transmission Utility as on 16.08.2017

ADANI TRANSMISSION LTD

Sr. No.	Name of Transmission Line	Length in Ckt Km	Total Locations	Present Status as on 16.08.2017			Anticipated Completion Target	Remark
				Stub Setting Completed	Tower Erected	Stringing Completed		
I	Sipat Transmission Limited							
1	Sipat STPS - Bilaspur 765 KV S/C	23	73	69	53	11.8	Mar'18	Bilaspur Bay (PG) Anticipated completion June'18
2	Bilaspur - Rajnandgaon 765 KV D/C	322	428	427	379	231.04	Mar'18	Bilaspur Bay (PG) Anticipated completion Nov'18
II	Raipur - Rajnandgaon Warora Transmission Limited							
1	Raipur - Rajnandgaon 765 KV D/C	80	104	104	104	79.38	Completed in May'17	Gantry connection at Raipur Bay (PGCIL) is pending due to non readiness of gantry, Anticipated completion Raipur Bay (PGCIL) Nov'18
2	Rajnandgaon - Warora 765 KV D/C	532	687	537	435	188.66	Mar'18	
III	Chhattisgarh - WR Transmission Limited							

1	Gwalior - Morena 400 KV D/C	96	145	145	145	94.62	Sept'17	Readiness of 220 kV D/C Malanpur-Mehgaon line of MPPTCL required for onward evacution
2	Vindhyachal STPS - IV & V - Vindhyachal Pool 400 KV D/C	54	87	85	81	48.32	Jan'18	
3	Sasan UMPP - Vindhyachal Pooling Station 765 KV S/C	6	22	22	14	1.45	Jan'18	
4	Raigarh (Kotra) - Champa (Pool) 765 KV S/C	94	255	218	194	54.06	Jan'18	
5	Champa (Pool) - Dharamjaygarh 765 KV S/C	49	150	122	112	19.45	Jan'18	
6	LILO of one ckt of Aurangabad - Padghe 765 KV D/C line at Pune	128	179	85	49	7.00	May'18	

Sr. No.	Name of Sub station	Length in Ckt Km	Present Status as on 16.08.2017				Anticipated Completion Target	Remark
			Land Acquisition	**civil works completion**	**structure Transformer**	**structure, Transformer**		
1	765 kV Rajnandgaon Substation		100%	100%	100%	100%	Sept'17	
2	400/220 kV Morena Substation		100%	60%	80%	40%	Jan'18	

B Completed Transmission Projects in year 2016-17 so far:

Sr. No.	Name of Transmission Line	Length in Ckt Km	Date of Completion / COD
	NIL		

EPTCL

A) Status of Progress of Ongoing Transmission Schemes undertaken by Transmission Utility as on 21.08.2017

Sr.No	Name of Transmission line	Length in Ckt Km	Total Location	Present Status as on 20.12.2016			Anticipated completion Target	Remark
				Stub setting completed	Tower erected	Stringing completed		
1	400kV D/C Mahan Sipat transmission line	674	942	938	912	204.61	Dec-17	EPTCL have already submitted completion plan for Dec-17 to WRPC, Powergrid and CEA considering ROW issues at site and monsoon period. However, EPTCL will put in best efforts for expediting the work for early completion.

400kV Mahan-Sipat Transmisson line - by EPTCL

Weekly Progress Report for 3rd Week of Aug-17

Sl. No.	Activity Description	Total Scope Quantity	Balance (as on Jun-17)	Cumulative Completion (upto 2nd week of Aug)	Balance (as on 2nd week of Aug)	Planned upto 3rd week of Aug	Actual upto 3rd week of Aug	Cumulative Completion (upto 3rd week of Aug)	Balance	Remarks
1	Foundation (In Nos.)	942.00	4.00	938.00	4.00	1.00	0.00	938.00	4.00	One foundation is Under progress, 75% completed. due to heavy rain, approach & working at site is closed, waiting for dry days.
2	Tower Erection (In Nos.)	942.00	33.00	912.00	30.00	0.00	3.00	912.00	30.00	One tower erection is under progress. Taking time due to QD+18 type with 60MT weight.
3	Stringing (In Kms)	337.00	140.00	202.970	134.030	5.000	7.610	204.610	132.390	1.6 km achived during this week.Progress affected due to Rain.

Sl. No	Activity Description	Total Scope	Cumulative Completion (upto Jun-17)	Balance (upto Jun-17)	Planned upto 4th week of Sep	Actual upto 4th week of Sep	Cumulative Completion (upto 4th week of Sep)	Balance (as on 4th week of Sep)	Remarks
1	Foundation (In No`s)	942	938	4	1	One foundation: 3 footing out of 4 completed. Second foundation: excavation completed &concreting started under police protection	939	2 and 2 under progress	1: RoW issues; matter is being persuaded at Collector & SDM level. 2. Based upon our request CEA also has issued letter to concerned collector. 3: At 2nd location excavation for foundation,completed under police protection.
2	Tower Erection (In No`s)	942	909	33	7	9	918	24	Two tower erection under progress
3	Stringing (In Km`s)	337	197	140	27	19.8	216.8	120.2	Less progress due to continuous rain.

Constraints:

ROW issues:

1. Foundation:
a. Mahan(3 no`s close to plant boundary) -at 2 places, work in progress under Police Protection
b. Wadrafnagar area(1 no`s) - being pursued with the help of local administration
2. Stringing:
    a. ROW issues are being faced in Wadrafnagar& Pratapur Tehsil area of Chhattisgarh however, all out efforts are being made to resolve the issue through intervention of local administration.

ANNEXURE-13.1

ESSAR POWER

Continuation of LILO arrangement

Essar Power M.P. Limited

Background – Unit 1

ESSAR POWER

EPMPL is a subsidiary of the Essar Power Ltd. developing, owning and operating the Power Plants. EPMPL is a generating company and is setting up a 1200 (2 x 600) MW Thermal Power Plant at District- Singrauli, Madhya Pradesh. Unit-1 of 600 MW is under operation and Unit-2 is expected by July'17.

Unit -1

- Unit-1 COD achieved in April 2013.
- Long Term PPA has been signed with Essar Steel in May 2017 for 12 years. Power Grid requested to operationalize the 450 MW LTA and they have agreed to take it to WR Standing Committee for approval.

2

Background – Unit 2

ESSAR POWER

Status of Unit-2

- All auxiliaries commissioned.
- Control system (DCS) commissioned on 1st May 2017.
- Boiler light up achieved on 14th May 2017.
- Turbine Barring gear achieved on 19th June 2017.
- Steam blowing completed on 25th June 2017.
- Turbine rolling expected by 2nd week of July 2017.
- Turbine synchronisation expected by 3rd week of July 2017.
- Coal system ready and coal firing will be achieved in 3rd week of July 2017.
- COD expected by end of July 17.

3

Background: Fuel

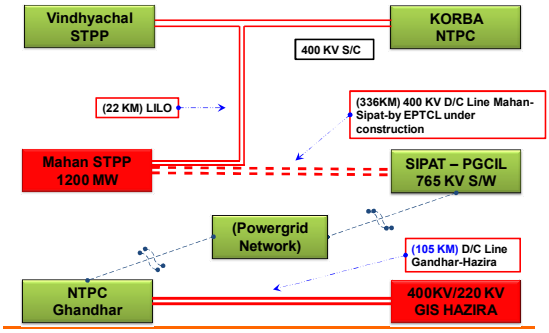
ESSAR POWER

Coal for Mahan TPS (2x600 MW)

- Mahan Coal Block allocated in 2006.
- Hon'ble Supreme Court on 24.09.2014 cancelled the Mahan coal block along with 204 other coal blocks.
- EPMPL is currently procuring coal under E-auctions. At present coal is easily available on e-auction.
- New policy (SHAKTI) of the GoI on coal linkage has been announced and its implementation is awaited.

4

Transmission Scheme for EPMPL



5

Transmission Scheme for EPMPL

1. Transmission scheme has following elements
   a) LILO of existing 400 kV S/C Vindhyachal - Korba transmission line. Line Length – 22.4 Kms.
   b) 400 kV D/C (twin conductor) transmission line from Gandhar NTPC switchyard to Hazira. Line Length – 104.6 Kms.
   c) 400/220 kV sub-station at Hazira
   d) 400 kV D/C Quad transmission line from EPMPL to Sipat sub-station along with associated bays. Line Length-336 Kms.

2. Based on the recommendation of the CTU (Powergrid), CERC granted ISTS license to EPTCL on 08.04.2008 for the above scheme including the LILO (under discussion).

3. Elements a), b), c) are commissioned since April 2013. Element d), detail status is indicated in the next slide.

6

EPMPL petition 127/MP/2017

- EPMPL approached CERC with a petition (127/MP/2017) on 14th June, 2017 requesting Hon'ble Commission to grant extension for usage of LILO arrangement up to January 2018 and to ask WRPC to expeditiously consider the request of EPMPL to continue use of LILO arrangement. During the hearing on 20.06.2017, our senior counsel informed the Hon'ble Commission that there is no overloading on the LILO line, LILO is part of licensed ISTS scheme and LILO is necessary for anchoring Mahan TPS to avoid grid oscillation and in the event of N-1 contingency on Mahan Sipat line having a long length of 337 Kms.
- CERC considered our request and accordingly have asked WRPC forum to consider the matter, vide order dated 30.06.2017.

7

Mahan-Sipat line

Physical Status

S.N.	Item	Unit	Scope Qty	Completed (as on date)	Balance	% Completion
1	Foundation	Nos.	942	938	4	99.6
2	Tower erection	Nos.	942	909	33	96.5
3	Stringing	Kms.	337	197	140	59

Approximately total 85% Completed

8

Mahan-Sipat line

Financial Status:

Additional fund required for completion of Mahan-Sipat line have recently been arranged as follows

1. Entire upfront equity of Rs. 75 Cr. have been infused and deposited in the Trust and Retention Account (TRA) account.
2. The TRA account is controlled by the lead lender (REC)
3. All the lenders (REC, PFC and Axis Bank) have sanctioned the additional funding of Rs. 217 crores for the Project.
4. Bilateral documentation with lead lender is completed.
5. Rs.25 Cr. released to the contractor (KPTL) from TRA account for mobilization. The contractor has started the work.
6. We will give monthly physical progress report to WRPC till the line is completed i.e. latest by Dec 2017 as directed by CEA on 28.06.2017.
7. Considering the quantum of work to be completed & the difficulty of execution of work during monsoon, the work schedule has been tightly compressed to meet the deadline of Dec'17.

9

Mahan-Sipat line

Gearing up for completing Mahan-Sipat line

1. EPC contractor has been mobilized.
2. Stringing T&P (Tension stringing equipment etc.) for stringing (3 nos. of 16 Tons TSE machines) have been deployed at site.
3. Foundation and erection gang mobilized and work started.
4. In spite of monsoon, we are carrying on the work and making progress with sufficient gangs at site.
5. By end of Sep'17 (Monsoon end),for critical path activity i.e. stringing gangs along with T&P will be increased to 9.
6. Conductor of about 700 km have already reached at site. Balance conductor supply order is already placed.

10

Transmission Scheme for EPMPL

➢ **Revised Completion Schedule of Mahan – Sipat Line**

						Monsoon period					
Sl. No.	Description	Scope Qty	Completed as on date	Balance	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
1	Foundation	942	938	4	1				3		
	Gang				1				3		
2	Tower erection	942	909	33				5	11	17	
	Gang							2	4	4	
3	Stringing	337	197	140		5		16	36	41	42
	Gangs (TSE & Manual)				3	3		3	9	9	9
4	Conductor	3250	650	2600		700	700	700	500		

11

Extracts of CEA meeting 28.06.2017

CTU informed that system studies carried out by them indicate the requirement of another anchoring of Mahan TPS apart from Mahan-Sipat Pooling point 400 kV D/C line. The summary of the studies carried out by CTU is given below:

*a) **Case-1 : Without Mahan STPS-Sipat pooling station 400 kV D/C line***

i) With one unit of 600 MW in service at Mahan STPS – No instability/oscillations observed in power evacuation under n-1 condition.

ii) With both units of 600 MW in service - Rotor angle instability of Mahan STPS units as well as sustained grid oscillations are observed under outage of Mahan STPS -Vindhyachal 400 kV S/C line. With tripping of one unit through SPS (within 450 ms), the system remains stable.

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Extracts of CEA meeting 28.06.2017

b) *Case-2 : With only Mahan STPS–Bilaspur Pooling Station 400 kV D/C line*

i) With one unit of 600 MW in service at Mahan STPS – No instability/oscillations observed in power evacuation under n-1 condition.

ii) With both 600 MW units in service at Mahan STPS - Grid instability issues (oscillations) are observed under N-1 conditions of the line. With tripping of one unit through SPS (within 300 ms), the system remains stable.

13

Extracts of CEA meeting 28.06.2017

c) *Case-3 : With both lines i.e. LILO of Vindhyachal – Korba STPP 400 kV S/C line at Mahan STPS and Mahan STPS–Bilaspur Pooling Station 400 kV D/C line*

i) With one unit of 600 MW in service at Mahan STPS – No instability / oscillations observed in power evacuation under n-1 condition.

ii) With both 600 MW units in service at Mahan STPS - Power can be reliably evacuated from both units of Mahan TPS. Issue of increase in short circuit level at Vindhyachal due to both the lines needs to be studied in detail.

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Extracts of CEA meeting 28.06.2017

- *Thus from the above it is seen that there is requirement of LILO of Vindhyachal –Korba STPP 400 kV S/C line at Mahan STPS in addition to Mahan STPS–Bilaspur Pooling Station 400 kV D/C line for safe and reliable evacuation of power from Mahan STPS.*
- *Similar case of instability / oscillations being observed in the case of Lalitpur Generating station in Northern Region, under the contingency of one ckt of the only 765 kV D/C line was pointed out during the deliberations.*

15

Conclusion of CEA meeting on 28.06.2017

- The transmission system for evacuation of power from EPMPL is now an ISTS system being implemented by EPTCL and not a dedicated transmission system.
- As such LILO of Vindhyachal–Korba STPP 400 kV S/C would not be an interim arrangement. This change would be brought to the notice of constituents in the next meeting of SC PSP-WR.

16

Conclusion of CEA meeting on 28.06.2017

- The system studies indicate LILO of Vindhyachal–Korba STPP 400 kV S/C line at Mahan STPS would also be essential to take care of contingency of outage of one ckt of Mahan SPTS–Bilaspur Pooling Station line for reliable evacuation of power from 2x600 MW units of Mahan TPS.
- EPTCL has agreed to complete the remaining works of Mahan STPS–Bilaspur Pooling Station 400 kV D/C line by December 2017.

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ANNEXURE-13.2

REVIEW OF IMMEDIATE TRANSMISSION SYSTEM FOR EVACUATION OF POWER FROM ESSAR POWER MP LTD. MAHAN POWER PLANT: STUDY REPORT

Prepared By

CENTRAL TRANSMISSION UTILITY - PLANNING

POWER GRID CORPORATION OF INDIA LTD.

GURGAON

June, 2017

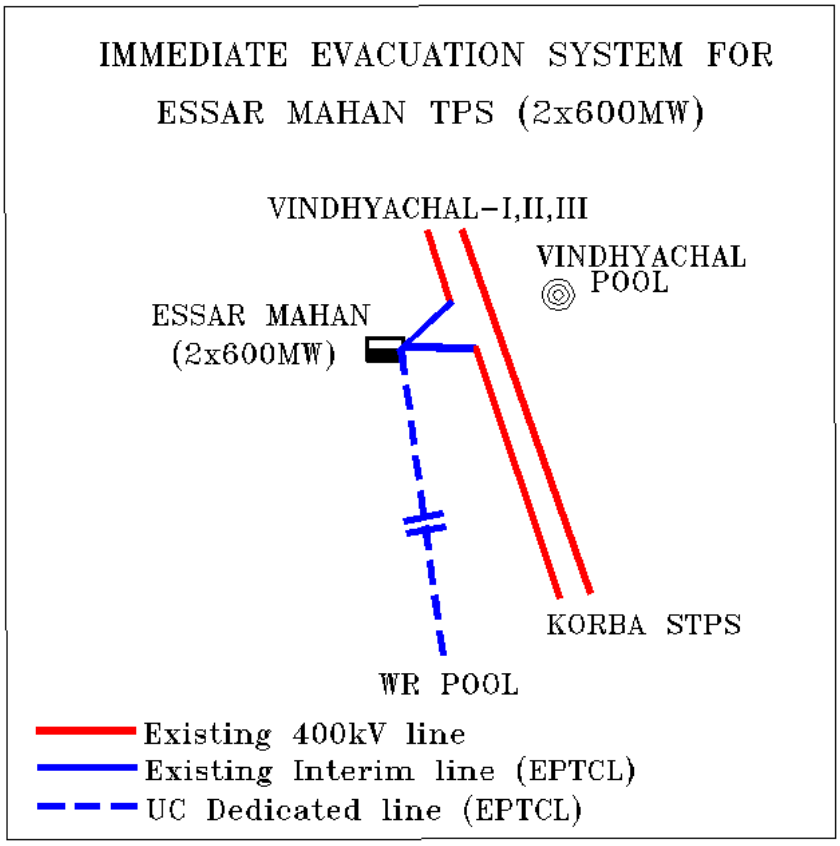
Review of Immediate Transmission System for evacuation of power from Essar Power MP Ltd. Mahan Power Plant: Study Report

1. Background

1. 1 Essar Power MP Ltd. (EPMPL) is a generating company having 2x600MW generation project at Mahan, out of which Unit-I (600MW) has already achieved COD on 29.04.2013 and the second unit is expected by Aug'17. Further, an interim LILO of one circuit of Vindhyachal – Korba STPP 400kV D/c line, commissioned by Essar Power Transmission Co Ltd (EPTCL) in Dec'11, at Mahan TPS was agreed till the commissioning of the dedicated connectivity line. (till WR Pool)

1. 2 EPMPL was granted LTOA vide intimation (revised) dated 23.12.2008 for transfer of 1200MW from its Essar Mahan Project to following beneficiaries: MP (400MW) & Essar Steel Ltd. (Hazira) (700MW). Following dedicated transmission system strengthening requirement was identified for implementation by M/s EPMPL at its own cost before commencement of LTOA (refer following diagram):

- Essar Mahan TPS – WR Pooling Station 400kV D/c (triple) line
- Gandhar (NTPC) – Hazira (Essar Steel) 400kV D/c line along-with establishment of 400/220kV, 3x500MVA substation at Hazira (Essar Steel)



1. 3 As per LTOA intimation, the interim arrangement of LILO of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS was to be removed and restored to original configuration by M/s EPMPL as a prerequisite for start of LTOA.

1. 4 There has been delay in commissioning of EPMPL – WR Pool 400kV D/c line and the same is expected by Dec'17. As per CERC order no. 30/MP/2014 dated 28.09.2016 –

"CTU shall take up all the existing cases of connectivity on interim LILO with the RPC of respective regions within a period of one month from the date of issue of this order for review and decision on disconnection of the interim arrangements through LILO. All such interim arrangements through LILO shall be disconnected within a period of three months of the issue of this order unless the RPC grants extension for continuation of LILO keeping in view of all relevant factors."

1. 5 The issue regarding connectivity on interim LILO of Essar Mahan TPS (among others) was referred to WRPC by the 41st WR SCM dated 21.12.2016. During the 33rd TCC/WRPC meeting held on 31.01.2017 and 01.02.2017 at Diu, TCC recommended that EPMPL shall complete the line by 30th June 2017, else the interim connection would be removed by CTU. WRPC agreed to the TCC recommendation for EPMPL case to complete the line by 30th June 2017. Communication in this regard has already been sent to WRLDC vide letter dated 15.06.2017.

1. 6 As per the latest schedule of Essar Mahan TPS – WR Pool 400kV D/c line submitted by EPTCL in June'17, following balance works are still pending:

(i) 4 nos. tower foundations
(ii) 33 nos. tower erection
(iii) 140 kms stringing.

The same status was also furnished by EPTCL in the 41st WR SCM dated 21.12.2016, but no progress has been reported since then.

1. 7 M/s EPMPL vide letter dated 22.12.2016 has intimated that it has decided to relinquish a part of LTOA upto 750MW and requested to operationalise the balance LTOA of 450MW through existing LILO of Vindhyachal – Korba 400kV S/c line at Essar Mahan. M/s EPMPL has further informed POWERGRID vide letter dated 07.04.2017 that the beneficiary for availing LTOA for 450MW shall be M/s Essar Steel India Limited, Hazira located in Gujarat (WR). Further, EPMPL vide letter dated 30.05.2017 to CTU and 13.06.2017 to CEA has informed the need for extension of their interim connectivity in anticipation of undamped power oscillations under N-1 outage of their extremely long (337km) dedicated line till WR Pooling station.

1. 8 Studies have been subsequently carried out to review the adequacy of immediate evacuation system from Essar Mahan TPS in view of long line length of the dedicated line.

2. Study Results

2.1 Load flow as well as dynamic stability studies were carried out to determine the adequacy of immediate evacuation system for transfer of power from Mahan TPS. Following cases were studied considering availability of both units at Essar Mahan TPS with dispatch of 2x540MW:

a) Case 1 – With Only Interim Arrangement in service:
With existing interim LILO arrangement of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS and without Mahan TPS – WR Pool 400kV D/c line (337km)

b) Case 1A - With Only Interim Arrangement in service with SPS:
Without Mahan TPS – WR Pool 400kV D/c line (337km) and with existing interim LILO arrangement of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS and with SPS at Mahan TPS that trips 2nd Unit of Mahan TPS under outage of Vindhyachal – Mahan TPS 400kV S/c line. Unit II is assumed to be tripped within 450ms of fault occurrence

c) Case 2 – With Only Dedicated line in service:
With only Mahan TPS – WR Pool 400kV D/c line (337km)

d) Case 2A – With Only Dedicated line in service with SPS:
With only Mahan TPS – WR Pool 400kV D/c line (337km) and with SPS at Mahan TPS that trips 2nd Unit of Mahan TPS under N-1 of dedicated line. Unit II is assumed to be tripped within 300ms & 450ms (2 cases) of fault occurrence

e) Case 3 – With LILO + Interim arrangement in service:
With Mahan TPS - WR Pool 400kV D/c line along-with existing interim LILO arrangement of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS

a) Case 4 – With Dedicated line + Additional anchoring proposed at Vindhyachal PS
With Mahan TPS - WR Pool 400kV D/c line and additional anchoring of the generation at Vindhyachal Pool through Mahan TPS - Vindhyachal Pool 400kV D/c line (about 25km)

2.2 Summary of load flow/stability study results (detailed results enclosed at ***Annexure-I***) are tabulated below:

Case	Load Flow (in MW)				Stability	Remarks
	Dedicated	**Interim**		**Addl anchoring studied**		
	Mahan TPS – WR Pool 400kV D/c	*Mahan TPS – Vindhyachal 400kV S/c*	*Mahan TPS – Korba STPS 400kV S/c*	*Mahan TPS – Vindhyachal PS*	*Stable / Unstable*	*2 x 540MW dispatch set in all cases*
Case-1	-	765	307	-	Unstable under outage of Mahan TPS – Vindhyachal 400kV line	System N-1 non-compliant. Oscillations observed on Mahan TPS – Korba 400kV section (~220km.)
Case-1A	-	765	307	-	Stable	System N-1 non-compliant. Stable with SPS setting of 450ms (Unit-II Trip)
Case-2	2x540	-	-	-	Unstable under N-1 contingency of the dedicated line	
Case-2A	2x540	-	-	-	300ms case: Stable 450ms case: Unstable	
Case-3*	2x123	586	242	-	Stable under N-1 outage of long dedicated line (to WR Pool)	Power tends to flow to Vindhyachal instead of WR Pool. Fault level (LG) at Vindhyachal reaches 43kA in 2021-22 time frame
Case-4	2x271	-	-	2x267	Stable under N-1 outage of long dedicated line (to WR Pool)	With commissioning of Vin-Pool – Jabalpur as well as Vin-Pool – Varanasi 765kV D/c line it is observed that Mahan-TPS – WR Pool 400kV D/c line is floating & all power rushes to Vin-Pool.**

**An additional case was carried out in which Mahan – Vindhyachal 400kV S/c line was kept out of service in base case itself so that fault level at Vindhyachal remains within limits. No issues in power flow as well as stability are observed even under N-1 outage of the long dedicated line to WR Pool.*

***With this option, in 2021-22 time frame, fault level at Vindhyachal PS crosses 50kA. Further, 2x1500MVA ICTs at Vindhyachal PS violate N-1 criteria. Power flow on Vindhyachal – Varanasi IR line gets enhanced from 2700MW to about 3000MW.*

3. Observations

From system studies carried out above, the following is observed:

b) Cases 1 & 1A – With Only Interim Arrangement in service:

Evacuation of power from 2x600MW Mahan TPS through interim arrangement of LILO of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS results in ***rotor angle instability of Mahan TPS as well as sustained Grid oscillations*** under outage of Vindhyachal – Mahan 400kV S/c line. Moreover, the system is N-1 non-compliant under outage of either of the two circuits. However, in case an SPS is installed that trips Unit-II of Mahan TPS (*within 450ms of fault occurrence*) under outage of Vindhyachal – Mahan 400kV S/c line, the system remains stable.

c) Cases 2 & 2A– With Only Dedicated line in service:

Removal of the interim arrangement after commissioning of the dedicated transmission line upto Bilaspur Pooling station (337km), may result in ***Grid instability issues on N-1 contingency of dedicated line***. However, in case an SPS is installed that trips Unit-II of Mahan TPS (*within 300ms of fault occurrence*) under N-1 outage of dedicated line, the system remains stable even without interim arrangement.

d) Case 3 – With LILO + Interim arrangement in service:

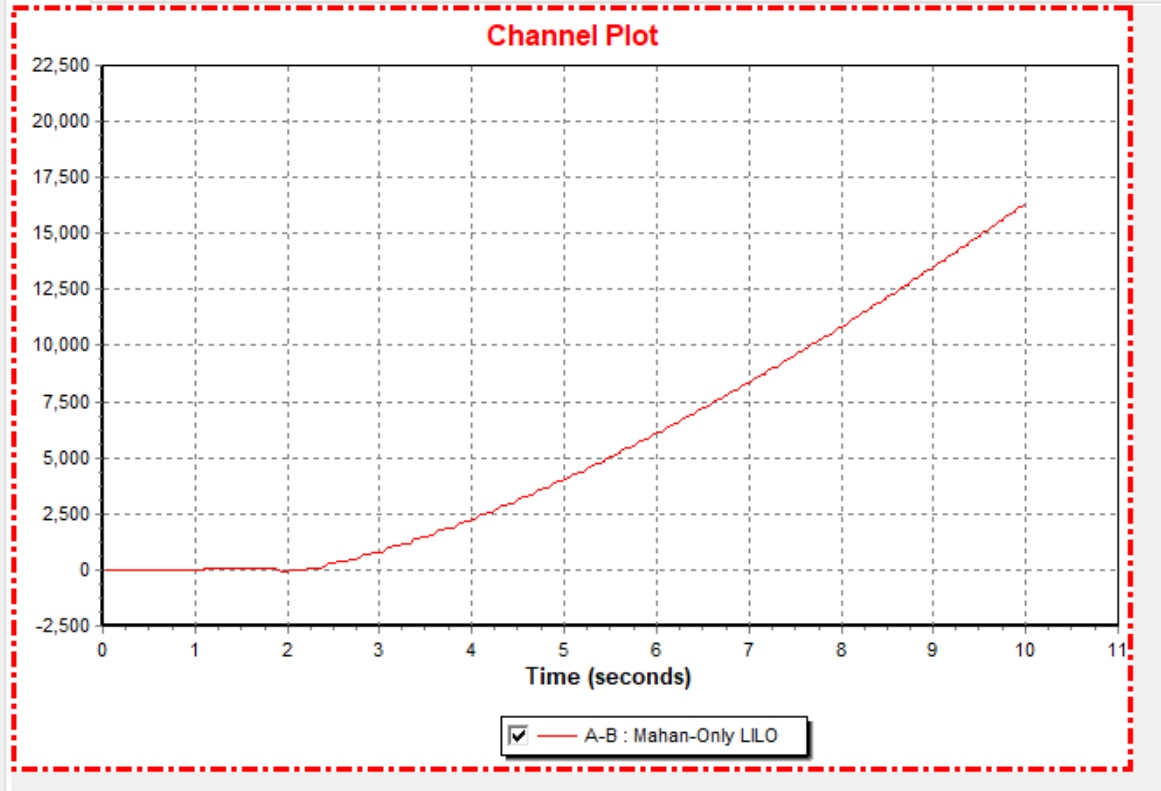
In case the dedicated line upto WR Pool(Bilaspur) along with the interim arrangement of LILO of one circuit of Vindyachal-Korba D/c at Mahan TPS is kept in service, ***power can be reliably evacuated from both the units of Mahan TPS. However, the fault level at Vindhyachal crosses 40kA in 2021-22 time frame, with a significant contribution from Mahan TPS.*** Further, in case the dedicated line upto WR Pool along-with the interim LILO of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS, is kept in service ***with the Mahan TPS-Vindyachal 400kV section kept under open condition, no constraints are observed*** in respect of both power evacuation considering N-1 contingency conditions and stability issues.

e) Case 4 – With Dedicated line + Additional anchoring proposed at Vindhyachal PS

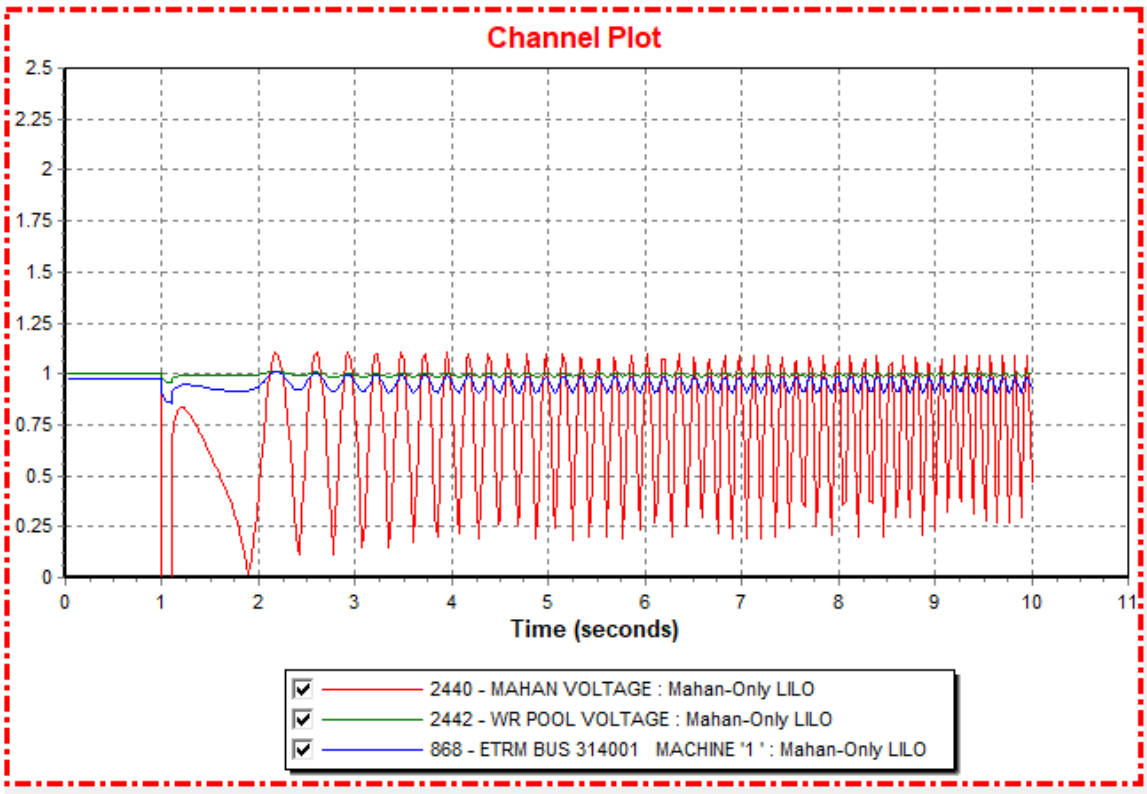
If interim LILO arrangement at Mahan TPS is bypassed then an additional 400kV D/c line will be required to evacuate the power with reliability and security from Mahan TPS. For providing additional anchoring to Mahan TPS, ***if another 400kV D/c line is planned till Vindhyachal PS (nearest pooling sub-station, line length about 25km), no stability issues are observed***. ***However, in time frame of 2021-22 it is being observed that Mahan-TPS – WR Pool 400kV D/c line is floating & all power rushes to Vindhyachal Pool.*** Further additional measures need to be taken to solve N-1 violation at 765/400kV ICTs and to control fault level at Vindhyachal PS 400kV bus. However this additional anchoring helps in further dispersal of power to NR as it increases the load flow on Vindhyachal Pool – Varanasi 765kV D/c line.

a) CASE-1: Without Mahan TPS – WR Pool 400kV D/c line (337km) and with existing interim LILO arrangement of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS

ANGLE PLOT OF ESSAR MAHAN TPS

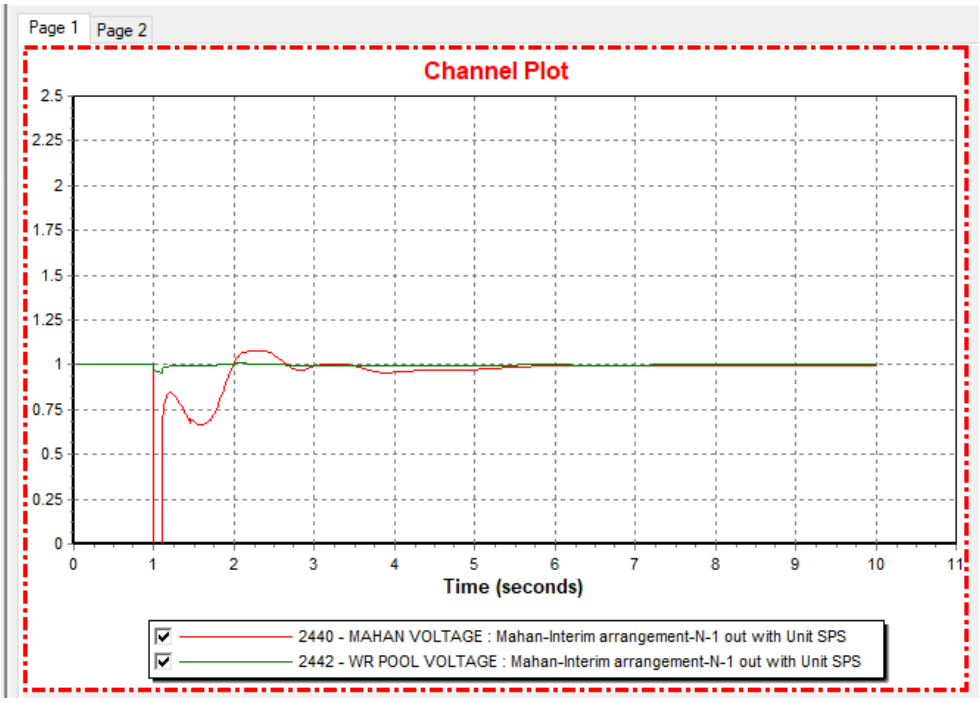


VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL

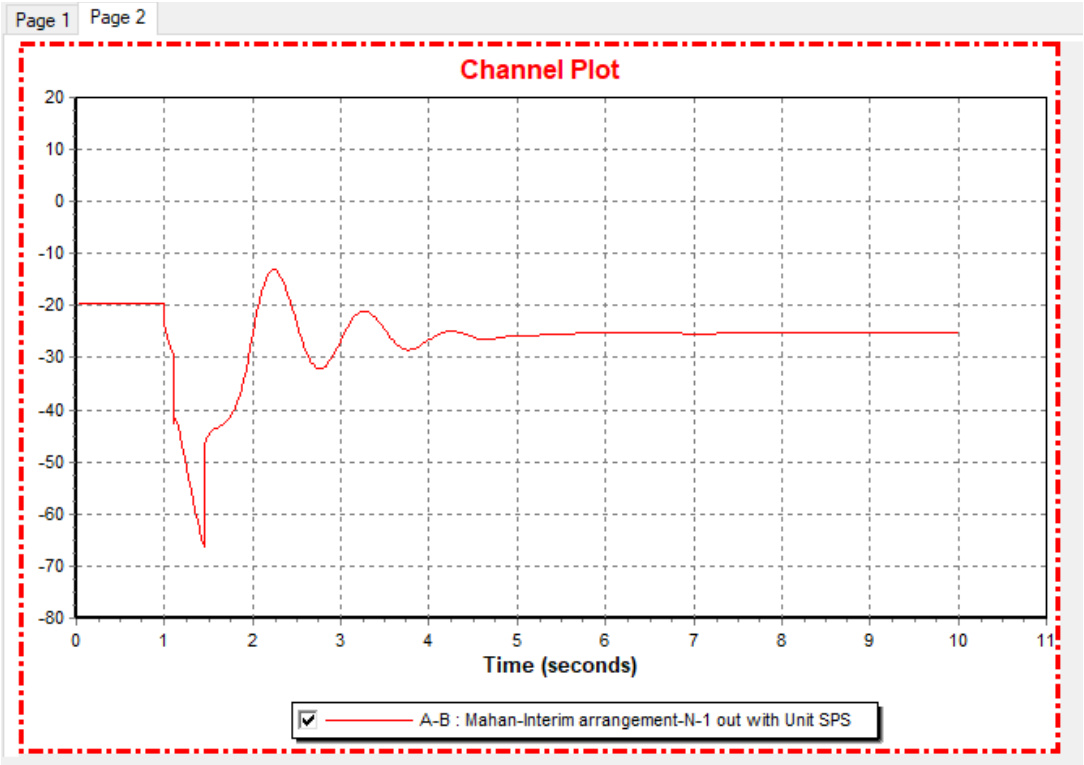


b) CASE-1A: Without Mahan TPS – WR Pool 400kV D/c line (337km) and with existing interim LILO arrangement of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS and with SPS at Mahan TPS that trips 2nd Unit of Mahan TPS under outage of Vindhyachal – Mahan TPS 400kV S/c line. Unit II is assumed to be tripped within 450ms of fault occurrence

SPS Unit trip time of 450ms: VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL

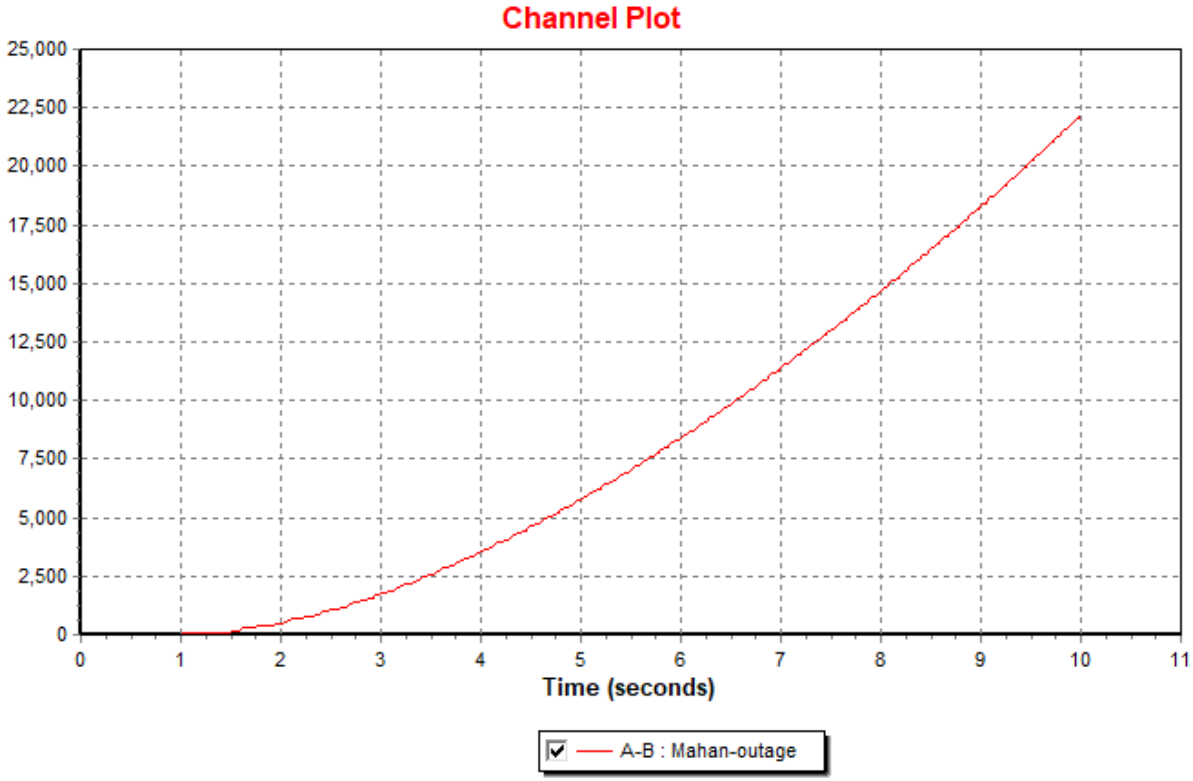


SPS Unit trip time of 450ms: ANGLE PLOT OF MAHAN TPS

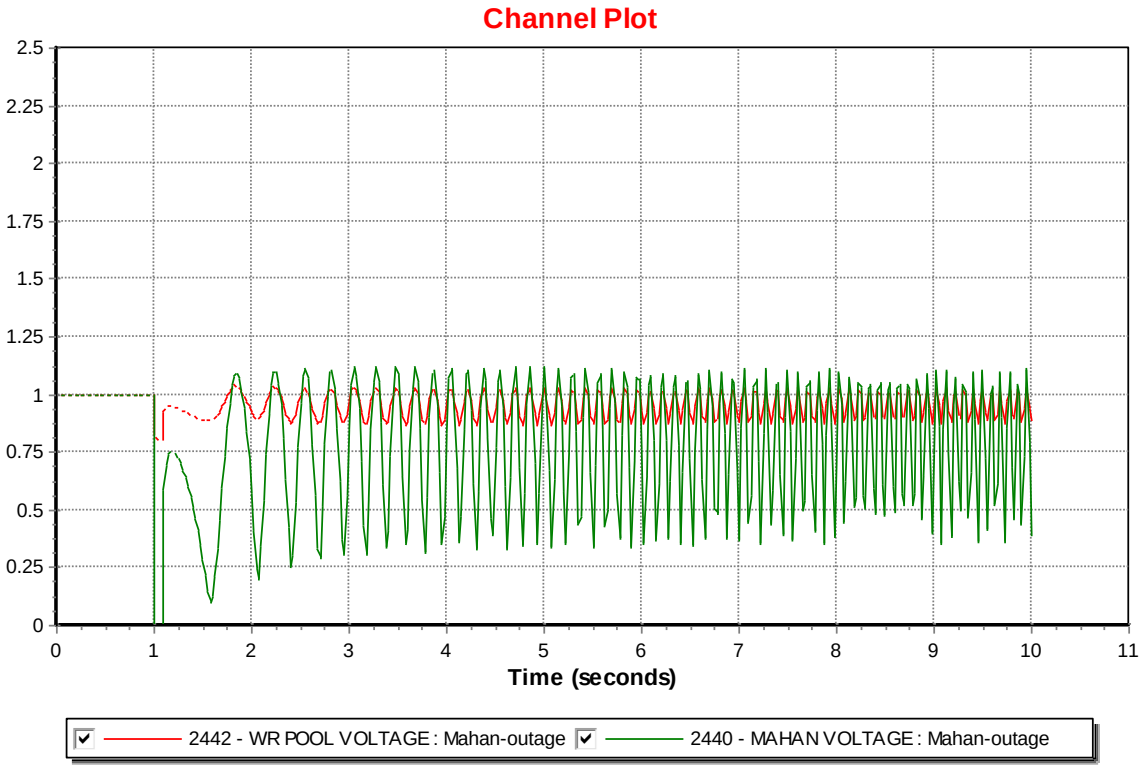


c) CASE-2- With only Mahan TPS – WR Pool 400kV D/c line (337km)

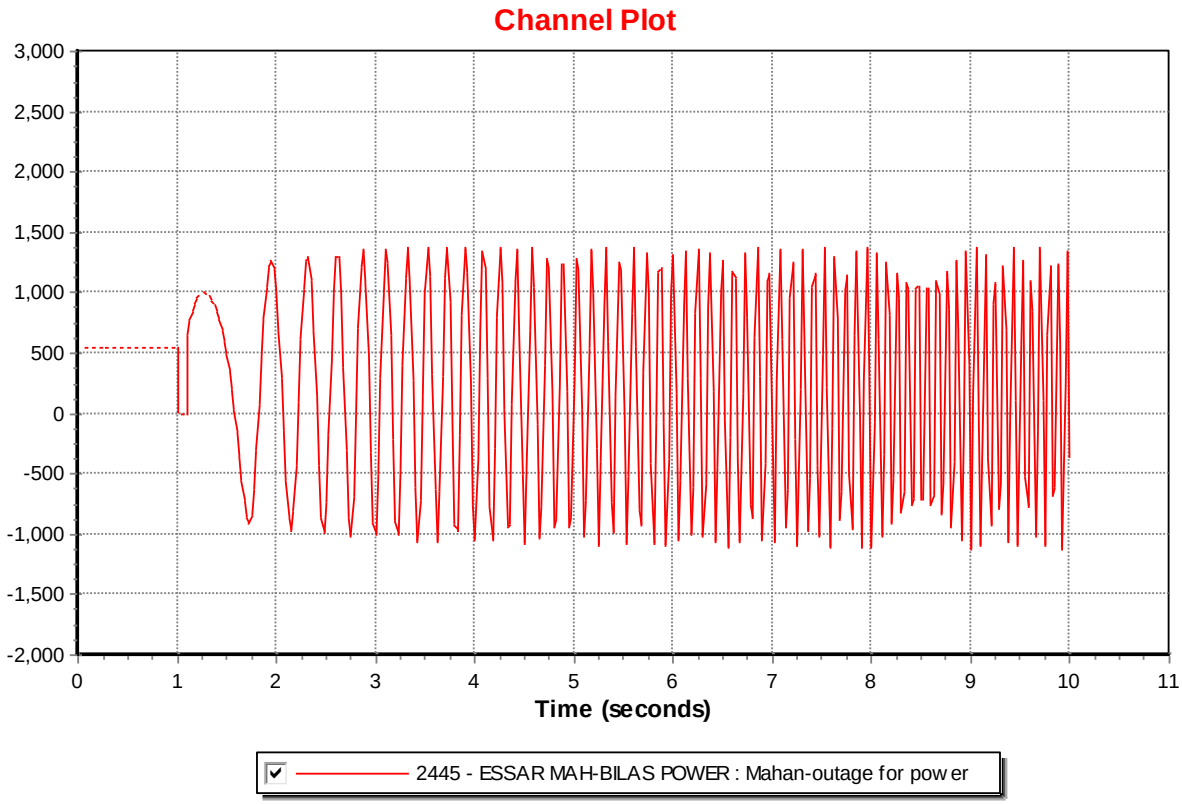
ANGLE PLOT OF ESSAR MAHAN TPS



VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL

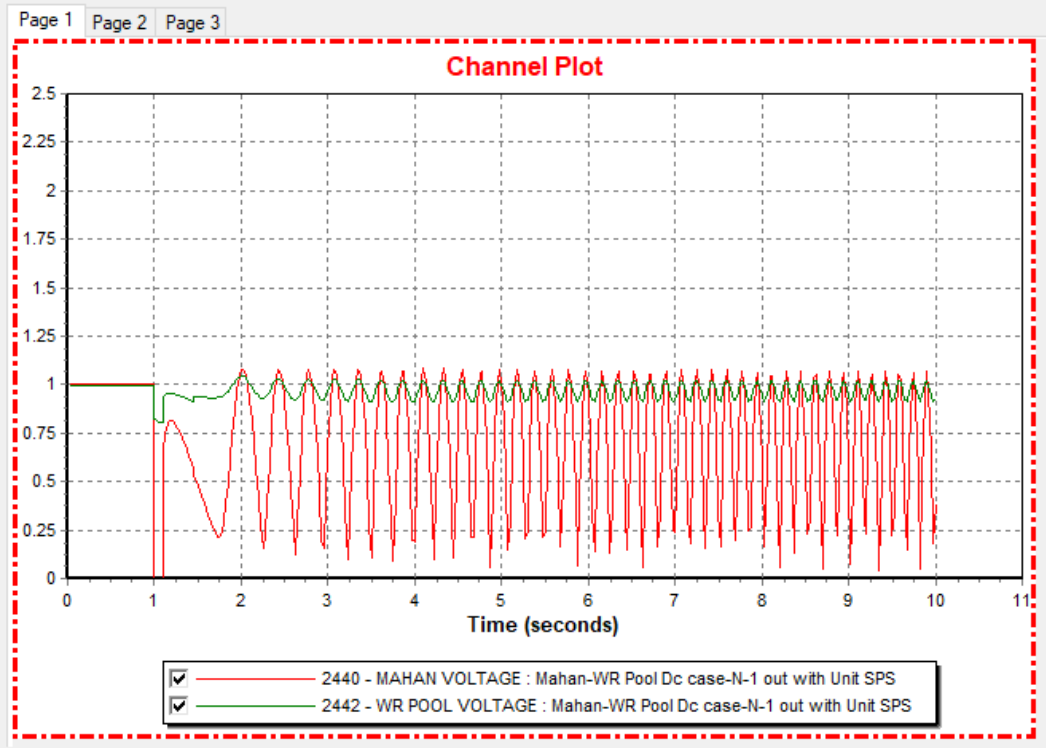


POWER PLOT ON EPMPL – BILASPUR LINE

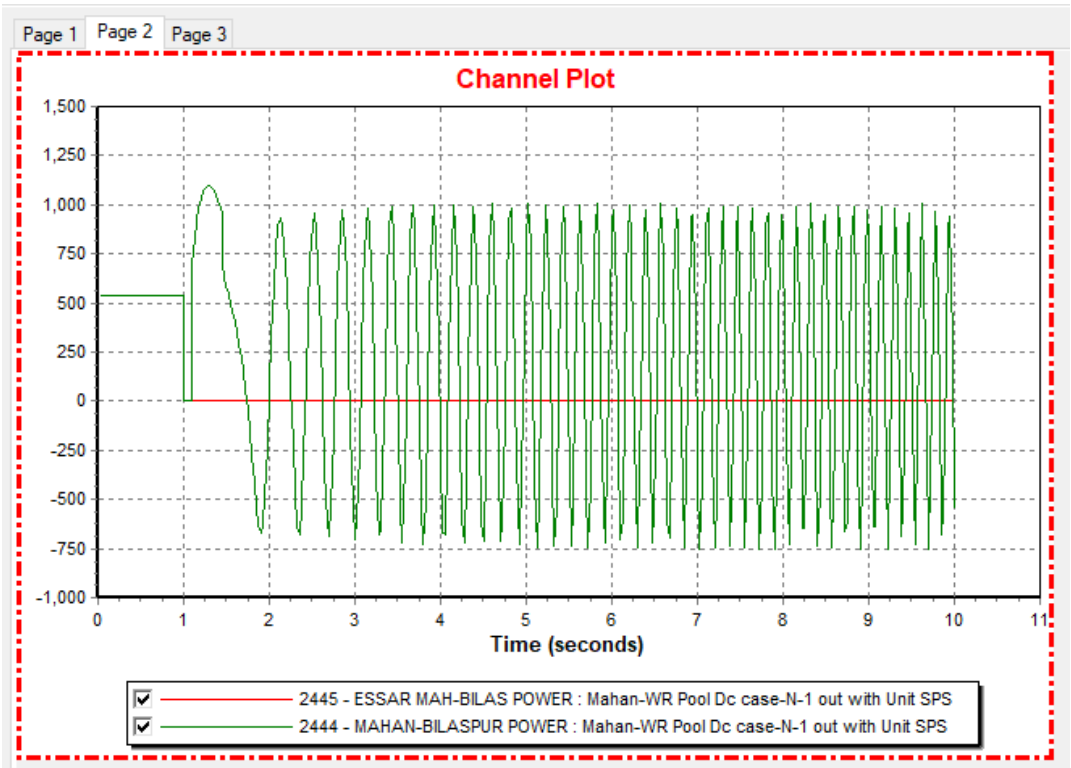


d) ***CASE-2A: With only Mahan TPS – WR Pool 400kV D/c line (337km) and with SPS at Mahan TPS that trips 2nd Unit of Mahan TPS under N-1 of dedicated line. Unit II is assumed to be tripped within 300ms & 450ms (2 cases) of fault occurrence***

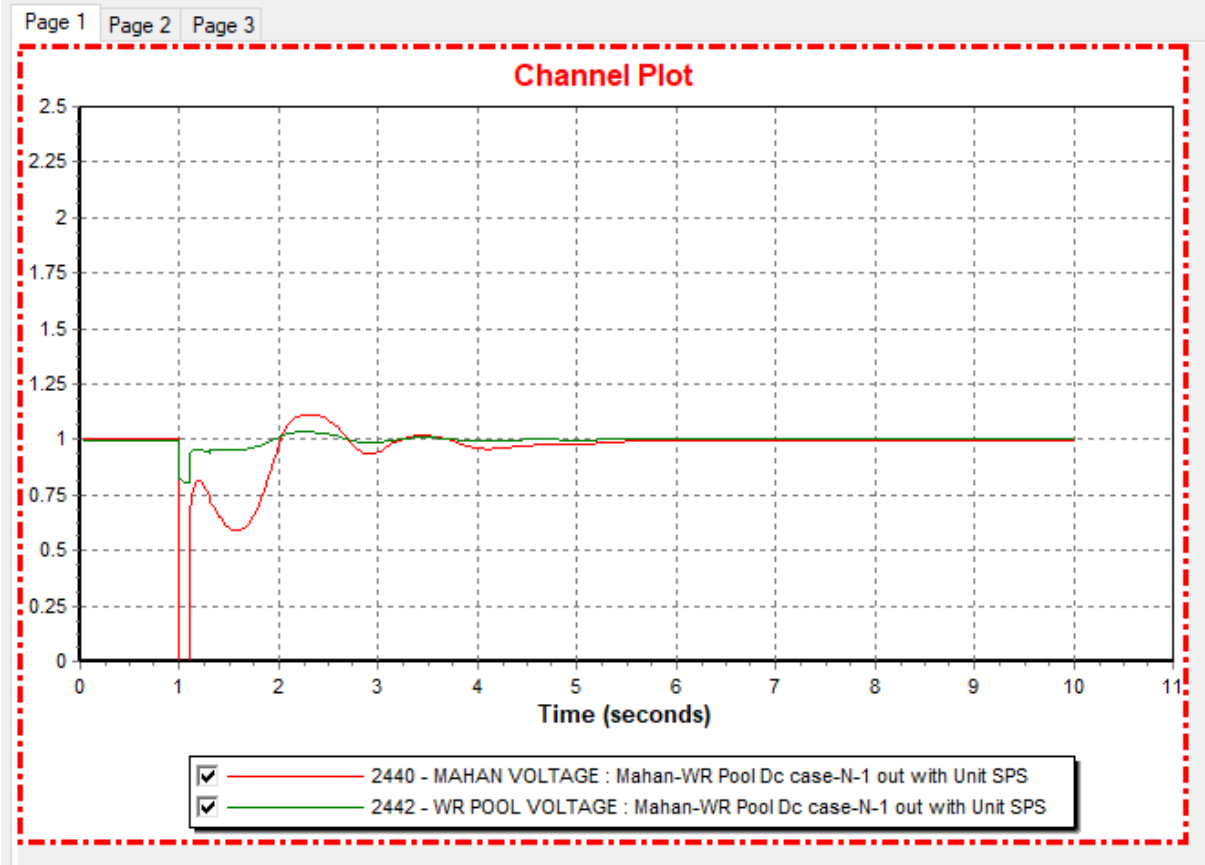
SPS Unit trip time of 450ms: VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL



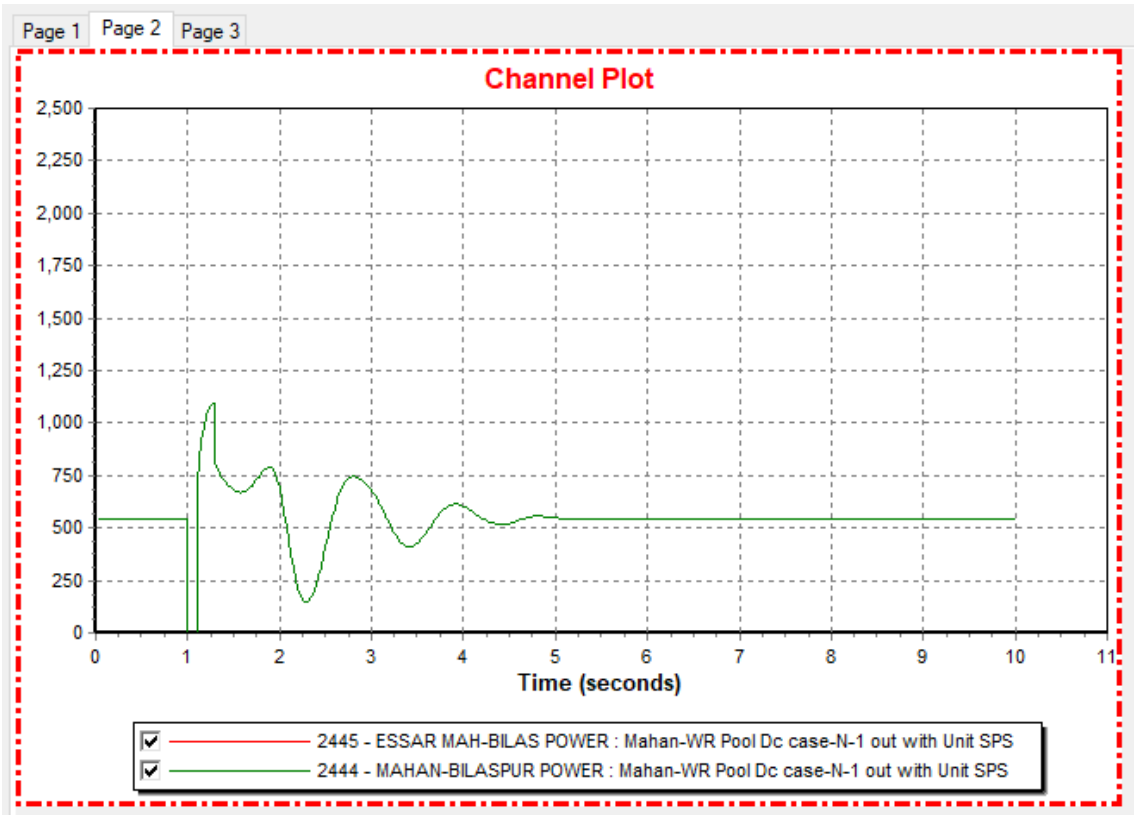
SPS Unit trip time of 450ms: POWER PLOT ON EPMPL – BILASPUR LINE



SPS Unit trip time of 300ms: VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL

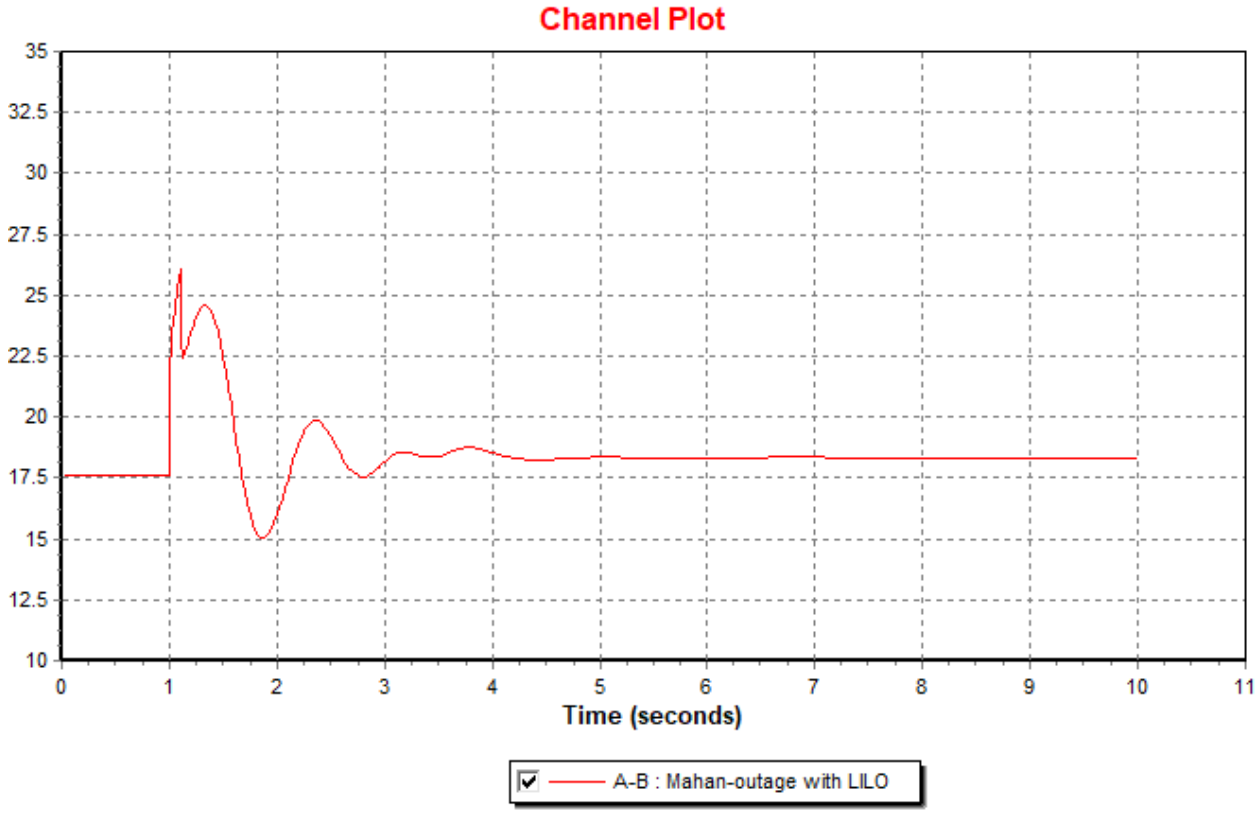


SPS Unit trip time of 300ms: POWER PLOT ON EPMPL – BILASPUR LINE

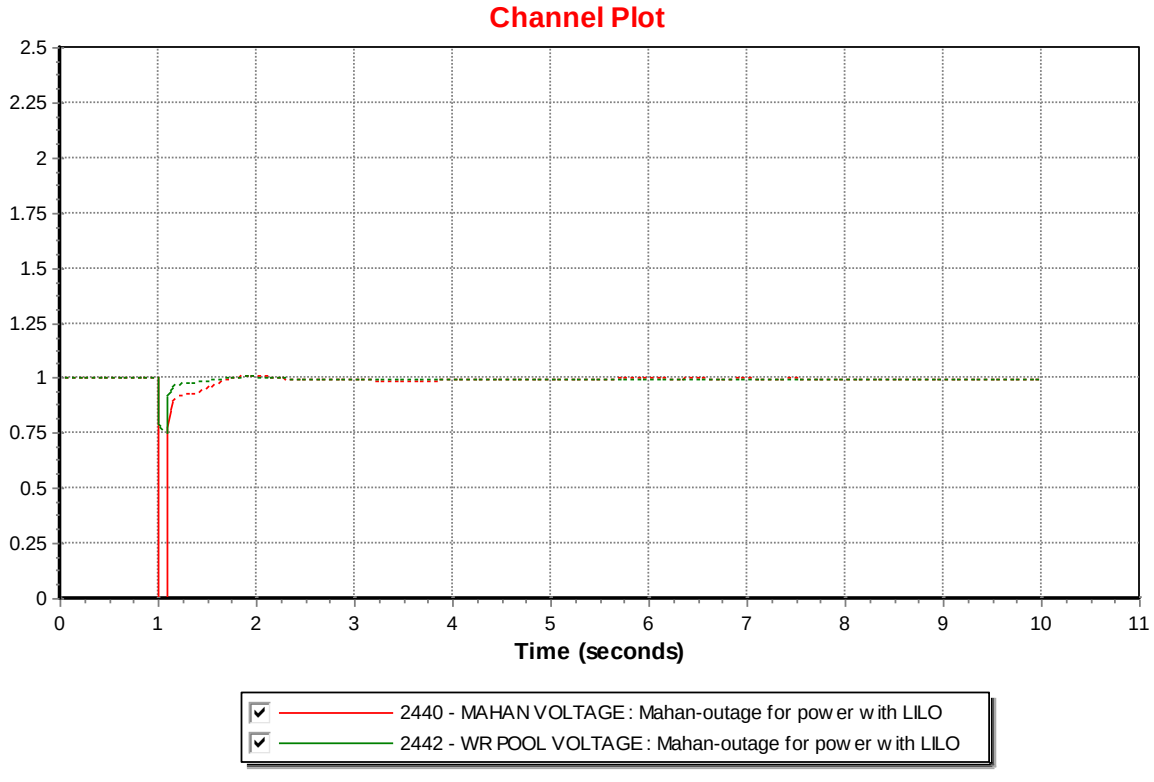


e) ***CASE-3: With Mahan TPS - WR Pool 400kV D/c line along-with existing interim LILO arrangement of one circuit of Vindhyachal – Korba STPP 400kV D/c line at Mahan TPS***

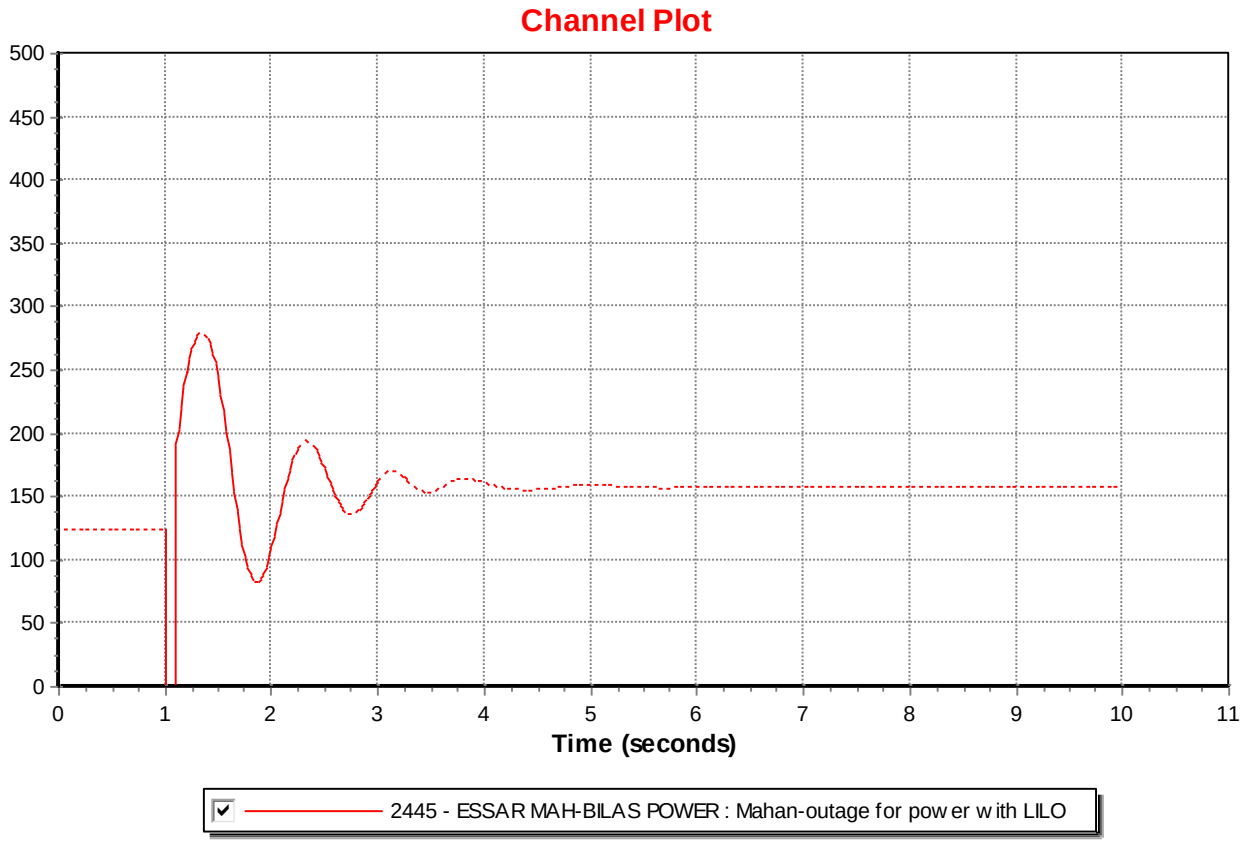
ANGLE PLOT OF ESSAR MAHAN TPS



VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL

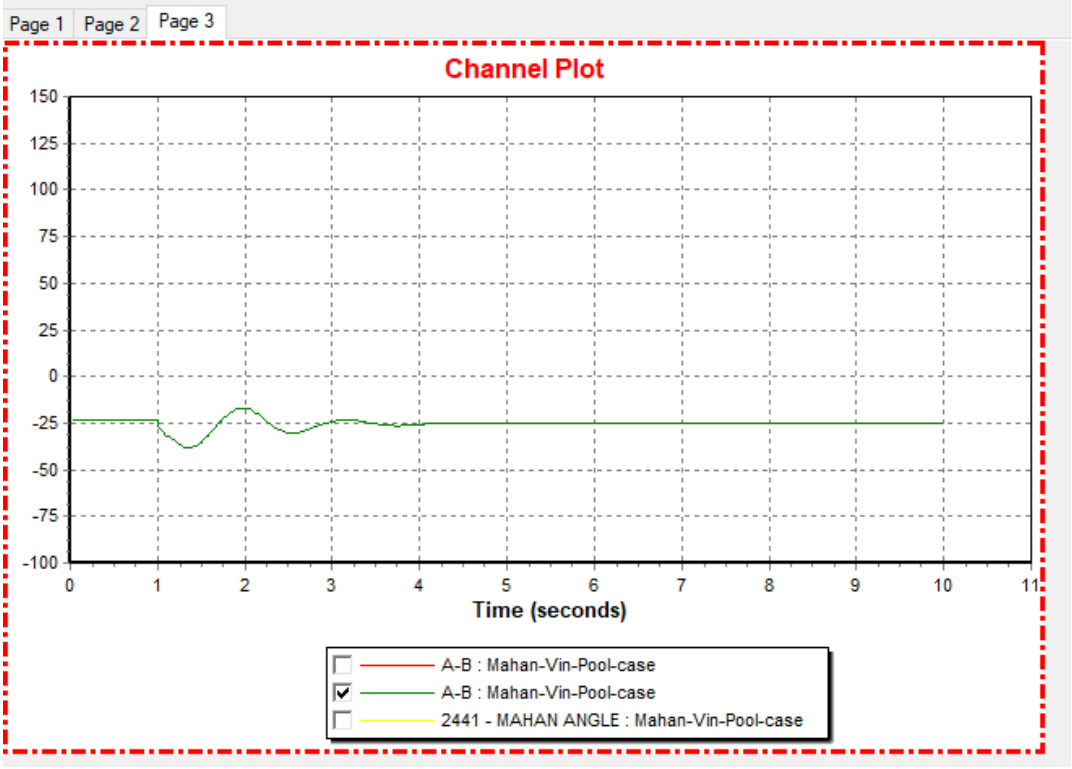


POWER PLOT ON EPMPL – BILASPUR LINE

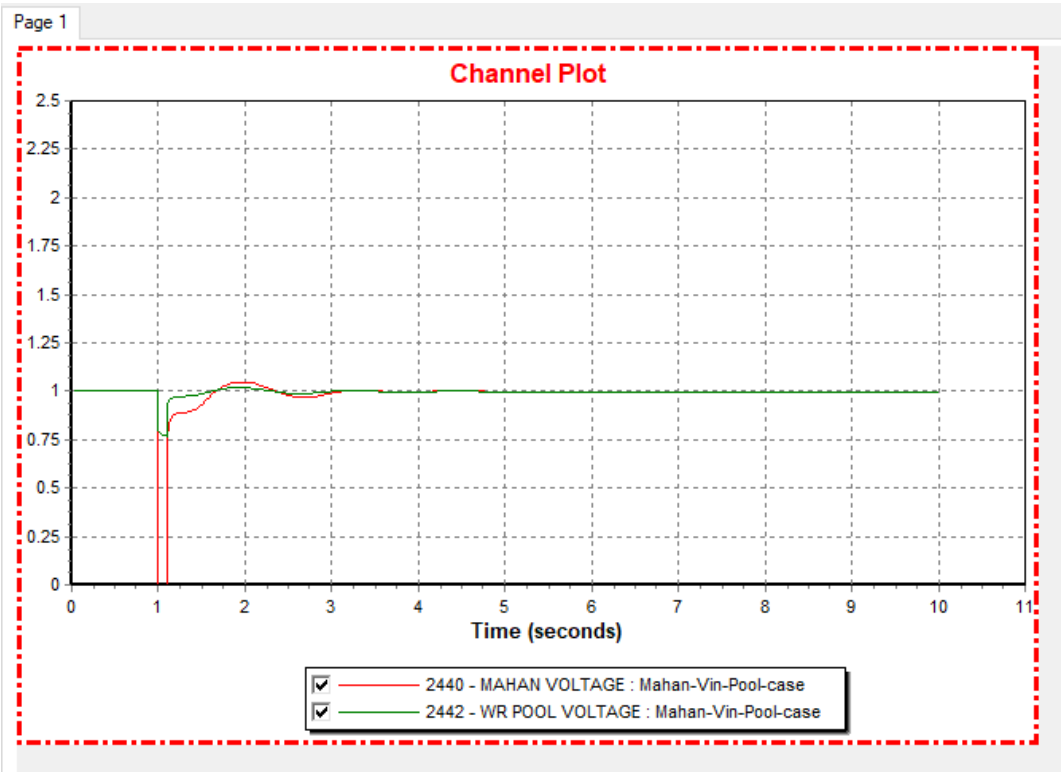


f) CASE-4: With Mahan TPS - WR Pool 400kV D/c line and additional anchoring of the generation at Vindhyachal Pool through Mahan TPS - Vindhyachal Pool 400kV D/c line (about 25km)

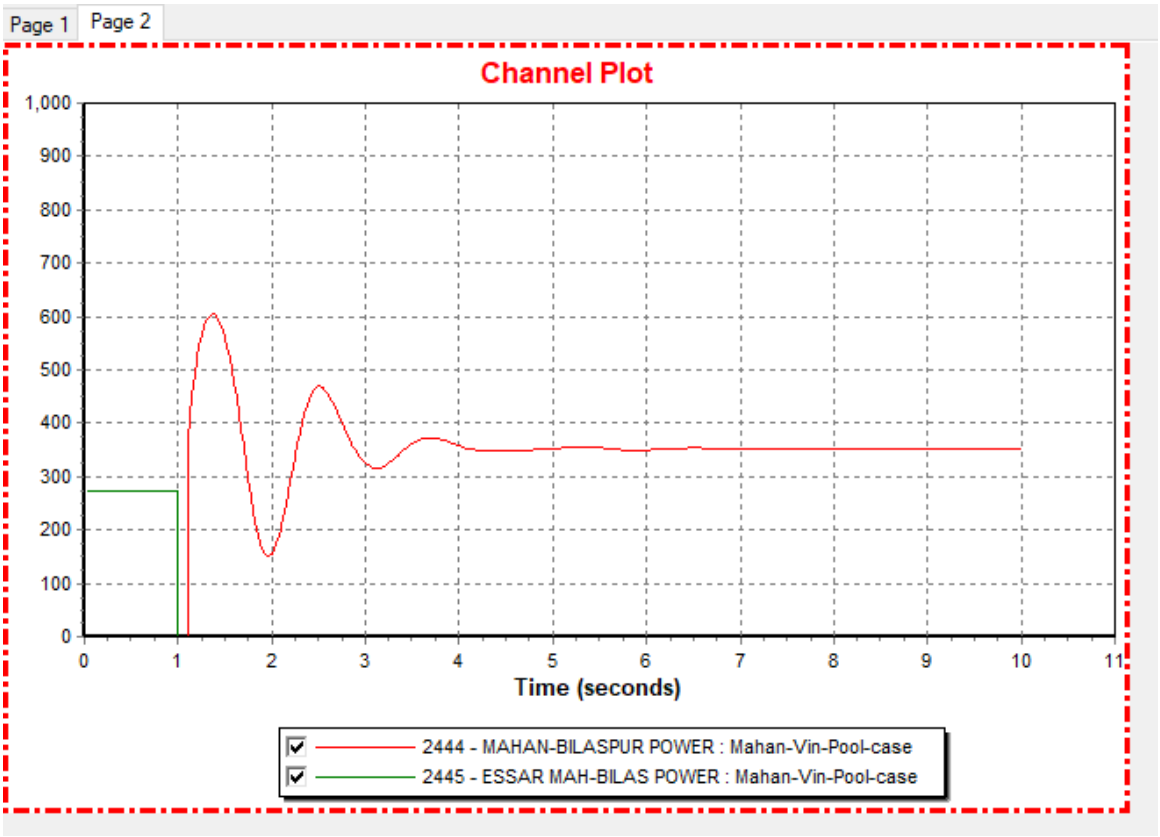
ANGLE PLOT OF ESSAR MAHAN TPS



VOLTAGE PLOT OF ESSAR MAHAN TPS & WR POOL



POWER PLOT ON EPMPL – BILASPUR LINE



Annexure-19 - (i)(a)

FREQUENCY PARTICULARS OF WESTERN REGION FOR THE PERIOD

JULY 2017 TO OCTOBER 2017

Sr.No.	PARTICULARS	Jul-17	Aug-17	Sep-17	Oct-17
1	**MAXIMUM FREQUENCY (Hz)**				
1.1	Integrated over an hour	50.09	50.10	50.07	50.08
1.2	Instantaneous	50.26	50.20	50.20	50.20
2	**MINIMUM FREQUENCY (Hz)**				
2.1	Integrated over an hour	49.82	49.81	49.80	49.85
2.2	Instantaneous	49.69	49.65	49.62	49.65
3	**AVERAGE FREQUENCY (Hz)**	49.99	49.99	49.97	49.97
4	**NUMBER OF TIMES FREQUENCY TOUCHED**				
4.1	48.6 Hz	0	0	0	0
4.2	48.8 Hz	0	0	0	0
4.3	51.0 Hz	0	0	0	0
5	**PERCENTAGE TIME WHEN FREQUENCY WAS**				
5.1	Above 50.05 Hz	17.29	15.98	9.73	9.21
5.2	***Between 49.9 Hz & 50.05 Hz***	76.15	76.82	78.50	77.18
5.3	Below 49.9 Hz	6.56	7.20	11.77	13.61

POWER SUPPLY POSITION IN WR FOR PERIOD FROM JULY 2017 TO OCTOBER 2017 (IN EX-BUS MW)

Details	Chhattisgarh				Gujarat				Madhya Pradesh				Maharashtra			
	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17
Availability (MW)	3553	3814	3817	3636	11946	14689	15476	16566	7243	8186	8231	10453	19290	19951	19428	18248
Unrestricted demand (MW)	3758	4035	4169	3651	11954	14689	15476	16566	7290	8249	8251	10465	19339	20015	19490	20310
Deficit(-)/Surplus(+) in MW	-205	-221	-352	-15	-8	0	0	0	-47	-63	-20	-12	-49	-64	-62	-2062
Deficit(-)/Surplus(+) in %	-5.46	-5.48	-8.44	-0.41	-0.07	0.00	0.00	0.00	-0.64	-0.76	-0.24	-0.11	-0.25	-0.32	-0.32	-10.15

POWER SUPPLY POSITION IN WR FOR PERIOD FROM JULY 2017 TO OCTOBER 20177 (IN EX-BUS MW)

Details	Goa				Daman & Diu				Dadra & Nagar Haveli				Western Region			
	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17
Availability (MW)	558	554	508	517	322	336	351	349	790	785	788	790	41280	45174	45697	46378
Unrestricted demand (MW)	559	557	509	542	322	336	351	349	790	785	788	790	41325	45228	46369	48517
Deficit(-)/Surplus(+) in MW	-1	-3	-1	-25	0	0	0	0	0	0	0	0	-45	-54	-672	-2139
Deficit(-)/Surplus(+) in %	-0.18	-0.54	-0.20	-4.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.11	-0.12	-1.45	-4.41

POWER SUPPLY POSITION IN WR FOR PERIOD FROM JULY 2017 TO OCTOBER 2017 (IN MUs) EX-BUS

Details	Chhattisgarh				Gujarat				Madhya Pradesh				Maharashtra			
	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17
Availability (MUs)	2122	2432	2339	2366	7160	8291	9169	10030	4713	5191	5313	5111	11534	12123	11422	11959
Unrestricted Requirement (MUs)	2140	2447	2373	2369	7160	8291	9169	10030	4713	5191	5313	5111	11534	12123	11499	12056
Deficit(-)/Surplus(+) in MUs	-18.14	-15	-34	-3	0	0	0	0	0	-0.32	0	0	0	0	-77	-97
Deficit(-)/Surplus(+) in %	-0.85	-0.61	-1.43	-0.13	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	-0.67	-0.80

POWER SUPPLY POSITION IN WR FOR PERIOD FROM JULY 2017 TO OCTOBER 2017 (IN MUs) EX-BUS

Details	Goa				Daman & Diu				Dadra & Nagar Haveli				Western Region			
	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17	Jul-17	Aug-17	Sep-17	Oct-17
Availability (MUs)	328	344	331	349	207	214	207	213	501	517	520	510	26873	29239	29424	30243
Unrestricted Requirement (MUs)	328	344	331	349	207	214	207	213	501	517	520	510	26891	29254	29536	30343
Deficit(-)/Surplus(+) : in MUs	0	0	0	0	0	0	0	0	0	0	0	0	-18	-15	-112	-100
Deficit(-)/Surplus(+) : in %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.07	-0.05	-0.38	-0.33

VOLTAGE PROFILE FOR THE PERIOD OF JULY 2017 TO OCTOBER 2017

Annexure-19 - (ii)(a)

	भोपाल		खंडवा		इटारसी		दमोह		नागदा		इंदौर		ग्वालियर		रायपुर		रायगढ़	
MONTH	Bhopal		Khandwa		Itarsi		Damoh		Nagda		Indorer		Gwalior		Raipur		Raigarh	
	400kV		400kV		400kV		400kV		400kV		400kV		400kV		400kV		400kV	
	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Jul-17	422	400	430	405	419	397	426	384	426	405	425	402	417	383	425	400	427	415
Aug-17	419	401	426	404	414	396	422	404	423	404	421	400	417	385	422	410	427	411
Sep-17	419	401	426	407	414	397	422	405	423	403	421	401	413	387	423	408	426	406
Oct-17	420	398	424	404	412	392	417	400	425	396	420	395	411	391	423	412	425	405

	भिलाई		वर्धा		धुल		परली		बाइसर		कलवा		कराड		असाज		दहगाम	
MONTH	Bhilai		Wardha		Dhule		Parli		Boisar		Kalwa		Karad		Asoj		Dehgam	
	400kV		400kV		400kV		400kV		400kV		400kV		400kV		400kV		400kV	
	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Jul-17	422	407	429	381	437	402	434	396	427	391	437	398	434	382	423	399	436	381
Aug-17	419	406	428	407	436	400	435	393	426	390	435	392	433	407	421	391	435	402
Sep-17	423	404	429	412	438	390	435	384	425	392	434	384	434	406	420	401	435	382
Oct-17	427	407	428	413	435	404	435	384	429	384	437	397	436	412	417	396	432	389

	कासोर		जेतपुर		अमरेली		वापी		मापुसा		कला		मगरवाड़ा		हज़ीरा		बीना		इंदौर	
MONTH	Kasor		Jetpur		Amreli		Vapi		Mapusa		Kala		Magarwada		Hazira		**Bina**		**Indore**	
	400kV		400kV		400kV		400kV		400kV		400kV		400kV		400kV		765Kv		765Kv	
	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Jul-17	427	410	422	400	430	406	430	394	434	389	427	391	429	393	424	388	798	756	794	752
Aug-17	425	407	422	395	428	397	428	392	433	391	425	390	428	390	426	391	794	754	788	750
Sep-17	424	409	420	382	426	392	426	395	431	388	423	392	424	395	425	393	793	759	789	752
Oct-17	423	408	411	380	418	380	433	396	435	385	430	394	433	398	422	396	790	760	790	746

	सासन		सतना		तमनार		कोटरा		वडादरा		दुर्ग		ग्वालियर		सिपत		सियोनि		वर्धा	
MONTH	Sasan		Satna		Tamnar		Kotra		Vadodara		Durg		Gwalior		**Sipat**		**Seoni**		**Wardha**	
	765Kv		765Kv		765Kv		765Kv		765Kv		765Kv		765Kv		765Kv		765Kv		765Kv	
	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	अधिकतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम	अधिकतम	न्युनतम
	Max	Min	Max	Min	Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Jul-17	780	752	793	749	805	785	805	785	806	763	809	774	803	741	773	756	797	761	805	757
Aug-17	773	751	785	751	808	765	811	784	801	753	812	778	799	749	776	759	794	761	803	755
Sep-17	777	752	784	752	804	781	805	780	801	764	810	776	799	758	773	755	792	759	805	761
Oct-17	773	748	778	748	804	779	806	727	795	755	807	762	794	759	772	756	790	761	803	759

Annexure-19(ii)(b)

Status of Reactors in WR:

Sl. No.	400 kV Sub/Stn.	Size (MVAr)	Implementing agency	Expected date of commissioning
1	Nanded	125	MSETCL	November – 2017
2	Sholapur	125	MSETCL	Dec – 2017
3	Kolhapur	125	MSETCL	Dec – 2017
4	Akola	125	MSETCL	November – 2017
5	ISP	125	NHDC	November – 2017 expected (Tendering done)
6	Satpura-ISP Line Rx	50	MPPGCL	Dec-2017

Chief Engineer, SLDC Maharashtra informed following during the meeting:

a. Commissioning of 125 MVAR shunt reactor at Karad, Kolhapur, Solapur, by MSETCL –Tender are floated for above 3 Number substation.

b. Planning of additional shunt reactors in south Maharashtra – shunt reactors are planned under phase- II by MSETCL. Proposed 125 MVAR Bus reactors are at following 400 KV substations:-

1. Chandrapur-II
2. Koradi-II
3. Khaparkheda
4. Bhusawal-II
5. Lonikand-II
6. Chakan
7. Kudus

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ANNEXURE -20

ANTICIPATED POWER SCENARIO IN WR FOR PERIOD FROM JANUARY 2018 TO MARCH 2018 (IN MW)(EX-BUS)

Details	CHATTISHGARH			GUJARAT			MADHYA PRADESH			MAHARASHTRA		
	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18
Unrestricted demand (MW)	4175	4051	4156	13340	13387	14150	11154	10676	9408	19600	20500	20700
Availability (MW)	4488	4234	4330	13856	13400	14254	11549	10909	10720	22085	22504	22620
Deficit(-)/Surplus(+)												
(i) MW	313	183	174	516	12	104	395	233	1312	2485	2004	1920
(ii) %	6.98	4.32	4.01	3.72	0.09	0.73	3.42	2.14	12.24	11.25	8.91	8.49

Details	GOA			DD			DNH			WESTERN REGION		
	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18
Unrestricted demand (MW)	510	525	530	320	325	325	710	715	715	50588	50959	50880
Availability (MW)	513	530	533	324	327	327	733	737	737	54328	53420	54300
Deficit(-)/Surplus(+)												
(i) MW	3	5	3	4	2	2	23	22	22	3739	2461	3420
(ii) %	0.59	1.03	0.56	1.15	0.53	0.53	3.13	2.97	2.97	6.88	4.61	6.30

ANTICIPATED POWER SCENARIO IN WR FOR PERIOD FROM JANUARY 2018 TO MARCH 2018 (IN MUs)(EX-BUS)

Details	CHATTISHGARH			GUJARAT			MADHYA PRADESH			MAHARASHTRA		
	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18
Unrestricted Requirement (MUs)	2260	2090	2384	8246	7874	8800	7035	6205	6091	12095	11829	13088
Availability (MUs)	2320	2280	2446	9617	8392	9934	7869	6690	7352	12875	12034	13103
Deficit(-)/Surplus(+)												
(i) MUs	60	190	62	1371	518	1134	834	485	1261	780	205	15
(ii) %	2.59	8.33	2.53	14.26	6.17	11.41	10.59	7.25	17.15	6.06	1.70	0.12

Details	GOA			DD			DNH			WESTERN REGION		
	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18	Jan-18	Feb-18	Mar-18
Unrestricted Requirement (MUs)	360	370	380	197	190	200	485	490	490	31258	29572	32014
Availability (MUs)	365	370	385	202	197	205	516	529	538	34344	31016	34543
Deficit(-)/Surplus(+)												
(i) MUs	5	0	5	5	7	5	31	39	48	3086	1443	2530
(ii) %	1.37	-0.08	1.30	2.39	3.66	2.36	6.09	7.36	9.00	8.99	4.65	7.32

Annexure-21

Status of Generating Units

The status regarding Generating units, commissioned /expected to be commissioned during the current year 2017-18 according the available information is as below:

Name of the Power Projects	**Unit No.**	**Capacity (MW)**	**Date of Commissioning /Schedule Date**
Gujarat			
NIL			
Chhattisgarh			
NIL			
Maharashtra			
CHANDRAPUR	8	500	COD on 04.06.2016
CHANDRAPUR	9	500	Commissioned on 21.03.2016. COD done on 24.11.2016
Madhya Pradesh			
Essar Power MP Ltd(Mahan)	2	600	Synchronized on 03.08.2017
BLA	2	45	Commissioned on 20.03.2017
Central sector/IPP			
KSK	3	600	Dec -2017
KSK	4	600	July – 2018
RKM	3	360	Nov 2017
RKM	4	360	December 2017
TRN Energy	2	300	COD on 01.05.2017
SKS	1	300	Commissioned on 12.06.2017. COD yet to be done.
SKS	2	300	Expected by Sept 2017
Rattan India	3	270	Achieved full load on 14.04.2017
NTPC Mouda	4	660	Commissioned on

			18.03.2017. Trial run of 72 hrs completed on 20.08.2017. COD done on 18.09.2017
NTPC Lara	1	800	Dec 2017
NTPC Solapur	1	660	Commissioned on 25.03.2017. COD done on 25.09.2017
NTPC Solapur	2	660	April 2018

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Annexure-22(a)

(1/3)

Record of discussion of the review meeting for implementation of new environmental norms for Thermal Power Plants (TPPs)

A meeting was held to review the implementation of new environmental norms for Thermal Power Plants (TPPs) under the Chairmanship of Shri Ajay Narayan Jha Secretary EF&CC and Shri Ajay Bhalla, Secretary, MoP at Indira Parayavaran Bhawan, New Delhi on 01/09/2017. The list of participants is Annexed

2. At the outset Secretary EF&CC welcomed Shri Ajay Bhalla, Secretary Power and other participant. He requested Shri A.K. Mehta Additional Secretary, MoEF&CC to brief the meeting about the background of the meeting and action taken on the implementation of new environmental norms of TPPs

3. Shri A.K. Mehta explained in detail the issues relating to implementation of new environmental norms in Thermal Power Plants as per plan of action submitted by Ministry of Power (MoP). At the same time Secretary and Joint Secretary, MoP also explained the difficulties that would arise in implementation of new environmental norms from December, 2017 onwards and minimum time required to achieve the norms taking into account supply side constraints related to equipment etc

After detailed discussion, the following decisions were taken:

1. The action plan submitted by MoP for 7 years i.e upto 2024 should commence from 2018 and implemented before, 2022, with respect to all pollutants. The revised action plan shall be submitted within 45 days. The action should also indicate timeline for installation of FGDs.

(Action: MoP)

2. The aforesaid revised plan should take into account the possible environmental and health impact considering location of TPPs and distance from habitation for the purpose of prioritisation of installation of necessary equipment.

(Action: MoP)

3. As suggested by MoP the applicability of emission limit of 300 mg/Nm^3 for NO_x shall be reviewed by a Sub-Group Chaired by Chairman CPCB and comprising representatives from CPCB, MoP / CEA, NTPC and MoEF&CC. The group shall also suggest way out for disposal of Gypsum and Calcium Sulphite also.

(Action: CPCB, MoP/CEA, NTPC and MOEF&CC)

4. The Thermal Power Plants (11-14 nos.) which are located in Ganga Basin shall utilise the treated sewage from the STPs to meet their water requirement. A plan for the purpose shall be submitted within a month

(Action: MoP/CEA, NTPC)

5. With regard to Fly Ash utilisation, it was decided that MoEF&CC shall issue appropriate directions in the matter covering aspects such as clay brick units in vicinity of Power Plants definition of national assets etc

(Action: MoEF&CC, NHAI, NTPC and other construction agencies)

4. The meeting ended with vote of thanks to the Chair

****

(9/2)

Annexure

List of the Participants

Sl. No.	Name	Designation and Ministry / Department / Organisation
1.	Shri. A.N. Jha	Secretary, EF&CC and Chairman
2.	Sh. Ajay Bhalla	Secretary, Ministry of Power
3.	Sh. S.P Singh Parihar	Chairman, CPCB
4.	Sh. A.K. Jain	Additional Secretary, MoEF&CC
5.	Sh. A.K. Mehta	Additional Secretary, MoEF&CC
6.	Sh. Aniruddha Kumar	Joint Secretary, Ministry of Power
7.	Ms. Archana Agrawal	Joint Secretary Hydro, Ministry of Power
8.	Sh. Gyanesh Bharati	Joint Secretary, MoEF&CC
9.	Sh. Ritesh Kumar Singh	Joint Secretary, MoEF&CC
10.	Dr. A.K. Senthil Vel	Advisor, MoEF&CC
11.	Sh. Ravindra Kumar Verma	Chairperson, CEA
12.	Sh. P.B. Siwal	Member, CEA
13.	Sh. Narender Singh	Chief Engineer, CEA
14.	Sh. L.D.Papney	Chief Engineer, CEA
15.	Sh. A.K. Gupta	Director (Commercial), NTPC
16.	Sh. Harpreet Sigh Pruthi	Director, Ministry of Power
17.	Sh. Gurdeep Singh	CMD, NTPC
18.	Sh. A.K. Sinha	ED (NTPC)
19.	Dr. S.K. Paliwal	Scientist 'D' CPCB
20.	Dr. H. Kharkwal	Scientist 'D' MoEF&CC

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ANNEXURE-22(b) SPEED POST

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
पश्चिम क्षेत्रीय विद्युत समिति
Western Regional Power Committee
एफ -3, एमआयडीसी क्षेत्र, अंधेरी (पूर्व), मुंबई - 400 093
F-3, MIDC Area, Andheri (East), Mumbai - 400 093
दूरभाष Phone: 022- 28221636; 28200194/95/96; फैक्स Fax : 022 - 28370193
Website : www.wrpc.gov.in E-mail : ms-wrpc@nic.in

आई एस ओ : 9001-2008
ISO : 9001-2008

सं :पक्षेविस / बैठक/ सहा सचिव/ 2017-
No. WRPC/ Mtg./AS/2017/ 14540

Date : 29 SEP 2017

सेवा में, /To,

(संलग्न सूची के अनुसार)
(As per enclosed list)

महोदय/Sir,

Sub.: Minutes of Special TCC Meeting of WRPC held on 28.09.2017 at WRPC.

Please find enclosed herewith the Minutes of Special TCC Meeting of WRPC held on 28.09.2017 at WRPC Mumbai for information and further needful.

संलग्न :उपरोक्तानुसार

Encl: As Above

भवदीय/Yours faithfully,

ए. बालन

(ए. बालन/ A. Balan)
सदस्य सचिव /Member Secretary

	List of members of TCC	
1	Chairman,TCC/ Managing Director I/c.GETCO,Vadodara.	0265-2338152
2	Chief Engineer (GM), CEA, New Delhi.	011-26109750
3	Executive Director (Comml.), CSPDCL, Raipur	0771-2574442
4	Executive Director(O&M:Gen), CSPGCL, Raipur	0771-2574425
5	Executive Director(Gen.), GSECL, Vadodara	0265- 2344537
6	Superintending Engineer (R & C), GETCO, Vadodara.	0265-2353086 / 2337918
7	Addl. C.E.(R&C),Paschim Gujarat Vij.Co.Ltd,Rajkot, Gujarat	0281-2380428
8	Executive Director (O&M-Gen), MPPGCL, Jabalpur.	0761-2664572
9	CGM (Coml.)M.P.Poorv Kshetra Vidyut Vitaran Co.Ltd,Jabalpur.	0761-2660182
10	Director (Operation), MSETCL,Mumbai	022-26590383, 26591254
11	Director (Operation), MSPGCL, Mumbai.	26478852
12	Director (Operation), MSEDCL, Mumbai.	26581465
13	Executive Engineer, DD, Nani Daman	0260-2250889
14	Executive Engineer, DNH, Silvassa	0260-2642338
15	Executive Director, POSOCO, WRLDC, Mumbai.	28202630
16	Regional ED, NTPC Ltd., WRHQ-I, Mumbai.	28259364
17	Regional ED, NTPC Ltd., WRHQ-II, Raipur	0771- 2544550 / 2544513
18	Associated Director (Trans), NPCIL, Mumbai.	25993664
19	Executive Director, WRTS-I, PGCIL, Nagpur.	0712-2641471
20	Executive Director, WRTS-II, PGCIL, Vadodara.	0265-2488564
21	Head, Tata Power Company Ltd, Chembur, Mumbai	67175385
22	General Manager (Power), RGPPL, Ratnagiri	02359-241071
23	Chief Engineer(Elect.), NHDC, Bhopal, M.P.	0755-4030130
24	Executive Director (O&M), Torrent Power, Surat	02621-661151
25	Sr.VP(OTS) / AGM(BD), Adani P0wer Ltd., Ahmedabad	079-25557176
26	Director(O&M)LANCO Amarkantak Power Pvt.Ltd,Korba,C.G	07759-279970
27	G.M. NTPC Vidyut Vyapar Nigam Ltd,New Delhi.	
28	Vice President (EHV),Torrent Power Ltd, Ahmedabad.	079-26764159
29	Director (Technical), JSW Energy Ltd., Bandra(E),Mumbai	022-42863000
30	President, Jindal Power Ltd., Chhattisgarh.	07767-281995.
31	Sr.Vice President (O),RattanIndia Power Ltd,Gurgaon	0124-6695868
32	Chief (O&M),Coastal Gujarat Power Ltd,Kutch. &	02838-661181
	Dy,CEO,Coastal Gujarat Power Ltd., Kutch.	
33	General Manager, Jaypee Nigrie STPP,Sigrauli,MP	
34	Project Head, D.B.Power Ltd, Raigarrh, Chhattisgarh.	
35	Project Head, Adani Power Maharashtra Ltd, Tiroda,Gondia	
36	Project Head, KSK Mahanadi Power Co.Ltd.,Bilaspur, C.G.	
37	GM-Business Development, MB Power (M.P.)Ltd,New Delhi.	
38	Project Head,Sasan UMPP,Sasan Power Ltd,Waidhan,M.P	
39	Member Secretary, NPC, New Delhi	011-26868528, 26865206
	SPECIAL INVITEE	
1	COO, KWPCL, Raigarh, Chhattisgarh.	
2	President, SKS Energy Ltd., Raigarh.	
3	CGM, R K M Powergen Pvt Ltd	
4	VP(O&M), GCEL, Chhattishgarh	
5	Station Head Jhabua Power Seoni MP	
6	Station Head ACBIL Korba	
7	Station Head TRN Energy Raigarh	
8	Station Head Torrent Power Ahmedabad	
9	Station Head Gujarat Industries Power Co.Ltd	
10	Station Head Gujarat Paguthan Energy Corporation Pvt.Ltd.	
11	Station Head EMCO Energy GMR CHHATTISHGARH	
12	ALL Other WR Generators	

Minutes of Special TCC Meeting of WRPC held on 28.09.2017 at WRPC, Mumbai

A Special TCC meeting of WRPC was held on 28.09.2017 at WRPC, Mumbai to discuss a single point agenda for revised plan for Installation of FGD in generating units to comply with new MOEF norms of SOX emissions. The list of the participants is enclosed at **Annexure- I.**

Member Secretary, WRPC welcomed Chairman, TCC, and Chief Engineer, CEA and other participants of the Special TCC meeting called at a very short notice to discuss the agenda for revising the plan of Installation of FGD in generating units to comply with new MOEF norms of SO_X emissions.

Dr. L. D. Papney, Chief Engineer, CEA informed briefly about the meeting between Secretary (MoP), Secretary (MoEF) and others held on 01/09/2017. He informed about the decisions/ directives given in the meeting. The decisions taken during the aforesaid meeting are as follows:

- The action plan submitted by MoP (Ministry of Power) for seven years i.e. up to 2024 should commence from 2018 and implemented before 2022 with respect to all pollutants. The revised action plan shall be submitted within 45 days. The action should also indicate timeline for installation of FGDs.

- The aforesaid revised plan should take into account the possible environmental and health impact considering location of TPPs and distance from habitation for the purpose of prioritization of installation of necessary equipment.

- As suggested by MoP, the applicability of emission limit of 300 mg/Nm3 for NOx shall be reviewed by a sub-group chaired by Chairman, CPCB and comprising representatives from CPCB, MoP/CEA, NTPC and MoEF & CC. The group shall also suggest way out for disposal of Gypsum and Calcium sulphate also.

Thereafter Member Secretary, WRPC took up the agenda items.

Item no. 1: Thermal Power plants without FGD where emission of SO_x and SPM is within the limit prescribed as per new revised norms.

Preparation and finalization of list of Thermal Power Plants without FGD where the emission of SOx and SPM is within the limit prescribed in new revised norms given at **Annexure- II**. In all such cases, the compliance certificate from State Pollution Control Board is required to be submitted.

Discussion: Member Secretary, WRPC informed that following 3 Generators have submitted compliance report from State pollution control boards.

1. NSPCL Bhilai (2x250 MW JV of NTPC and SAIL)
2. TRN Energy (2x300 MW IPP)
3. Jaypee Bina (2x270 MW IPP)

There was discussion on the compliance report issued by State pollution control boards to some of the generating units which are not having FGD installed. Chief Engineer, CEA raised the concern about the consistency in emission parameters in future considering level of sulphur content in Indian coal. Representative from NTPC told that it was not possible to consistently comply under present Indian Coal quality and they have decided to install FGD at their 2x250 MW NSPCL TPP, Bhilai, tendering work for the same has been done and FGD will be commissioned by December 2022. Chairman, TCC/ CEA suggested the generators, who have submitted compliance certificates, to submit detailed calculation procedure (by 10th October 2017) to establish that SO2 level in the flue gas is within the norms considering coal consumption & level of sulphur in coal.

The Special TCC participants noted as above.

Item no. 2: Thermal Power plants where emission of SO_x and SPM is not within the limit prescribed as per new revised norms but the same can be reduced to the limit by installing FGD

In this category of Thermal Power Plants, the emission level is not within the limit but space for FGD installation is available and therefore after the usage of FGD, the emission can be brought within the limit given in new norms. Under this item, list of Thermal Power Plants along with the time line for FGD installation is to be finalized.

Discussion:

The list of generating units where FGD has to be installed, was discussed in detail. The updated list of generating units which have been finalised for FGD installation in consultation with generators in TCC forum is enclosed at **Annexure–III**.

The Special TCC participants noted as above.

Item no. 3: Phasing out Plan for Thermal units where FGD can not be installed.

Under this item, list of those Thermal units are required to be prepared wherein emission level is more than the limit of new norms and also there is a space constraints for FGD installation. Under this item, list of Thermal Power Plants along with the time line for phasing out is to be finalized.

Discussion:

There are no thermal generating units under this category in Western Region. Representative from Mahagenco informed that Bhusawal Unit#2 (210 MW) has been retired since 1.04.2017.

The Special TCC participants noted as above.

Item no. 4: Record of Discussions held on 21.9.2017 by Principal Chief Engineer, CEA with some of generators in WR on revised schedule for FGD related matters. (Copy enclosed at **Annexure-II**).

The Special TCC participants noted as above.

The meeting ended with thanks to the Chairman.

****

ANNEXURE-A

ATTENDANCE SHEET

SPECIAL TCC MEETING

ON 28.09.2017 AT WRPC MUMBAI

Sl.No	Name	Design/ Organization	MOBILE Number	Email address	Signature
1.	S K SAHOO	CHIEF MGR (CO) CGPL, MUNDRA	9099006553	sushanta.sahoo @tatapower.com	
2.	Ratnesh Kumar Yadav	Asst. Director-I WRPC	9969948089	Rateshkumar7487@gmail.com	
3.	D.N. Gawali	E.E (WRPC)	9930666765	Comml-wrpc@nic.in	
4.	S.K. Chaudhary	AM (Env.)	9978408634	aips@gmdcltd.com	
5.	Sanjay Jadhav	Dy. GM (Power Sale) DB Power	9769190360	sanjay.jadhav @dbpower.in	
6.	B.A. Gandhi	Ex Engineer (Retd) GSECL, Vadodara	9925210270	bagandhi007 @gmail.com.	
7.	A.B. Jaiswal	E.E. (Environment) GSECL, CO, Vadodara	9978935825	envcell@gebmail.com abjaiswal67@gmail.com	
8.	B.H. Tannarana	DM (CTS) GIPCL-SLPP	9662521511	btannarana@gipcl.com mksingh@gipcl.com csjadeja@gipcl.com	
9.	L.K.S Rathore	DD, WRPC	9833371844	rlesr_ies@nic.in	
10.	P.D. Lone	"	9867628823	pramod.lone @gmail.com	
11.	J.K. Rathod	"	9987910799	Jkrathod77 @gmail.com	
12.	K.K. SHARMA	Dy. Dir., CEA	9968248148	KK10262@gmail.com	

Sl.No	Name	Design/ Organization	MOBILE Number	Email address	Signature
13.	Dr. L.D. Papney	CE, CEA	9968308829	ldpapneyegmail.com	[signature]
14.	A. Murthy	GM, Sasan power	9324574491	Murthi.Thandavaram@relianceada.com	[signature]
15.	N.P. JOSHI	GM (GENERATION)	9227253445	nitinjoshi@torrentpower.com	[signature]
16.	Viral Mehta	V.P	9099006660	viralmehta@torrentpower.com	[signature]
17.	M.K. JAIN	AGM, NTPC	9004497017	ntpccomml@gmail.com	[signature]
18.	ANIL NAUTIYAL	GM	9004497012	anilnautiyal@ntpc.co.in	[signature]
19.	S.K. Takhele	AGM(OS) NTPC-Mumbai	9004472114	sktakhele@ntpc.co.in	[signature]
20.	H HARCHANDANI	AGM (Comml) NTPC-WR2	9109917825	hharchandani@ntpc.co.in	[signature]
21.	E.S. Moze	SE (WORKS) Mahagenco	8879770737	esmoze@gmail.com	[signature]
22.	S. R. Chaudhary	AVP-Project. APL Ahmedabad	9687660383	shivratan.chaudhary@adani.com	[signature]
23.	R.C. Hiwale	Supt. Engr. MAHAGENCO	8879770694	rajendra.hiwale@mahagenco.co.in	[signature]
24.	S.G Chopde	Supdtg Engr MAHAGENCO	8879690198	segppbtg@mahagenco.in	[signature]
25.	P. M. Nikhare	CE, Mahagenco.	8411958587	cegro@mahagenco.in	[signature]
26.	D K Rokade	SE(OP) MSLDC MSETCL Kalwa	9167831551	dkrokade@gmail.com	[signature]

Sl.No	Name	Design/ Organization	MOBILE Number	Email address	Signature
27.	Pushpa. S	Asst. Chief WRLDC	9869404482	pushpa@posoco.in	
28.	Sachala Mishra	Asst. GM WRLDC	9869450223	sachalamishra@posoco.in	
29.	V. K. Srivastava	ED WRLDC		VKS@POSOCO.IN	
30.	Abhimanyu Garg	GM WRLDC	9869088058	agarg@posoco.in	
31.	RAMNIWASH SARDA	G.M, Jindal Power Ltd	9329445032	ramniwas@jindalpower.com	
32.	DIVESH GOYAL	AGM, Jindal PPEL Power Ltd	7471118003	goyaldevesh@ppelpc.com	
33.	A. Balan	MS/ WRPC	9483540528	ms-wrpc@nic.in	
34.	Absar Ahmed	Engr/ WRLDC			
35.					
36.					
37.					
38.					
39.					
40.					

ANNEXURE - II

Sr. No.	Developer	Name of Project	Sector	State	Unit No	Total Capacity	DT-of COMMISSIONING	Age in years	Whether CT (Y/N)	Whether FGD Installed	Whether CFBC	Present SPM Norms	Revised SPM Norms	Present SPM Level	Whether ESP retrofit required	Whether ESP upgrade space Available (Y/N)	Whether ESP upgrade planned (Y/N)	Whether FGD space available (Y/N)	Whether FGD planned (Y/N)	Year of Completion/Ongoing of LE Works	Phasing Plan for Implementation	Revised Phasing Plan for Implementation	Phase out plan	Revised Phase out plan	Comments of GM Division
1	ACB (INDIA)LTD	CHAKABURA TPP	Private Secto	Chhatisgarh	2	30	28/03/2014	3		N	Y	50	50	45	N		N	N/A	N/A						CFBC BOILER
2	ACB (INDIA)LTD	KASAIPALLI TPP	Private Secto	Chhatisgarh	1	135	13/12/2011	6	Y	N	Y	50	50	49	N	N	N	N/A	N/A						CFBC BOILER
3	ACB (INDIA)LTD	KASAIPALLI TPP	Private Secto	Chhatisgarh	2	135	21/06/2012	5	Y	N	Y	50	50	49	N	N	N	N/A	N/A						CFBC BOILER
4	ACB (INDIA)LTD	SWASTIK KORBA TPP	Private Secto	Chhatisgarh	1	25	31/03/2015	2		N	Y	NA	50	NA	Y			N/A	N/A						ESP UPGRADATION/ CFBC BOILER
5	Bharat Aluminium Co. Ltd.	BALCO TPS	Private Secto	Chhatisgarh	1	300	04/06/2015	2		N	N	NA	50	NA	Y			Y	Y		30/09/2021				FGD POSSIBLE
6	Bharat Aluminium Co. Ltd.	BALCO TPS	Private Secto	Chhatisgarh	2	300	24/03/2016	1		N	N	NA	50	NA	Y			Y	Y		30/06/2021				FGD POSSIBLE
7	CSEB	MARWA TPS	State Sector	Chhatisgarh	1	500	30/03/2014	3		N	N	50	50	NA	N	N/A	N	Y	Y		30/06/2021				FGD POSSIBLE
8	CSEB	MARWA TPS	State Sector	Chhatisgarh	2	500	15/07/2016	1		N	N	50	50	41	N	N/A	N	Y	Y		31/03/2021				FGD POSSIBLE
9	CSPGCL	DSPM TPS	State Sector	Chhatisgarh	1	250	30/03/2007	10	Y	N	N	50	50	40	N			Y	Y		30/06/2021				FGD POSSIBLE
10	CSPGCL	DSPM TPS	State Sector	Chhatisgarh	2	250	11/12/2007	10	Y	N	N	50	50	46	N			Y	Y		30/09/2021				FGD POSSIBLE
11	CSPGCL	KORBA-II	State Sector	Chhatisgarh	1	50	01/09/1966	51		N	N	150	100	277	Y	N	N	N		NA	31/03/2022				IDENTIFIED FOR RETIREMENT
12	CSPGCL	KORBA-II	State Sector	Chhatisgarh	2	50	01/05/1967	50		N	N	150	100	277	Y	N	N	N							IDENTIFIED FOR RETIREMENT
13	CSPGCL	KORBA-II	State Sector	Chhatisgarh	3	50	01/03/1968	49		N	N	150	100	277	Y	N	N	N							IDENTIFIED FOR RETIREMENT
14	CSPGCL	KORBA-II	State Sector	Chhatisgarh	4	50	01/10/1968	49		N	N	150	100	277	Y	N	N	N		NA					IDENTIFIED FOR RETIREMENT
15	CSPGCL	KORBA-III	State Sector	Chhatisgarh	1	120	22/03/1976	41		N	N	150	100	286	Y	Y		N	N	NA			31/12/2018		TO BE PHASED OUT
16	CSPGCL	KORBA-III	State Sector	Chhatisgarh	2	120	05/04/1981	36		N	N	150	100	286	Y	Y		N	N	NA			31/03/2019		TO BE PHASED OUT
17	CSPGCL	KORBA-WEST Ext. TPS	State Sector	Chhatisgarh	5	500	22/03/2013	4		N	N	50	50	48	N	N	N	Y	Y		30/09/2021				FGD POSSIBLE
18	CSPGCL	KORBA-WEST TPS	State Sector	Chhatisgarh	1	210	21/06/1983	34	N	N	N	150	100	144	Y	Y	Y	N	N				31/01/2020		TO BE PHASED OUT
19	CSPGCL	KORBA-WEST TPS	State Sector	Chhatisgarh	2	210	30/03/1983	34	N	N	N	150	100	142	Y	Y	Y	N	N				31/03/2020		TO BE PHASED OUT
20	CSPGCL	KORBA-WEST TPS	State Sector	Chhatisgarh	3	210	26/03/1985	32	N	N	N	150	100	165	Y	Y	Y	N	N				30/06/2020		TO BE PHASED OUT
21	CSPGCL	KORBA-WEST TPS	State Sector	Chhatisgarh	4	210	13/03/1986	31	N	N	N	150	100	172	Y	Y	Y	N	N				31/12/2020		TO BE PHASED OUT
22	DB Power	BARADARHA TPS	Private Secto	Chhatisgarh	1	600	23/02/2014	3		N	N	50	50	42	N			Y	Y		30/06/2021				FGD POSSIBLE
23	DB Power	BARADARHA TPS	Private Secto	Chhatisgarh	2	600	24/03/2015	2		N	N	50	50	40	N			Y	Y		30/09/2020				FGD POSSIBLE
24	GMR	RAIKHEDA TPP	Private Secto	Chhatisgarh	1	685	24/02/2015	2		N	N	50	50	NA	N			Y	Y		30/06/2020				FGD POSSIBLE
25	GMR	RAIKHEDA TPP	Private Secto	Chhatisgarh	2	685	28/03/2016	1		N	N	50	50	NA	N			Y	Y		30/09/2020				FGD POSSIBLE
26	KORBA-WEST TPS Pvt Ltd	AVANTHA BHANDAR	Private Secto	Chhatisgarh	1	600	31/03/2014	3		N	N	50	50	34	N	N	N	Y	Y		31/03/2022				FGD POSSIBLE
27	KSK Mahanadi Power Co Ltd	AKALTARA TPS	Private Secto	Chhatisgarh	1	600	13/08/2013	4	Y	N	N	50	50	31	N			Y	Y		30/06/2022				FGD POSSIBLE
28	KSK Mahanadi Power Co Ltd	AKALTARA TPS	Private Secto	Chhatisgarh	2	600	22/08/2014	3	Y	N	N	50	50	30	N			Y	Y		31/03/2022				FGD POSSIBLE
29	M/s Lanko Amarkantak Ltd,	PATHADI TPP	Private Secto	Chhatisgarh	1	300	04/06/2009	8		N	N	50	50	47	N			Y	Y		31/03/2021				FGD POSSIBLE
30	M/s Lanko Amarkantak Ltd,	PATHADI TPP	Private Secto	Chhatisgarh	2	300	25/03/2010	7		N	N	50	50	48	N			Y	Y		31/03/2021				FGD POSSIBLE
31	M/s O.P.Jindal	OP JINDAL TPS	Private Secto	Chhatisgarh	1	250	02/09/2007	10	Y	N	N	50	50	41	N	M	N	Y	Y		31/03/2022				FGD POSSIBLE
32	M/s O.P.Jindal	OP JINDAL TPS	Private Secto	Chhatisgarh	2	250	10/02/2008	9	Y	N	N	50	50	39	N	M	N	Y	Y		31/03/2022				FGD POSSIBLE
33	M/s O.P.Jindal	OP JINDAL TPS	Private Secto	Chhatisgarh	3	250	06/03/2008	9	Y	N	N	50	50	40	N	M	N	Y	Y		30/06/2022				FGD POSSIBLE
34	M/s O.P.Jindal	OP JINDAL TPS	Private Secto	Chhatisgarh	4	250	17/06/2008	9	Y	N	N	50	50	39	N	M	N	Y	Y		30/06/2022				FGD POSSIBLE
35	M/s O.P.Jindal	TAMNAR TPP	Private Secto	Chhatisgarh	1	600	10/03/2014	3	Y	N	N	50	50	38	N	M	N	Y	Y		31/03/2021				FGD POSSIBLE
36	M/s O.P.Jindal	TAMNAR TPP	Private Secto	Chhatisgarh	2	600	30/03/2014	3	Y	N	N	50	50	37	N	M	N	Y	Y		31/12/2021				FGD POSSIBLE
37	M/s O.P.Jindal	TAMNAR TPP	Private Secto	Chhatisgarh	3	600	07/01/2015	2	Y	N	N	50	50	38	N	M	N	Y	Y		31/03/2022				FGD POSSIBLE
38	M/s O.P.Jindal	TAMNAR TPP	Private Secto	Chhatisgarh	4	600	28/03/2015	2	Y	N	N	50	50	NA	N	M	N	Y	Y		30/06/2022				FGD POSSIBLE
39	Maruti Power Limited	BANDAKHAR TPP	Private Secto	Chhatisgarh	1	300	31/07/2015	2		N	N	50	50	47	N	Y	N	Y	Y		31/03/2020				FGD POSSIBLE
40	NTPC	KORBA STPS	Central Secto	Chhatisgarh	1	200	28/02/1983	34	Y	N	N	150	100	130	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
41	NTPC	KORBA STPS	Central Secto	Chhatisgarh	2	200	31/10/1983	34	Y	N	N	150	100	164	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
42	NTPC	KORBA STPS	Central Secto	Chhatisgarh	3	200	17/03/1984	33	Y	N	N	150	100	95	N	N	N	N	Y		31/12/2022				FGD POSSIBLE
43	NTPC	KORBA STPS	Central Secto	Chhatisgarh	4	500	31/05/1987	30	Y	N	N	150	100	143	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
44	NTPC	KORBA STPS	Central Secto	Chhatisgarh	5	500	25/03/1988	29	Y	N	N	150	100	141	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
45	NTPC	KORBA STPS	Central Secto	Chhatisgarh	6	500	26/02/1989	28	Y	N	N	150	100	65	N	N	N	N	Y		31/12/2022				FGD POSSIBLE
46	NTPC	KORBA STPS	Central Secto	Chhatisgarh	7	500	25/11/2010	7	Y	N	N	50	50	56	N		N	Y	Y		31/12/2022				FGD POSSIBLE
47	NTPC	SIPAT STPS	Central Secto	Chhatisgarh	4	500	20/06/2008	10	Y	N	N	50	50	45	N	N	N	Y	Y		31/12/2021				FGD POSSIBLE
48	NTPC	SIPAT STPS	Central Secto	Chhatisgarh	5	500	01/01/2009	9	Y	N	N	50	50	44	N	N	N	Y	Y		31/12/2021				FGD POSSIBLE
49	NTPC	SIPAT STPS	Central Secto	Chhatisgarh	1	660	01/10/2011	6	Y	N	N	50	50	44	N	N	N	Y	Y		31/12/2022				FGD POSSIBLE
50	NTPC	SIPAT STPS	Central Secto	Chhatisgarh	2	660	25/05/2012	6	Y	N	N	50	50	42	N	N	N	Y	Y		31/12/2022				FGD POSSIBLE
51	NTPC	SIPAT STPS	Central Secto	Chhatisgarh	3	660	01/08/2012	5	Y	N	N	50	50	43	N	N	N	Y	Y		31/12/2021				FGD POSSIBLE
52	NTPC & Sail	BHILAI TPS	Central Secto	Chhatisgarh	1	250	20/04/2008	9	Y	N	N	50	50	NA	N	Y		N	Y		31/12/2022				FGD POSSIBLE
53	NTPC & Sail	BHILAI TPS	Central Secto	Chhatisgarh	2	250	12/07/2009	8	Y	N	N	50	50	NA	N	Y		N	Y		31/12/2022				FGD POSSIBLE
54	RKM Powergen Private Ltd.	UCHPINDA TPP	Private Secto	Chhatisgarh	1	360	28/10/2015	2		N	N	50	50	43	N	Y	N	Y	Y		31/03/2022				FGD POSSIBLE
55	RKM Powergen Private Ltd.	UCHPINDA TPP	Private Secto	Chhatisgarh	3	360	28/01/2016	1		N	N	50	50	43	N	Y	N	Y	Y		31/12/2021				FGD POSSIBLE

56	S V Power Ltd	SVPL TPP	Private Secto	Chhatisgarh	1	63	07/12/2011	6		N	Y	50	50	36	N			N/A	N/A							CFBC BOILER
57	SKS Power Gen. (CG	Binjkote TPP	Private Secto	Chhatisgarh	1	300	25/04/2017	0													30/09/2020					FGD POSSIBLE
58	Spectrem Coal & Power Ltd	RATIJA TPS	Private Secto	Chhatisgarh	1	50	04/02/2013	4		N	Y	50	50	33	N			N/A	N/A							CFBC BOILER
59	Spectrem Coal & Power Ltd	RATIJA TPS	Private Secto	Chhatisgarh	2	50	10/11/2016	1		N	Y	50	50		N			N/A	N/A							CFBC BOILER
60	TRN Energy Private Ltd.	NAWAPARA TPP	Private Secto	Chhatisgarh	1	300	14/08/2016	1		N	N	50	50	NA	N			N	N							NORMS COMPLIANT
61	TRN Energy Private Ltd.	NAWAPARA TPP	Private Secto	Chhatisgarh	2	300	18/04/2017	0													30/09/2020					FGD POSSIBLE
62	Vandana Vidyut	KATGHORA TPP	Private Secto	Chhatisgarh	1	35	14/02/2012	5		N	Y	NA	50	NA	Y			N/A	N/A							ESP UPGRADATION/ CFBC BOILER
63	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	1	330	04/08/2009	8	Y	N	N	50	50	42	N	Y	Y	Y	Y		31/12/2022					FGD POSSIBLE
64	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	2	330	17/03/2010	7	Y	N	N	50	50	39	N	Y	Y	Y	Y		31/12/2022					FGD POSSIBLE
65	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	3	330	02/08/2010	7	Y	N	N	50	50	33	N		N	Y	Y		30/09/2022					FGD POSSIBLE
66	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	4	330	20/12/2010	7	Y	N	N	50	50	32	N	NR	N	Y	Y		30/09/2022					FGD POSSIBLE
67	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	5	660	26/12/2010	6	Y	N	N	50	50	43	N	NR	N	Y	Y		30/06/2022					FGD POSSIBLE
68	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	6	660	20/07/2011	6	Y	N	N	50	50	39	N	NR	N	Y	Y		31/03/2022					FGD POSSIBLE
69	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	7	660	07/11/2011	6	Y	Y	N	50	50	24	N	NR	N	N/A	N/A							FGD INSTALLED
70	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	8	660	03/03/2012	5	Y	Y	N	50	50	38	N	NR	N	N/A	N/A							FGD INSTALLED
71	Adani Power Ltd.	MUNDRA TPS	Private Secto	Gujarat	9	660	09/03/2012	5	Y	Y	N	50	50	46	N	NR	N	N/A	N/A							FGD INSTALLED
72	Bhavnagar Energy Company Ltd	Bhavnagar Lignite TPP	State Sector	Gujarat	1	250	16/05/2016	1		N	Y	50	50	NA	N			N/A	N/A							CFBC BOILER
73	Bhavnagar Energy Company Ltd	Bhavnagar Lignite TPP	State Sector	Gujarat	2	250	27/03/2017	0		N	Y															CFBC BOILER
74	Essar Gujarat	SALAYA TPP	Private Secto	Gujarat	1	600	04/01/2012	5	Y	N	N	50	50	49	N	N	N	Y	Y		30/06/2021					FGD POSSIBLE
75	Essar Gujarat	SALAYA TPP	Private Secto	Gujarat	2	600	15/06/2012	5	Y	N	N	50	50	48	N	N	N	Y	Y		31/03/2021					FGD POSSIBLE
76	GIPCL	SURAT LIG. TPS	Private Secto	Gujarat	1	125	16/01/2000	17	Y	N	Y	150	100	80	N			N/A	N/A							ESP UPGRADATION/ CFBC BOILER
77	GIPCL	SURAT LIG. TPS	Private Secto	Gujarat	2	125	06/11/1999	18	Y	N	Y	150	100	86	N			N/A	N/A							ESP UPGRADATION/ CFBC BOILER
78	GIPCL	SURAT LIG. TPS	Private Secto	Gujarat	3	125	12/04/2010	7	Y	N	Y	150	50	73	Y			N/A	N/A		30/09/2020					ESP UPGRADATION/ CFBC BOILER
79	GIPCL	SURAT LIG. TPS	Private Secto	Gujarat	4	125	23/04/2010	7	Y	N	Y	150	50	70	Y			N/A	N/A		31/12/2020					ESP UPGRADATION/ CFBC BOILER
80	GMD Corpn.	AKRIMOTA LIG TPS	State Sector	Gujarat	1	125	31/03/2005	12	Y	N	Y	100	50	80	Y	N	N	N/A	N/A		30/09/2020					ESP UPGRADATION/ CFBC BOILER
81	GMD Corpn.	AKRIMOTA LIG TPS	State Sector	Gujarat	2	125	19/12/2005	12	Y	N	Y	100	50	80	Y	N	N	N/A	N/A		31/12/2020					ESP UPGRADATION/ CFBC BOILER
82	GSECL	GANDHI NAGAR TPS	State Sector	Gujarat	1	120	13/03/1977	40		N	N	150	100	114	Y			N								IDENTIFIED FOR RETIREMENT
83	GSECL	GANDHI NAGAR TPS	State Sector	Gujarat	2	120	10/04/1977	40		N	N	150	100	102	Y			N								IDENTIFIED FOR RETIREMENT
84	GSECL	GANDHI NAGAR TPS	State Sector	Gujarat	3	210	20/03/1990	27		N	N	150	100	77	N	N	N	Y	Y		31/12/2021					PARTIAL FGD
85	GSECL	GANDHI NAGAR TPS	State Sector	Gujarat	4	210	20/07/1991	26		N	N	150	100	92	N	N	N	Y	Y		31/12/2021					PARTIAL FGD
86	GSECL	GANDHI NAGAR TPS	State Sector	Gujarat	5	210	17/03/1998	19		N	N	150	100	87	N	N	N	Y	Y		31/12/2021					PARTIAL FGD
87	GSECL	KUTCH LIG. TPS	State Sector	Gujarat	1	70	29/03/1990	27	Y	N	N	150	100	138	Y	N	N	Y	Y		31/12/2021					PARTIAL FGD
88	GSECL	KUTCH LIG. TPS	State Sector	Gujarat	2	70	25/03/1991	26	Y	N	N	150	100	127	Y	N	N	Y	Y		31/12/2021					PARTIAL FGD
89	GSECL	KUTCH LIG. TPS	State Sector	Gujarat	3	75	31/03/1997	20	Y	N	N	150	100	125	Y	N	N	Y	Y		31/12/2021					PARTIAL FGD
90	GSECL	KUTCH LIG. TPS	State Sector	Gujarat	4	75	01/10/2009	8	Y	N	Y	150	50	92	Y	N	N	N/A	N/A		31/12/2020					ESP UPGRADATION/ CFBC BOILER
91	GSECL	SIKKA REP. TPS	State Sector	Gujarat	1	120	26/03/1988	29		N	N	150	100	102	Y			N								RETIRED
92	GSECL	SIKKA REP. TPS	State Sector	Gujarat	2	120	31/03/1993	24	N	N	N	150	100	55	N			N	N				30/06/2017			RETIRED
93	GSECL	SIKKA REP. TPS	State Sector	Gujarat	3	250	29/03/2015	2	Y	N	N	50	50	26	N	N	N	Y	Y		31/01/2022					FGD POSSIBLE
94	GSECL	SIKKA REP. TPS	State Sector	Gujarat	4	250	25/09/2015	2	Y	N	N	50	50	43	N	N	N	Y	Y		31/01/2022					FGD POSSIBLE
95	GSECL	UKAI TPS	State Sector	Gujarat	1	120	28/03/1976	41		N	N	150	100	128	Y			N		2008						RETIRED
96	GSECL	UKAI TPS	State Sector	Gujarat	2	120	23/06/1976	41		N	N	150	100	90	N			N		2010						RETIRED
97	GSECL	UKAI TPS	State Sector	Gujarat	3	200	21/01/1979	38	N	N	N	150	100	115	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
98	GSECL	UKAI TPS	State Sector	Gujarat	4	200	28/03/1979	38	N	N	N	150	100	158	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
99	GSECL	UKAI TPS	State Sector	Gujarat	5	210	30/01/1985	32	N	N	N	150	100	146	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
100	GSECL	UKAI TPS	State Sector	Gujarat	6	500	05/03/2013	4	Y	N	N	50	50	65	Y	N	N	Y	Y		31/03/2022					FGD POSSIBLE
101	GSECL	WANAKBORI TPS	State Sector	Gujarat	1	210	23/03/1982	35	Y	N	N	100	100	190	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
102	GSECL	WANAKBORI TPS	State Sector	Gujarat	2	210	15/01/1983	34	Y	N	N	100	100	160	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
103	GSECL	WANAKBORI TPS	State Sector	Gujarat	3	210	15/03/1984	33	Y	N	N	100	100	182	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
104	GSECL	WANAKBORI TPS	State Sector	Gujarat	4	210	09/03/1986	31	Y	N	N	100	100	154	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
105	GSECL	WANAKBORI TPS	State Sector	Gujarat	5	210	23/09/1986	31	Y	N	N	100	100	136	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
106	GSECL	WANAKBORI TPS	State Sector	Gujarat	6	210	18/11/1987	30	Y	N	N	100	100	169	Y	Y	Y	Y	Y		31/12/2021					PARTIAL FGD
107	GSECL	WANAKBORI TPS	State Sector	Gujarat	7	210	31/12/1998	18	Y	N	N	100	100	123	Y	N	N	Y	Y		31/12/2021					PARTIAL FGD
108	Tata Power (CGPL)	MUNDRA UMTPP	Private Secto	Gujarat	1	800	07/03/2012	5		N	N	50	50	41	N	N	N	Y	Y		30/06/2020					FGD POSSIBLE
109	Tata Power (CGPL)	MUNDRA UMTPP	Private Secto	Gujarat	2	800	30/07/2012	5		N	N	50	50	38	N	N	N	Y	Y		31/03/2021					FGD POSSIBLE
110	Tata Power (CGPL)	MUNDRA UMTPP	Private Secto	Gujarat	3	800	27/10/2012	5		N	N	50	50	40	N	N	N	Y	Y		30/06/2021					FGD POSSIBLE
111	Tata Power (CGPL)	MUNDRA UMTPP	Private Secto	Gujarat	4	800	21/01/2013	4		N	N	50	50	43	N	N	N	Y	Y		31/03/2022					FGD POSSIBLE
112	Tata Power (CGPL)	MUNDRA UMTPP	Private Secto	Gujarat	5	800	22/03/2013	4		N	N	50	50	39	N	N	N	Y	Y		31/03/2022					FGD POSSIBLE
113	Torrent Power Generation Ltd,.	SABARMATI	Private Secto	Gujarat	1	120	12/10/1978	39		N	N	100	100	57	N		N	Y	Y		31/12/2022					PARTIAL FGD
114	Torrent Power Generation Ltd,.	SABARMATI	Private Secto	Gujarat	2	121	31/12/1984	32		N	N	100	100	58	N		N	Y	Y		31/12/2022					PARTIAL FGD
115	Torrent Power Generation Ltd,.	SABARMATI	Private Secto	Gujarat	3	121	28/09/1988	29		N	N	100	100	67	N		N	Y	Y		31/12/2022					PARTIAL FGD
116	Torrent Power Generation Ltd,.	SABARMATI	Private Secto	Gujarat	15	30	25/02/1962	55		N	N	100	100	67	N		N	N	N				31/12/2017			TO BE PHASED OUT

117	Torrent Power Generation Ltd,.	SABARMATI	Private Secto	Gujarat	16	30	19/05/1963	54		N	N	100	100	67	N		N	N	N				31/12/2017		TO BE PHASED OUT
118	BLA Pvt Limited	NIWARI TPP	Private Secto	Madhya Pradesh	1	45	10/12/2013	4		N	N	50	50	50	N			N	N						NORMS COMPLIANT
119	BPSCL	BINA TPS	Private Secto	Madhya Pradesh	1	250	12/08/2012	5		N	N	50	50	48	N		N	N	N						NORMS COMPLIANT
120	BPSCL	BINA TPS	Private Secto	Madhya Pradesh	2	250	31/03/2013	4		N	N	50	50	49	N		N	N	N						NORMS COMPLIANT
121	ESSAR power	MAHAN TPP	Private Secto	Madhya Pradesh	1	600	24/02/2013	4		N	N	50	50	NA	N			Y	Y		31/12/2020				FGD POSSIBLE
122	Jaipraksh Power Venture Ltd	NIGRI TPP	Private Secto	Madhya Pradesh	1	660	29/08/2014	3		N	N	50	50	35	N		N	Y	Y		30/06/2020				FGD POSSIBLE
123	Jaipraksh Power Venture Ltd	NIGRI TPP	Private Secto	Madhya Pradesh	2	660	27/02/2015	2		N	N	50	50	40	N		N	Y	Y		30/09/2020				FGD POSSIBLE
124	Jhabua Power Ltd.	SEIONI TPP	Private Secto	Madhya Pradesh	1	600	22/03/2016	1		N	N	50	50	NA	N			Y	Y		31/03/2020				FGD POSSIBLE
125	MB Power	ANUPPUR TPP	Private Secto	Madhya Pradesh	1	600	20/04/2015	2		N	N	50	50	NA	N			Y	Y		31/03/2022				FGD POSSIBLE
126	MB Power	ANUPPUR TPP	Private Secto	Madhya Pradesh	2	600	30/03/2016	1		N	N	50	50	NA	N			Y	Y		30/06/2022				FGD POSSIBLE
127	MPPGCL	AMARKANTAK EXT TPS	State Sector	Madhya Pradesh	5	210	15/06/2008	9	Y	N	N	50	50	90	Y	N	N	Y	Y		31/03/2021				PARTIAL FGD
128	MPPGCL	SANJAY GANDHI TPS	State Sector	Madhya Pradesh	1	210	26/03/1993	24	N	N	N	150	100	159	Y			Y	Y		31/03/2021				PARTIAL FGD
129	MPPGCL	SANJAY GANDHI TPS	State Sector	Madhya Pradesh	2	210	27/03/1993	24	N	N	N	150	100	146	Y			Y	Y		31/03/2021				PARTIAL FGD
130	MPPGCL	SANJAY GANDHI TPS	State Sector	Madhya Pradesh	3	210	28/02/1999	18	N	N	N	150	100	270	Y			Y	Y		30/06/2021				FGD POSSIBLE
131	MPPGCL	SANJAY GANDHI TPS	State Sector	Madhya Pradesh	4	210	23/11/1999	18	N	N	N	150	100	138	Y			Y	Y		30/06/2021				FGD POSSIBLE
132	MPPGCL	SANJAY GANDHI TPS	State Sector	Madhya Pradesh	5	500	18/06/2007	10	N	N	N	50	50	116	Y	N	N	Y	Y		31/03/2021				FGD POSSIBLE
133	MPPGCL	SATPURA TPS	State Sector	Madhya Pradesh	6	200	27/06/1979	38		N	N	50	100	140	Y			N							IDENTIFIED FOR RETIREMENT
134	MPPGCL	SATPURA TPS	State Sector	Madhya Pradesh	7	210	20/09/1980	37		N	N	50	100	150	Y			N							IDENTIFIED FOR RETIREMENT
135	MPPGCL	SATPURA TPS	State Sector	Madhya Pradesh	8	210	25/01/1983	34		N	N	50	100	143	Y			N							IDENTIFIED FOR RETIREMENT
136	MPPGCL	SATPURA TPS	State Sector	Madhya Pradesh	9	210	27/02/1984	33		N	N	50	100	150	Y			N							IDENTIFIED FOR RETIREMENT
137	MPPGCL	SATPURA TPS	State Sector	Madhya Pradesh	10	250	22/03/2013	4	Y	N	N	50	50	92	Y	N	N	Y	Y		31/03/2021				FGD POSSIBLE
138	MPPGCL	SATPURA TPS	State Sector	Madhya Pradesh	11	250	25/12/2013	3	Y	N	N	50	50	89	Y	N	N	Y	Y		31/03/2021				FGD POSSIBLE
139	MPPGCL	SHRI SINGHAJI TPP	State Sector	Madhya Pradesh	1	600	18/11/2013	4	Y	N	N	50	50	45	N	N	N	Y	Y		31/03/2021				FGD POSSIBLE
140	MPPGCL	SHRI SINGHAJI TPP	State Sector	Madhya Pradesh	2	600	15/10/2014	3	Y	N	N	50	50	45	N	N	N	Y	Y		31/03/2021				FGD POSSIBLE
141	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	1	210	10/10/1987	30	Y	N	N	150	100	138	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
142	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	2	210	23/07/1988	29	Y	N	N	150	100	140	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
143	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	3	210	03/02/1989	28	Y	N	N	150	100	138	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
144	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	4	210	26/12/1989	28	Y	N	N	150	100	138	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
145	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	5	210	31/03/1990	27	Y	N	N	150	100	137	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
146	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	6	210	01/02/1991	26	Y	N	N	150	100	139	Y	N	N	N	Y		31/12/2022				FGD POSSIBLE
147	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	7	500	03/03/1999	18	Y	N	N	100	100	88	N	N	N	N	Y		30/06/2021				FGD POSSIBLE
148	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	8	500	26/02/2000	17	Y	N	N	100	100	92	N	N	N	N	Y		30/06/2021				FGD POSSIBLE
149	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	9	500	27/07/2006	10.92	Y	N	N	100	50	90	Y	N	N	Y	Y		30/09/2021				FGD POSSIBLE
150	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	10	500	08/03/2007	10.30	Y	N	N	100	50	88	Y	N	N	Y	Y		30/09/2021				FGD POSSIBLE
151	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	11	500	14/06/2012	5.03	Y	N	N	50	50	47	N	N	N	Y	Y		31/12/2021				FGD POSSIBLE
152	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	12	500	22/03/2013	4.26	Y	N	N	50	50	48	N	N	N	Y	Y		31/12/2021				FGD POSSIBLE
153	NTPC	VINDHYACHAL STPS	Central Secto	Madhya Pradesh	13	500	06/08/2015	1.88	Y	Y	N	50	50	49	N	N	N	N/A	N/A						FGD INSTALLED
154	Reliance Power Ltd	SASAN UMTPP	Private Secto	Madhya Pradesh	1	660	30/05/2013	4		N	N	50	50	21	N			Y	Y		30/09/2021				FGD POSSIBLE
155	Reliance Power Ltd	SASAN UMTPP	Private Secto	Madhya Pradesh	2	660	18/12/2013	4		N	N	50	50	35	N			Y	Y		30/06/2021				FGD POSSIBLE
156	Reliance Power Ltd	SASAN UMTPP	Private Secto	Madhya Pradesh	3	660	21/05/2014	3		N	N	50	50	30	N			Y	Y		31/03/2022				FGD POSSIBLE
157	Reliance Power Ltd	SASAN UMTPP	Private Secto	Madhya Pradesh	4	660	25/03/2014	3		N	N	50	50	25	N			Y	Y		31/03/2022				FGD POSSIBLE
158	Reliance Power Ltd	SASAN UMTPP	Private Secto	Madhya Pradesh	5	660	24/08/2014	3		N	N	50	50	NA	N			Y	Y		31/12/2021				FGD POSSIBLE
159	Reliance Power Ltd	SASAN UMTPP	Private Secto	Madhya Pradesh	6	660	19/03/2015	2		N	N	50	50	NA	N			Y	Y		30/09/2021				FGD POSSIBLE
160	Abhijeetb MADC Nagpur Enery P L	MIHAN TPS	Private Secto	Maharashtra	1	246	09/02/2012	5		N	Y	50	50	NA	N	Y		N/A	N/A						CFBC BOILER
161	Adani Power Maharashtra Ltd	TIRORA TPS	Private Secto	Maharashtra	1	660	11/09/2012	5	Y	N	N	50	50	33	N	NR	N	Y	Y		31/03/2022				FGD POSSIBLE
162	Adani Power Maharashtra Ltd	TIRORA TPS	Private Secto	Maharashtra	2	660	25/03/2013	4	Y	N	N	50	50	47	N	NR	N	Y	Y		31/03/2021				FGD POSSIBLE
163	Adani Power Maharashtra Ltd	TIRORA TPS	Private Secto	Maharashtra	3	660	10/06/2013	4	Y	N	N	50	50	29	N	NR	N	Y	Y		31/03/2021				FGD POSSIBLE
164	Adani Power Maharashtra Ltd	TIRORA TPS	Private Secto	Maharashtra	4	660	23/03/2014	3	Y	N	N	50	50	23	N	NR	N	Y	Y		31/03/2021				FGD POSSIBLE
165	Adani Power Maharashtra Ltd	TIRORA TPS	Private Secto	Maharashtra	5	660	25/09/2014	3	Y	N	N	50	50	31	N	NR	N	Y	Y		31/03/2021				FGD POSSIBLE
166	BSES Pvt.	DAHANU TPS	Private Secto	Maharashtra	1	250	06/01/1995	22	N	Y	N	150	100	49	N		N	N/A	N/A						FGD INSTALLED
167	BSES Pvt.	DAHANU TPS	Private Secto	Maharashtra	2	250	29/03/1995	22	N	Y	N	150	100	48	N		N	N/A	N/A						FGD INSTALLED
168	Dhariwal Infrastructure	DHARIWAL TPP	Private Secto	Maharashtra	1	300	03/11/2013	4	Y	N	N	50	50	23	N		N	Y	Y		31/03/2022				FGD POSSIBLE
169	Dhariwal Infrastructure	DHARIWAL TPP	Private Secto	Maharashtra	2	300	28/05/2014	3	Y	N	N	50	50	40	N		N	Y	Y		31/03/2022				FGD POSSIBLE
170	GMR emco ENERGY ltd	EMCO WARORA TPS	Private Secto	Maharashtra	1	300	07/02/2013	4	Y	N	N	50	50	38	N	Y	N	Y	Y		31/03/2022				FGD POSSIBLE
171	GMR emco ENERGY ltd	EMCO WARORA TPS	Private Secto	Maharashtra	2	300	27/08/2013	4	Y	N	N	50	50	40	N	Y	N	Y	Y		31/03/2022				FGD POSSIBLE
172	Gupta Energy P L	GEPL TPP Ph-I	Private Secto	Maharashtra	1	60	28/04/2012	5		N	N	100	50	50	Y	N	N	N	N				31/03/2018		TO BE PHASED OUT
173	Gupta Energy P L	GEPL TPP Ph-I	Private Secto	Maharashtra	2	60	08/09/2012	5		N	N	100	50	50	Y	N	N	N	N				31/03/2018		TO BE PHASED OUT
174	Ideal Energy Projects Ltd.	BELA TPS	Private Secto	Maharashtra	1	270	20/03/2013	4	Y	N	N	100	50	NA	Y	Y	N	Y	N						NORMS COMPLIANT
175	JSW Energy(Ratnagiri)	JSW RATNAGIRI TPP	Private Secto	Maharashtra	1	300	24/08/2010	7	Y	Y	N	50	50	40	N			N/A	N/A						FGD INSTALLED

176	JSW Energy(Ratnagiri)	JSW RATNAGIRI TPP	Private Secto	Maharashtra	2	300	09/12/2010	7	Y	Y	N	50	50	40	N			N/A	N/A						FGD INSTALLED
177	JSW Energy(Ratnagiri)	JSW RATNAGIRI TPP	Private Secto	Maharashtra	3	300	06/05/2011	6	Y	Y	N	50	50	40	N			N/A	N/A						FGD INSTALLED
178	JSW Energy(Ratnagiri)	JSW RATNAGIRI TPP	Private Secto	Maharashtra	4	300	08/10/2011	6	Y	Y	N	50	50	40	N			N/A	N/A						FGD INSTALLED
179	MAHAGENCO	BHUSAWAL TPS	State Sector	Maharashtra	2	210	30/08/1979	38	Y	N	N	100	100	149	Y	N	N	Y	Y		31/03/2021	01/04/2017			RETIRED
180	MAHAGENCO	BHUSAWAL TPS	State Sector	Maharashtra	3	210	18/09/1982	35	Y	N	N	100	100	96	N	N	N	Y	Y		31/03/2021				PARTIAL FGD
181	MAHAGENCO	BHUSAWAL TPS	State Sector	Maharashtra	4	500	07/03/2012	5	Y	N	N	100	50	61	Y	N/A	N	Y	Y		31/03/2021				PARTIAL FGD
182	MAHAGENCO	BHUSAWAL TPS	State Sector	Maharashtra	5	500	30/03/2012	5	Y	N	N	100	50	54	Y	N/A	N	Y	Y		31/03/2021				PARTIAL FGD
183	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	1	210	15/08/1983	34		N	N	100	100	NA	N	N	N	N	N						IDENTIFIED FOR RETIREMENT
184	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	2	210	11/07/1984	33		N	N	100	100	618	Y	N	N	N	N						IDENTIFIED FOR RETIREMENT
185	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	3	210	03/05/1985	32	Y	N	N	100	100	107	N	N	N	Y	Y		31/03/2021				FGD POSSIBLE
186	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	4	210	08/03/1986	31	Y	N	N	100	100	99	N	N	N	Y	Y		31/03/2021				FGD POSSIBLE
187	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	5	500	22/03/1991	26	Y	N	N	100	100	100	N	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
188	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	6	500	11/03/1992	25	Y	N	N	100	100	101	N	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
189	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	7	500	01/10/1997	20	Y	N	N	100	100	103	N	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
190	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	8	500	29/03/2015	2	Y	N	N	50	50	74	Y	N/A	N	Y	Y		31/03/2021				FGD POSSIBLE
191	MAHAGENCO	CHANDRAPUR STPS	State Sector	Maharashtra	9	500	21/03/2016	1	Y	N	N	50	50	NA	N	N/A	N	Y	Y		31/03/2020				FGD POSSIBLE
192	MAHAGENCO	KHAPARKHEDA TPS	State Sector	Maharashtra	1	210	26/03/1989	28	Y	N	N	100	100	171	Y	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
193	MAHAGENCO	KHAPARKHEDA TPS	State Sector	Maharashtra	2	210	08/01/1990	27	Y	N	N	100	100	169	Y	N	N	Y	Y		31/03/2021				FGD POSSIBLE
194	MAHAGENCO	KHAPARKHEDA TPS	State Sector	Maharashtra	3	210	31/05/2000	17	Y	N	N	100	100	123	Y	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
195	MAHAGENCO	KHAPARKHEDA TPS	State Sector	Maharashtra	4	210	07/01/2001	16	Y	N	N	100	100	100	N	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
196	MAHAGENCO	KHAPARKHEDA TPS	State Sector	Maharashtra	5	500	05/08/2011	6	Y	N	N	50	50	47	N	Y	N	Y	Y		31/03/2021				FGD POSSIBLE
197	MAHAGENCO	KORADI TPS	State Sector	Maharashtra	5	200	15/07/1978	39		N	N	100	100	452	Y	N	N	N	N						IDENTIFIED FOR RETIREMENT
198	MAHAGENCO	KORADI TPS	State Sector	Maharashtra	6	210	30/03/1982	35	Y	N	N	100	100	NA	N	Y	Y	Y	Y	OG	31/03/2021				PARTIAL FGD
199	MAHAGENCO	KORADI TPS	State Sector	Maharashtra	7	210	13/01/1983	34	Y	N	N	100	100	182	Y	N	N	Y	Y		31/03/2021				PARTIAL FGD
200	MAHAGENCO	KORADI TPS	State Sector	Maharashtra	8	660	30/03/2015	2	Y	N	N	50	50	42	N	N	N/A	Y	Y		31/03/2021				FGD POSSIBLE
201	MAHAGENCO	KORADI TPS	State Sector	Maharashtra	9	660	15/03/2016	1	Y	N	N	50	50	NA	N	N	N/A	Y	Y		31/03/2021				FGD POSSIBLE
202	MAHAGENCO	KORADI TPS	State Sector	Maharashtra	10	660	28/12/2016	0						<50							31/12/2020				FGD POSSIBLE
203	MAHAGENCO	NASIK TPS	State Sector	Maharashtra	3	210	26/04/1979	38	Y	N	N	100	100	81	N	M	M	Y	Y		31/03/2021				PARTIAL FGD
204	MAHAGENCO	NASIK TPS	State Sector	Maharashtra	4	210	10/07/1980	37	Y	N	N	100	100	242	Y	N	Y	Y	Y		31/03/2021				PARTIAL FGD
205	MAHAGENCO	NASIK TPS	State Sector	Maharashtra	5	210	30/01/1981	36	Y	N	N	100	100	243	Y	N	N	Y	Y		31/03/2021				PARTIAL FGD
206	MAHAGENCO	PARAS TPS	State Sector	Maharashtra	3	250	31/05/2007	10	Y	N	N	100	50	91	Y	N	N	N	N		31/03/2021				NORMS COMPLIANT
207	MAHAGENCO	PARAS TPS	State Sector	Maharashtra	4	250	27/03/2010	7	Y	N	N	100	50	85	Y	N		N	N		31/03/2021				NORMS COMPLIANT
208	MAHAGENCO	PARLI TPS	State Sector	Maharashtra	3	210	10/10/1980	37		N	N	100	100	161	Y	N	N	N	N						IDENTIFIED FOR RETIREMENT
209	MAHAGENCO	PARLI TPS	State Sector	Maharashtra	4	210	26/03/1985	32	Y	N	N	100	100	151	Y	N	N	Y	Y		31/03/2021				PARTIAL FGD
210	MAHAGENCO	PARLI TPS	State Sector	Maharashtra	5	210	31/12/1987	29	Y	N	N	100	100	100	N	N	N	Y	Y		31/03/2021				PARTIAL FGD
211	MAHAGENCO	PARLI TPS	State Sector	Maharashtra	6	250	16/02/2007	10	Y	N	N	75	50	100	Y	Y	N	Y	Y		31/03/2021				PARTIAL FGD
212	MAHAGENCO	PARLI TPS	State Sector	Maharashtra	7	250	10/02/2010	7	Y	N	N	50	50	85	Y	Y	N	Y	Y		31/03/2021				PARTIAL FGD
213	MAHAGENCO	PARLI TPS	State Sector	Maharashtra	8	250	30/03/2016	1	Y	N	N	50	50	<100	N	N/A	N	Y	Y		31/03/2021				PARTIAL FGD
214	NTPC	MOUDA TPS	Central Secto	Maharashtra	1	500	19/04/2012	5	Y	N	N	100	50	40	N		N	Y	Y		31/12/2022				FGD POSSIBLE
215	NTPC	MOUDA TPS	Central Secto	Maharashtra	2	500	29/03/2013	4	Y	N	N	100	50	<100	Y		N	Y	Y		31/12/2022				FGD POSSIBLE
216	NTPC	MOUDA TPS	Central Secto	Maharashtra	3	660	28/03/2016	1	Y	N	N	100	50	<100	Y		N	Y	Y		31/12/2022				FGD POSSIBLE
217	NTPC	MOUDA TPS	Central Secto	Maharashtra	4	660	18/03/2017	0						<100							31/12/2020				FGD POSSIBLE
218	NTPC	SOLAPUR	Central Secto	Maharashtra	1	660	07/04/2017	0													31/12/2020				FGD POSSIBLE
219	Ratan Power	AMARAVATI TPS	Private Secto	Maharashtra	1	270	25/03/2013	4	Y	N	N	50	50	22	N	N	N	Y	N						NORMS COMPLIANT
220	Ratan Power	AMARAVATI TPS	Private Secto	Maharashtra	2	270	17/02/2014	3	Y	N	N	50	50	23	N	N	N	Y	N						NORMS COMPLIANT
221	Ratan Power	AMARAVATI TPS	Private Secto	Maharashtra	3	270	29/01/2015	2	Y	N	N	50	50	24	N	N	N	Y	N						NORMS COMPLIANT
222	Ratan Power	AMARAVATI TPS	Private Secto	Maharashtra	4	270	04/03/2015	2	Y	N	N	50	50	19	N	N	N	Y	N						NORMS COMPLIANT
223	Ratan Power	AMARAVATI TPS	Private Secto	Maharashtra	5	270	12/03/2015	2	Y	N	N	50	50	32	N	N	N	Y	N						NORMS COMPLIANT
224	Ratan Power	NASIK (P) TPS	Private Secto	Maharashtra	1	270	25/02/2014	3		N	N	50	50	<50	N			Y	Y		31/03/2021				PARTIAL FGD
225	Ratan Power	NASIK (P) TPS	Private Secto	Maharashtra	2	270	15/02/2017	0		N	N	50	50	<50	N			Y	Y		31/03/2021				PARTIAL FGD
226	Ratan Power	NASIK (P) TPS	Private Secto	Maharashtra	3	270	14/04/2017	0						<50							31/12/2022				FGD POSSIBLE
227	Ratan Power	NASIK (P) TPS	Private Secto	Maharashtra	4	270	19/05/2017	0						<50							31/12/2022				FGD POSSIBLE
228	Ratan Power	NASIK (P) TPS	Private Secto	Maharashtra	5	270	30/05/2017	0						<50							31/12/2022				FGD POSSIBLE
229	TATA Power Co.	TROMBAY TPS	Private Secto	Maharashtra	5	500	25/01/1984	33		Y	N	150	100	104	Y	Y	Y	N/A	N/A		31/03/2018				FGD INSTALLED
230	TATA Power Co.	TROMBAY TPS	Private Secto	Maharashtra	8	250	26/03/2009	8		Y	N	100	50	35	N		N	N/A	N/A						FGD INSTALLED
231	Vidarbha Industries Ltd	BUTIBORI TPP	Private Secto	Maharashtra	1	300	17/08/2012	5		N	N	50	50	44	N	N/A	N/A	Y	Y		30/06/2021				FGD POSSIBLE
232	Vidarbha Industries Ltd	BUTIBORI TPP	Private Secto	Maharashtra	2	300	19/03/2013	4		N	N	50	50	43	N	N/A	N/A	Y	Y		31/03/2021				FGD POSSIBLE
233	Wardha P C P L	WARDHA WARORA TPP	Private Secto	Maharashtra	1	135	05/06/2010	7	Y	N	N	100	50	40	N		N	Y	Y		30/09/2021				FGD POSSIBLE
234	Wardha P C P L	WARDHA WARORA TPP	Private Secto	Maharashtra	2	135	10/10/2010	7	Y	N	N	100	50	38	N		N	Y	Y		30/09/2021				FGD POSSIBLE
235	Wardha P C P L	WARDHA WARORA TPP	Private Secto	Maharashtra	3	135	21/01/2011	6	Y	N	N	100	50	32	N		N	Y	Y		31/12/2021				FGD POSSIBLE
236	Wardha P C P L	WARDHA WARORA TPP	Private Secto	Maharashtra	4	135	30/04/2011	6	Y	N	N	100	50	33	N		N	Y	Y		31/12/2021				FGD POSSIBLE

79666 MW 236 UNITS

Changes finalised during TCC meeting held at WRPC on 28-09-2017

Annexure –III

Record of Discussions held on 21.9.2017 at WRPC, Mumbai by Principal Chief Engineer, CEA with some of generators on revised schedule for FGD related matters.

Discussions were held with some of Generators in WR on revised schedule prepared by CEA regarding phasing out plan and FGD installation in respect of Thermal Power plants of Western Region on 21.09.2017 at WRPC, Mumbai. The list of participants is enclosed as ***Annexure-A*.**

Principal Chief Engineer (PCE), CEA informed the Generators regarding revised dates for their power plants and clarified many queries of Generators. The PCE informed briefly about the meeting between Secretary (MoP), Secretary (MoEF) and others held on 01/09/2017. He informed about the decisions /directives given in the meeting. The decisions taken during the meeting are as follows:

- The action plan submitted by MoP (Ministry of Power) for seven years i.e. up to 2024 should commence from 2018 and implemented before 2022 with respect to all pollutants. The revised action plan shall be submitted within 45 days. The action should also indicate timeline for installation of FGDs.

- The aforesaid revised plan should take into account the possible environmental and health impact considering location of TPPs and distance from habitation for the purpose of prioritization of installation of necessary equipment.

- As suggested by MoP, the applicability of emission limit of 300 mg/Nm3 for NOx shall be reviewed by a sub-group chaired by Chairman, CPCB and comprising representatives from CPCB, MoP/CEA, NTPC and MoEF & CC. The group shall also suggest way out for disposal of Gypsum and Calcium sulphate also.

- The Thermal power plants (11-14 nos.) which are located in Ganga basin shall utilize the treated sewage from the STPs to meet their water requirement. A plan for the purpose shall be submitted within a month.

- With regard to fly ash utilization, it was decided that MoEF&CC shall issue appropriate directions in the matter covering aspects such as clay brick units in vicinity of Power Plants definition of national assets etc.

The discussion on revision of scheduled dates of installation of FGD and upgradation of ESP with the representatives from Thermal generating companies are given as below:

Some of the representatives from the generating companies wanted to know whether CEA is taking up the issue with CERC related to revision in tariff owing to the additional investment in FGD installation. He replied that CEA has already prepared the draft specifications and the final specification would be issued shortly. To a query on recovery of expenditure to be incurred on FGD installation through tariff, he told that NTPC has already received NIT/financial bids for FGD installation for their power stations. Once it is opened, the benchmark cost of FGD would be decided and intimated to CERC.

Revision in target dates of ESP up-gradation has been matched with FGD installation target dates.

After the discussions, the revised schedule for FGD installation/ESP up-gradation was conveyed to the Generators and incorporated in **Annexure-III*** of Agenda. NTPC informed that they would revert back on the revised schedule within 10 days.

****

***-** the final list as per discussion on special TCC held on 28.09.2017 is at Annexure-II.

SPS for JP Nigrie, MB Power and for High Loading of Sugen-Vapi S/C, held on 23.08.2017 at WRPC, Mumbai.

A meeting to design SPS for JP Nigrie, MB Power and High Loading of Sugen-Vapi S/C was conducted on 23.8.2017. MS, WRPC welcomed all the participants for the meeting. The List of participants of the meeting is enclosed at **Annexure**.

A. SPS of JP Nigrie and MB Power:

JP Nigrie (2x660MW) is connected to the grid through 400kV JP Nigrie-Satna D/C (Quad conductor, 161 km each). There is no other interconnection to this station. WRLDC informed that system blackout has occurred at JP Nigrie on many occasions under N-1 contingency due to sudden high loading on the parallel circuit followed by power swing and low frequency oscillation. Also very high current was observed when one circuit is out and other circuit is under A/R and the relay has detected and tripped the line for power swing. Therefore SPS was suggested to take care of N-1 contingency of JP Nigrie-Satna ckt.

MB Power (2x600MW) is connected to the grid through 400kV MB Power-Jabalpur PS D/C (Triple snowbird, 256km each). There is no other interconnection to this station.

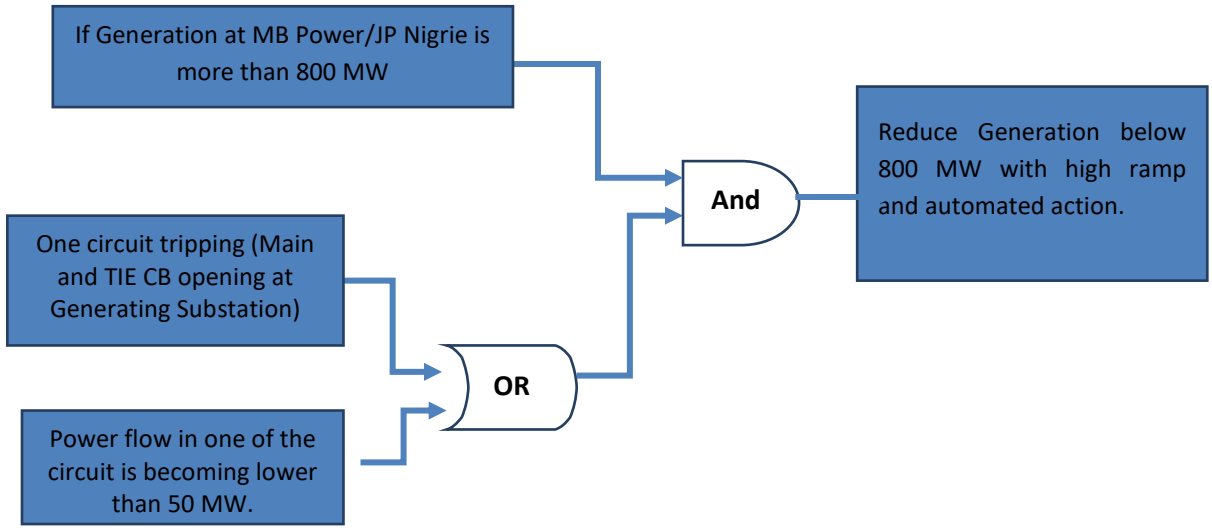
WRLDC informed that on 07/07/17, low frequency oscillations were observed at MB Power generating station under N-1 condition and the oscillation has persisted in Western Region grid for around 5 minutes. The absence of PSS and High angular separation (around 27 degree) were the two issues which has been observed at MB Power on tripping of MB Power-Jab PS one ckt. Further, in case of MB Power also there is high probability of tripping of the line in temporary fault due to power swing detection by relay. Therefore SPS was suggested to take care of N-1 contingency of MB Power-Jab PS ckt.

MB Power was requested to take the PSS into service in consultation with the OEM immediately. MB power representative informed that there were issues of ownership transfers. However they have successfully negotiated with the transferee company of the project and the OEM and by Sept. 2017 the PSS would be tuned and taken into service.

Conditions for SPS at JP Nigrie and MB Power stations:-

1. The SPS would be armed and kept in service whenever the generation at JP Nigrie and MB Power stations is more than 800 MW.
2. Triggering signal would be initiated for SPS action when both Main and Tie breaker position (at Nigrie/MB Power) of any of the line is OPEN for (Satna/Jabalapur PS lines respectively) **OR** line flow on any of the line (Nigrie- Satna /MB Power-Jabalapur PS) becomes less than 50 MW, when the generation is more than 800MW.
3. The generation to be reduced to 800 MW when one ckt is under planned shut down or as suggested by WRLDC. The SPS would be disarmed before opening the line manually. The SPS would be armed immediately after the restoration of line and the generation would be ramped up only after the SPS is armed.
4. The operators at the power station should be able to arm/disarm the SPS based on the above guidelines and the status of SPS must be clearly visible on the control panel.
5. The digital status of SPS arming/disarming signal should also be send to WRLDC.

The logic at both these generating stations which should be implemented by JP Nigrie and MB Power is as follows:



Further, it was decided during the meeting to further explore the possibility of power swing blocking for zone 1 when one line is already out and a temporary single phase fault on the other line.

This issue will be taken in the upcoming PCM in order to decide whether any configuration is available in the relay.

B. SPS for High Loading/Tripping of 400 kV Sugen-Vapi S/C

GETCO representative informed that during the last month, high loading of 400 kV Sugen-Vapi S/C of the order of 650-700MW was observed due the outage of Tarapur Unit 3 and 4, KAPS 1 & 2 and also outage of HVDC Mundra-Mahendragarh. Gujarat SLDC has suggested SPS in case of high loading above 750 MW or tripping of 400 kV Sugen-Vapi Line with generation reduction at Sugen and Load shedding at DD and DNH.

WRLDC informed that following actions in real time are taken to control Sugen-Vapi loading:-

a) Maximising HVDC Chandrapur-Padghe Bipole flow.
b) Advising MSLDC to run generation at Koyna or Ghatghar.
c) Opening of 400 kV Uno Sugen-Pirana (TPL) circuit and GPEC-Jhanor when loading is more than 700 MW which provide a relief of 30-40 MW.

After discussion, the following was decided:-

1. The above issue is temporary in nature and has aroused due to outage of entire generation at TAPS and KAPS.
2. The interim arrangement done with one ckt of 400 kV Jhanor-Navsari and one ckt of 400 kV Ukai-Kosamba to form Jhanor-Kosamba and Ukai-Navsari (Interim arrangement approved in the 36th SCM) may be restored which will relieve the loading on Sugen-Vapi and improves system reliability. The 400 kV Jhanor-Navsari D/C would be parallel path in case of tripping of 400 kV Sugen-vapi circuit and the system would be N-1 secure.
3. Further, in the 499th OCC meeting held on 22.8.17, it was informed by TAPS that their Unit 3 will be restored in Sept 2017 and unit 4 in Oct'17. This will reduce the loading of the present 400 kV Sugen –Vapi circuit to large extent.
4. In addition, in the TRM meeting of WR held on 21.8.17, PGCIL WRTS-1 informed that they will be charging the 400 kV Aurangabad(PG)-Boisar D/C in the Month of Sept'17. These circuits will attenuate the above problem as observed presently.

In view of the above it was decided that presently there is no requirement of SPS for 400 kV Sugen-Vapi circuit. Also, it was suggested that Gujarat will restore the interim arrangement of the 400 kV Jhanor-Navsari one circuit and 400 kV Ukai-Kosamba one circuit after ascertaining that the commissioning of that 400/220 kV Kosamba ICT 4 and any other issue in the down stream network of GETCO.

The meeting ended with thanks to the Chair.

xxxxxxx

Annexure-24 (1/2)

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
पश्चिम क्षेत्रीय विद्युत समिति
Western Regional Power Committee
एफ -3, एमआयडीसी क्षेत्र, अंधेरी (पूर्व), मुंबई - 400 093
F-3, MIDC Area, Andheri (East), Mumbai - 400 093
दूरभाष Phone: 022- 28221636; 28200195; 28200194 ; फैक्स Fax : 022 -28370193
Website : www.wrpc.gov.in E-mail : ms-wrpc@nic.in

आई एस ओ ः 9001 : 2008
ISO : 9001:2008

NO.WRPC/Accounts/Bud./2017-18/1289 Date: 04.10.2017

Subject:- Revised Estimate for the year 2017-18 and BE for the year 2018-19 in respect of WRPC,Mumbai.

Ref:- CEA's Budget letter No.2/1/2017-Bud(CEA)-B/734-24 dtd. 5th September,2017

With reference to the above, the proposals for RE (2017-18) and BE (2018-19) are submitted herewith. Summary of the sanctioned BE(2016-17), proposed RE (2017-18) & proposed BE (2018-19) is given below:-

1. Regional Co ordination – WRPC Secretariat:

Sanctioned BE & RE for the year 2017-18 and proposed BE for the year 2018-19 under this head is as below:- (Rs. In thousands)

Major Head of A/C 2801 Non-Plan Regional Coordination	Sanctioned BE For the year 2017-18	Revised Estimate For the year 2017-18	Budget Estimate For the year 2018-19
1. Salaries	4450	4411	5718
2. Medical Treatment	100	75	200
3. OTA	10	10	10
4. DTE	400	400	500
5. OE	600	524	554
6. R.R. & T.	50	50	50
7.Minor Works	2500	2500	2500
Total :	**8110**	**7970**	**9532**

The details are given in the enclosed **Annexures** as detailed below:-
Salary – i (RC): Actual expenditure for the period from 1-4-2017 to 30-9-2017.
Salary – ii (RC): Anticipated expenditure for the period from 1-10-2017 to 28-2-2018
Salary-Vacant post-RE-2017-18(RC):provision for vacant posts (3 months).
Salary – iii (RC): Anticipated expenditure for the year 2018-19 (BE for 2018-19).
Salary-Vacnt Posts (RC) ; provision for vacant posts (6 months).
Annexure:Estimated strength of Establishment and provision there of
Annexure-Posts (RC): No.of Posts
Annexure-DA(RC):Provision/impact of DA
Annexure-RC/OE: Details of contingent expenditure
Annexure-RC/R.R.& T : Details of contingent expenditure.
Annexure-RC/M.W. : Details of contingent expenditure.

Annexure - 24

2/2

2. LOAD DESPATCH STATIONS-OPERATION OF WRPC

Sanctioned BE & RE for the year 2017-18 and proposed BE for the year 2018-19 under this head is as below:-

(Rs. In thousands)

Major Head of A/C 2801 Non-Plan Load Despatching Stations	Sanctioned BE For the year 2017-18	Revised Estimate For the year 2017-18	Budget Estimate For the year 2018-19
1. Salaries	23950	21072	24456
2. Medical Treatment	250	200	500
3. OTA	05	5	5
4. DTE	700	700	800
5. OE	4500	4610	5862
6. Advt. & Pub.	50	50	50
Total :	**29455**	**26637**	**31673**

The details are given in the enclosed **Annexures** as detailed below:-
Salary – i (LDS): Actual expenditure for the period from 1-4-2017 to 30-9-2017.
Salary – ii (LDS): Anticipated expenditure for the period from 1-10-2017 to 28-2-2018
Salary-Vacant post-RE-2017-18(LDS):provision for vacant posts (3 months).
Salary – iii (LDS): Anticipated expenditure for the year 2018-19.
Salary-Vacnt Posts (LDS) ; provision for vacant posts (6 months)2018-19.
Annexure: Prov: Estimated strength of Establishment and provision there of.
Annexure-Posts (LDS): No.of Posts
Annexure-DA(LDS):Provision/impact of DA
Annexure-DA(LDS): Details of contingent expenditure
Annexure-LDS/OE: Details of contingent expenditure
Annexure-LDS/Advt&Pub.: Details of contingent expenditure

(A. BALAN)
Member Secretary.

Encl:- As above.

To,

The Secretary, Central Electricity Authority,Sewa Bhavan,R.K.Puram,New Delhi-66.

Copy to:-

1. The Under Secretary, Central Electricity Authority,Sewa Bhavan,R.K.Puram, New Delhi-66.
2. The Chief Engineer (GM Division) Central Electricity Authority, Sewa Bhavan, R.K.Puram,New Delhi-66.

ANNEXURE -27

Action Taken Report for MoM of 34th WRPC meeting (27-28 July, 2017)

Item no.	Details (as per 34th TCC/WRPC MoM)	Action By (as per 34th TCC/WRPC MoM)	Time Line (as per 34th TCC/WRPC MoM)	Page No. of 34th WRPC meeting MoM	Action Taken after 34th TCC/WRPC meeting	Present Status of the issue
1	Confirmation of the Minutes of 33rd Meeting of WRPC	To be noted by all	-	2	-	-
2	Error in computation of MVARh by SEM at 400/220kV Magarwada (PG) substation	WRLDC/WRPC	At the earliest	4	Revised REC account would be issued by WRPC.	Closed
3	LILO of 220 KV S/C Haldarva – Jhagadia line at NTPC Jhanor PS – regarding extending necessary support by Jhanor to GETCO	NTPC to give clearance.	By 10th August, 2017	6	• Clearance given by NTPC. • Tendering by GETCO under process.	Agenda in 35th WRPC
4	Increase in GETCO Transmission loss due to high power flow on + 500 KV Mundra-Mohindergarh Bi- Pole HVDC line	Studies to be completed by GETCO & WRLDC	by 31st August, 2017	7	• Correspondences took place among stake holders for joint study. • GETCO to give date for joint study.	Agenda in 35th WRPC
5	Status of alternate/standby	Gujarat to sign PSA.	Gujarat by	11	• PSA sighed by Gujarat	Closed

	supply arrangement by Indian Railways when source of power (RGPPL) is not available.	MP to sign PSA with Indian Railways.	At the earliest.		• Consensus for PSA between MP and IR but PSA yet to be signed. • Still PSA is pending with Maharashtra • In 76th CCM (23.10.2017), it was decided to close the agenda item till further updates are received from MSEDCL.	
		Maharashtra & Indian Railways has to explore various other ways to resolve issue on PSA.	Maharashtra is to take issue with Management by 13/08/17			
6	Establishing pump mode operation at SSP	NCA/WRPC Secretariat	At the earliest.	13	Issue to be discussed in NCA meeting.	Agenda in 35th WRPC
7	Operation of Kadana and Bhira in Pumping Mode	GSECL / TATA Power	At the earliest.	15	Kadana: • Refurbishment offer by M/s CKD Blansko is under scrutiny. • GSECL placed order for checking KHEP units for pump mode operation. Bhira: Tata power is to communicate with CEA.	Agenda in 35th WRPC

8	Power Swing Studies for Multiple tripping of evacuation lines at CGPL (Leading to tripping 5x830 MW generators) and 400 kV lines at 400 kV Bachhau S/S.	Group comprising WRPC/ WRLDC/ CTU/ STU/ CGPL/ APL and representative of Industries	At the earliest.	16	• Expert group formed and two meetings were held. • Simulation carried out by WRLDC and discussed in the meetings.	Agenda in 35th WRPC
9	Interconnection between CGPL UMPP and Adani Mundra STPS in Gujarat – provision of 400/220 KV ICT at CGPL Mundra and compensation mechanism for 220 KV S/C CGPL Mundra – Nanikhakhar line & bays	PGCIL	At the earliest.	20	Clarification is sought by CTU in regard to the phrase 'independent funding'.	Agenda in 35th WRPC
10	Reliable Communication Scheme under Central Sector for Western Region	PGCIL	At the earliest.	22	-	Closed
11	Progress of downstream network whose terminating bays are under construction by POWERGRID	WRPC has to convene TRM regularly	Monthly basis	23	2 TRM meetings were conducted.	Agenda in 35th WRPC

12	Proposals approved in the 41st Meeting of Standing Committee on Power System Planning in Western Region	Noted by all	-	26		
		GETCO to write to SCM for ICT at KAPS	At the earliest .		In 42nd SC-PSP-WR meeting (17.11.2017) KAPS informed that no space for ICT.	Closed.
13	Ratification of proposals approved in the 24th Meeting of WR constituents regarding Connectivity & LTA Applications held on 21.12.2016	To be noted by all	-	27	-	-
14	Transmission charges for RGPPL power share allocation to other state i.e. (Gujarat, Jharkhand and Madhya Pradesh)	To be noted by all	-	29	MSETCL & RGPPL to do the needful.	Closed.
		MSETCL- approach Appropriate authority.	As Desired			
15	MSETCL Proposal for declaration of 132 kV Nepanagar (Madhya Pradesh)- Dharni (Maharashtra) line as an Inter State Transmission Line (ISTS)	MSETCL / MPPTCL	As Desired	31	MSETCL & MPPTCL to do the needful.	Closed

16	Technical specifications for Interface Energy Meters (IEM), Automated Meter Reading (AMR) system and Meter Data Processing system (MDP) for Western Region	To be noted by all	At the earliest	33	As decided in 76th CCM, a letter was sent to Director (Opn), PGCIL to expedite the matter.	Agenda in 35th WRPC
17	Extension of LILO arrangement for evacuation of power by ESSAR Power M.P. Ltd., 2x600 MW ("EPMPL")	ESSAR(EPTCL / EPMPL) to submit progress report	Weekly report till 30.09.2017	34	• Weekly progress report is being submitted by Essar Mahan. • Extension given by WRPC up to 31st, December,	Agenda in 35th WRPC
18	STOA charges and operating charges applied for the FY-2017-18 by RLDCs for STU	To be noted by all	-	39	-	-

19	Status of implementation of SAMAST report recommendations	To be noted by all	-	40	-	Agenda in 35th WRPC
		Daman to indicate progress on SAMAST.	By 31/08/2017		Daman is yet to indicate.	

		Maharashtra to give feedback on progress on SAMAST particularly on intra state ABT composite meters.	By 31/08/2017		Intra-state ABT order is yet to be issued by MERC. (informed by MAH in 76th CCM (23.10.2017)).	
20	SPS and Islanding Schemes	WRPC - SPS shall be reviewed.	At the earliest	41	-	-
21	Declaration of Transmission elements into commercial operation by ISTS licensees	To be noted by all	-	44	-	-
22	Status of Letter of credit (LC) opening against Deviation charges liability for 2017-18	To be noted by all	-	46	-	-
23	Status of Deviation & RRAS charges	To be noted by all	-	47	-	-
24	Status of Reactive Energy charges	To be noted by all	-	49	-	-
25	Status of Congestion Charges	To be noted by all	-	49	-	-

26	Status of Reconciliation of Deviation and REC pool account for the period Jan'17 to Mar'17	To be noted by all	-	51	-	-
27	Interest calculation statement of Deviation Pool Account for the period from July 2016 to Sept 2016	To be noted by all	-	52	-	-
28	Interest calculation statement of Reactive Charge Account for the period from July 2016 to Sept 2016	To be noted by all	-	53	-	-
29	Interest calculation statement of Congestion Charge Account for the period from Apr 2016 to Jun 2016	To be noted by all	-	54	-	-
30	Performance of WR Grid During January 2017 To June 2017	To be noted by all	-	55	-	-
31	Anticipated Power Supply Position In Western Region For The Period From August 2017 To October 2017	To be noted by all	-	57	-	-

32	Status of completion of 765 / 400 kV and above ongoing transmission schemes being executed / implemented by transmission agencies	To be noted by all	-	57	2 TRM meetings were held.	Agenda in 35th WRPC
33	Commissioning of New Generating Units In Western Region and the capacity expected to be commissioned during the current Year 2017-18.	To be noted by all	-	60		Agenda in 35th WRPC
34	Default in payment of outstanding dues by beneficiaries	To be noted by all	-	61	-	-
35	MPPMCL Scheduling of Un- requisitioned Surplus Power (URS) on 50% Capacity	To be noted by all	-	62	-	-
36	Relay co-ordination groups at State level	All States (except MP) shall expedite group formation.	At the earliest	65	• Gujarat and MP held meetings. • Maharashtra and Chhattisgarh yet to hold meetings.	Closed
37	Maintaining reserves to handle contingencies, forecast errors and variability	To be noted by all	-	67	-	-

38	Additional Agenda items		-			
	1) Working Arrangement for commercial settlement of scheduling of ISGS during low demand period to meet the technical minimum requirement of ISGS.	-	-	68		
	2) Signing of TPA by State Govt. with GoI & RBI	Maharashtra	At the earliest	69	POWERGRID to update.	Agenda in 35th WRPC
	3) Report on "Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India" by the Forum of Load Dispatchers (FOLD)	To be noted by all	-	70	-	-

	4) Observations in RTDA: Charges to be borne by the State on account of deviation by ISGS	To be noted by all	-	71	-	-
39	Any Other Item	-	-	72	-	-
40	Date And Venue Of Next WRPC Meeting	To be noted by all	-	72	-	-

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Power System Operation Corporation Ltd.

(A Government of India Enterprise)

ANNEXURE 28.4

35th WRPC Meeting

19-20 Dec'17

At Jabalpur

Grid Operation Highlights

WR Highlights - July'17 to Nov'17

***WR-NR** TTC/ATC increased to 10050/9550MW from 7200/6700MW with commissioning of +/- 800 kV Champa –Kurukshetra HVDC Bi-pole*

***WR- SR** TTC/ATC increased to 5700/5200MW from 4000/3500MW with integration of* 765 KV Wardha-Nizamabad D/C and associated transmission system

WR Highest Demand

During July'17-Nov'17

Max : 51222 MW

(09th Nov 2017 at 14:00 hrs)

Max. 51420 MW

on 18th Apr 2017 at 16:00 hrs

Energy

During July'17-Nov'17

Max : 1124 MW

On 09th Nov 2017

Highest 1180 MU on *25th Apr 2017*

%Growth w.r.t. last year– 9.2% (1069 Mu)

Renewables

Wind capacity– 12677 MW

16 % growth w.r.t last year

(10961 MW in Nov'16)

Solar capacity– 3487 MW

54 % growth w.r.t last year

(2269 MW in Nov'16)

WR Highest Wind Generation

7885 MW on 4th July'17

27 % growth w.r.t last year

(6207 MW in July'16)

WR Highest Solar Generation

2435 MW on 26th Nov'17

53 % growth w.r.t last year

(1591 MW in Nov'16)

WR Highest RE Generation

9031MW on 4th July'17

Frequency Profile

Avg Freq- 49.98 Hz

Lowest FVI- 0.022 on 21st Oct

87.73% of the time freq was in IEGC Band on 17th July 2017.

New Elements

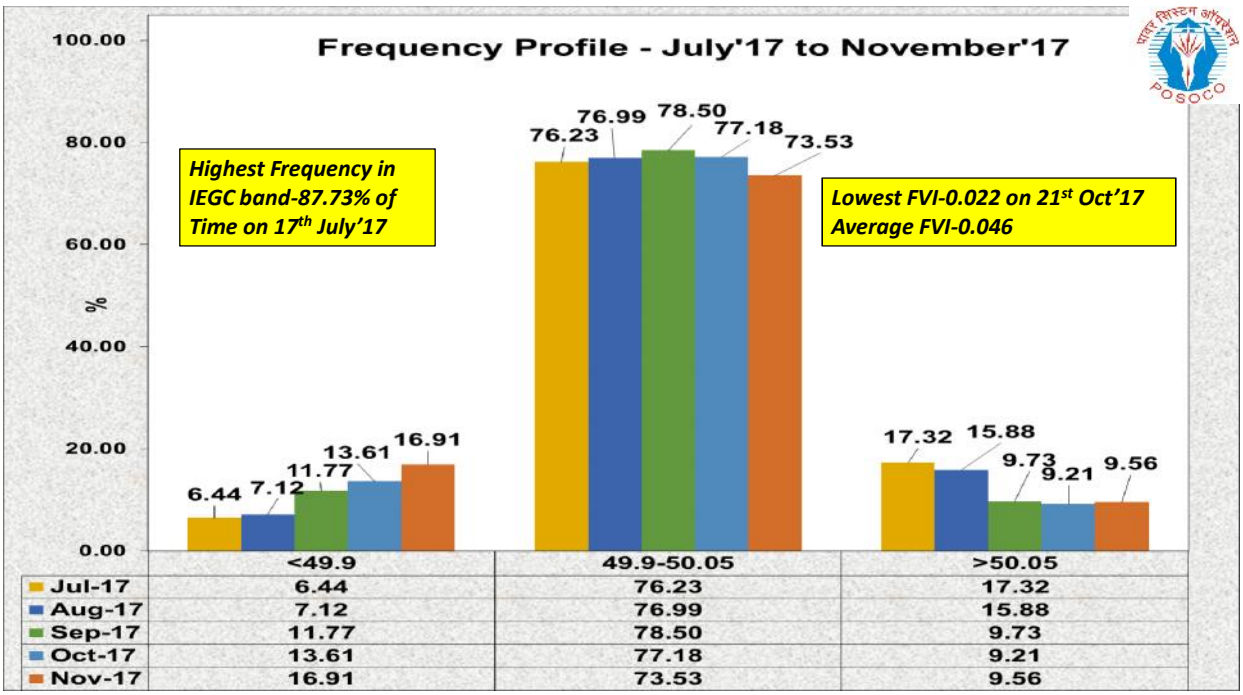
Generating Units syn.- 2360 MW

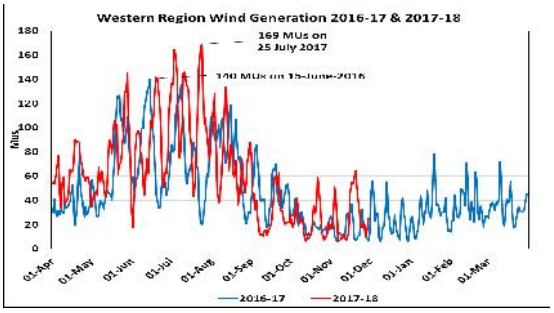
Transmission Lines- 3511 ckt Km.

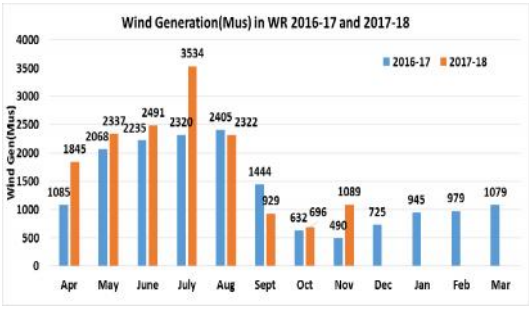
ICTs capacity added- 4830 MVA

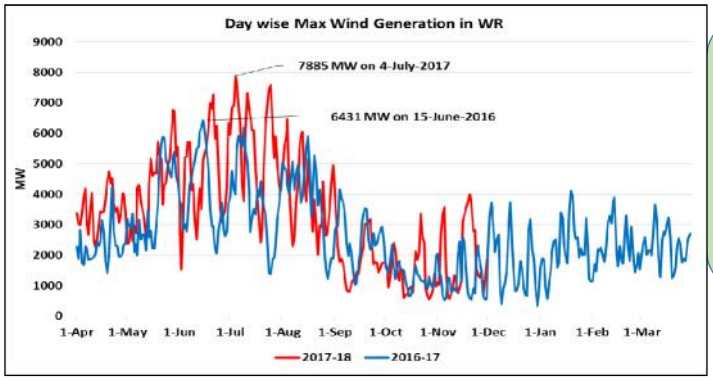
Bus Reactors- 250 MVAR

Line Reactors- 1470 MVAR



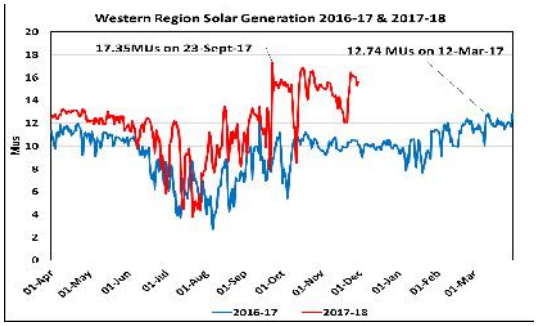


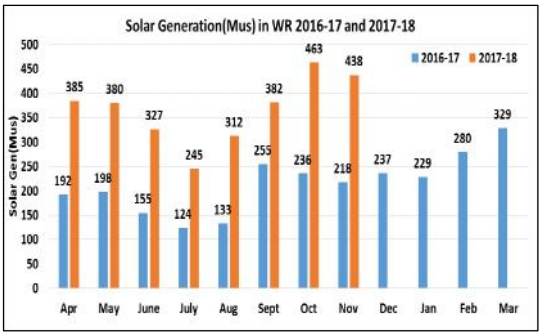


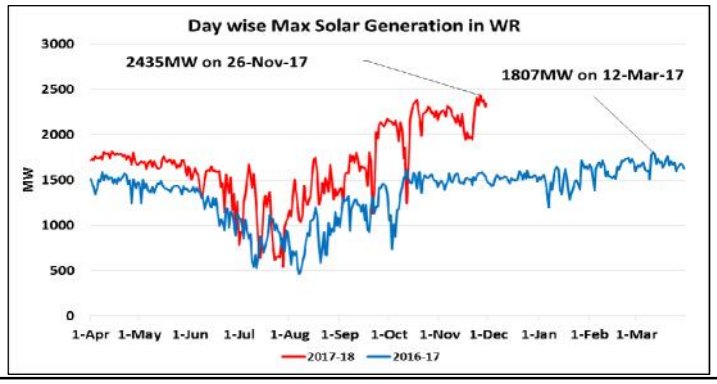


Highest Wind Generation(MUs) achieved-
3534MUs in July'17

Highest Wind Generation(MW) achieved-
7885MW on 4th July'17







Highest Solar Generation(Mus) achieved-
463MUs in Oct'17

WR achieved Highest ever Solar Generation on 26th Nov'17- 2435MW

Capacity of Solar Generation increased to 3487MW

Impact of Ockhi cyclone (5-6th Dec 2017) in WR

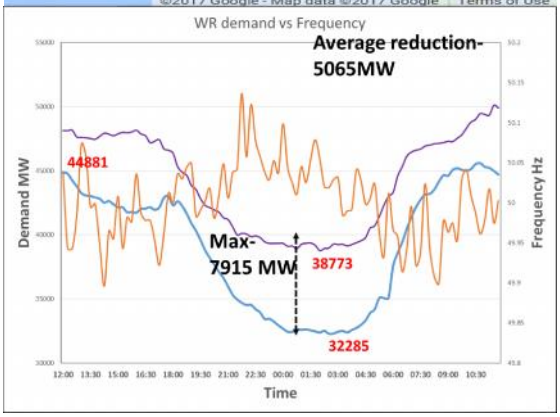
Drop in demand-

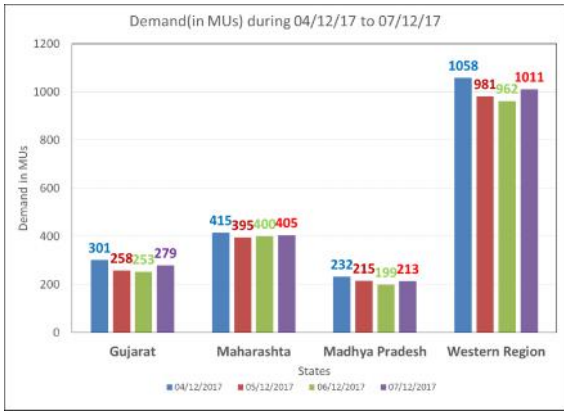
Gujarat: 3700 MW, 43 MUs

Maharashtra: 2250 MW, 20 MUs

Madhya Pradesh : 1800 MW,17 MUs

WR: **7915 MW, 77 MUs**

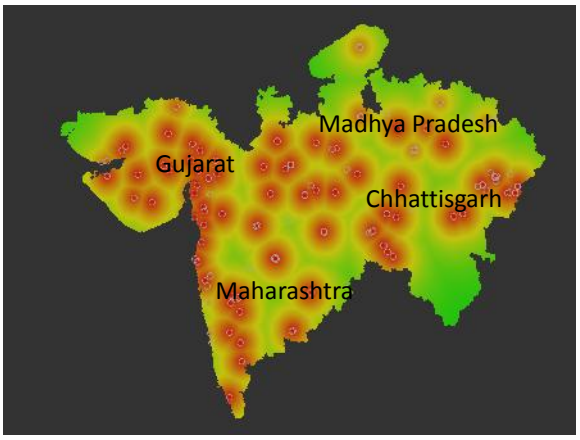




WR Voltage Contour

Red: High Voltage Green: Nominal Voltage **Blue:** Low Voltage

02:00 hrs of 06/12/17



RBPH unit-1,3 & 4 in condenser mode
Koyna unit-2 & 3 in condenser mode

9 number 765kV lines opened on HV
42 number 400kV lines opened on HV

Generators taken out on RSD in Gujarat:

- 1 number of 200 MW unit
- 9 number of 210 MW units
- 4 number of 218 MW units
- 1 number of 3251 MW unit

GJ total: 3313 MW

Generators taken out on RSD in MP

- One number of 210MW unit

MP total: 210MW

Total RSD : 3523 MW

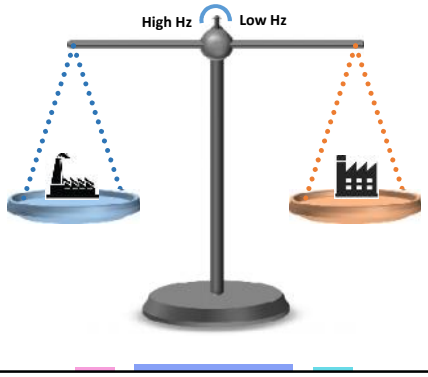
Major Grid Incidents

- **Tripping at 400kV Varsana S/S in Gujarat**
  - **05 Dec 17, 09:44**
  - 400kV Bus-2 tripped at Varsana due to R & Y phase fault.
- **Tripping at 400 kV Padghe S/S in Maharashtra**
  - **9 Dec 17, 12:58**
  - Blackout in 400/220 kV Padghe due to TBC breaker blast
- **Tripping at 220kV Chhegaon S/S in Madhya Pradesh**
  - **14 Dec 17, 02:37**
  - Bursting of Y-phase CT of 220kV Bus coupler at Chhegaon S/S.
- **Tripping of HVDC Champa-Kurukshetra**
  - Several tripping of HVDC Champa-Kurukshetra occurred since its commissioning

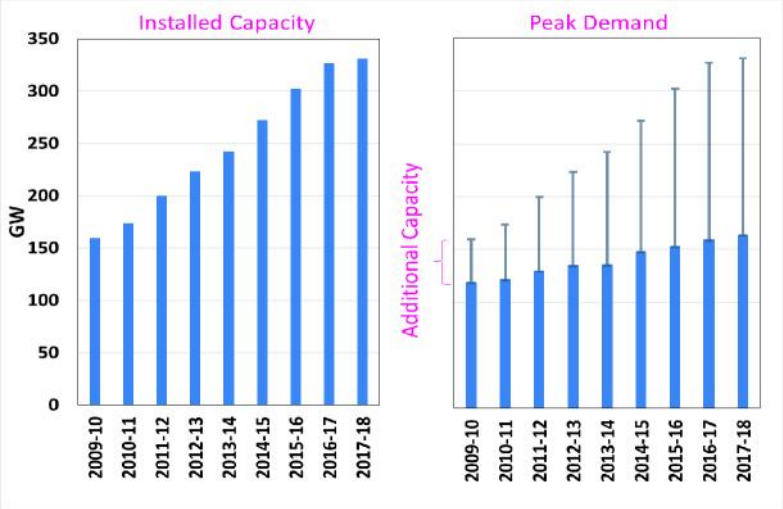
Attention for timely maintenance and Protection audit to avoid such incidents

Unusual Period (July-Nov'17)

Surplus or Shortage ?



Unusual Power Scenario



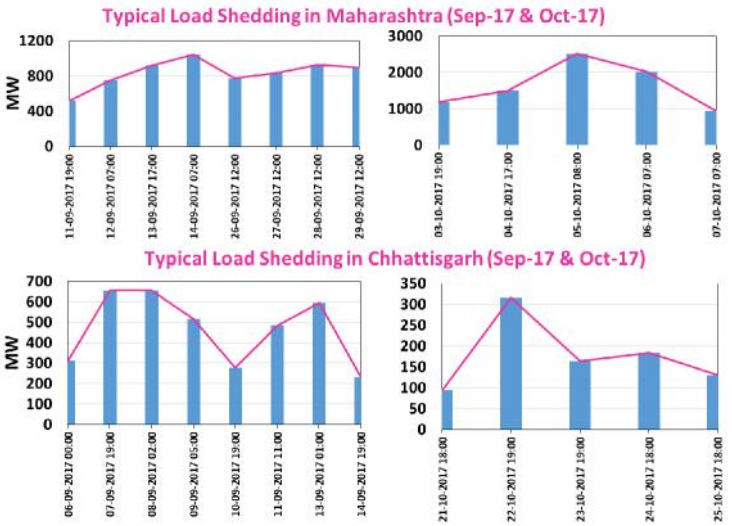
CEA 2017-18 LGBR

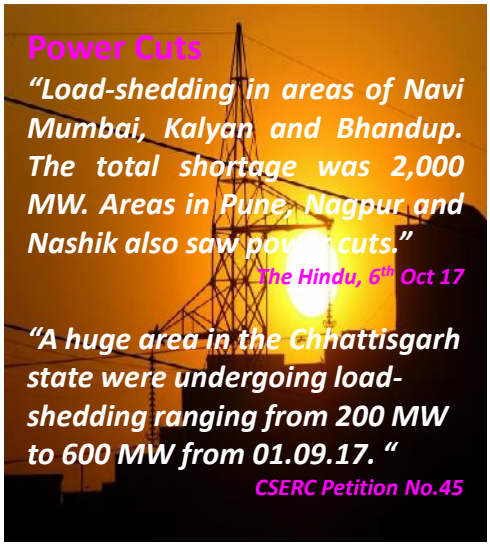
"*As per this LGBR, the country is likely to experience energy surplus of 8.8% and peak surplus of 6.8%.* "

"*State-wise power supply position shows that most the states/UTs would be having surplus energy*."

"Water, water, everywhere, And all the boards did shrink;

Power Cuts





"Water, water, everywhere, Nor any drop to drink.

Shortage

Spike in Market Clearing Price
- Less generation from Hydro and Nuclear
- Peak hour price in IEX is INR 10.80 per unit (17th Oct 17)

Lack of PPAs
- Private generators bid through Short term market
- No assurance of Coal Supply
- Less sell bids in short term market

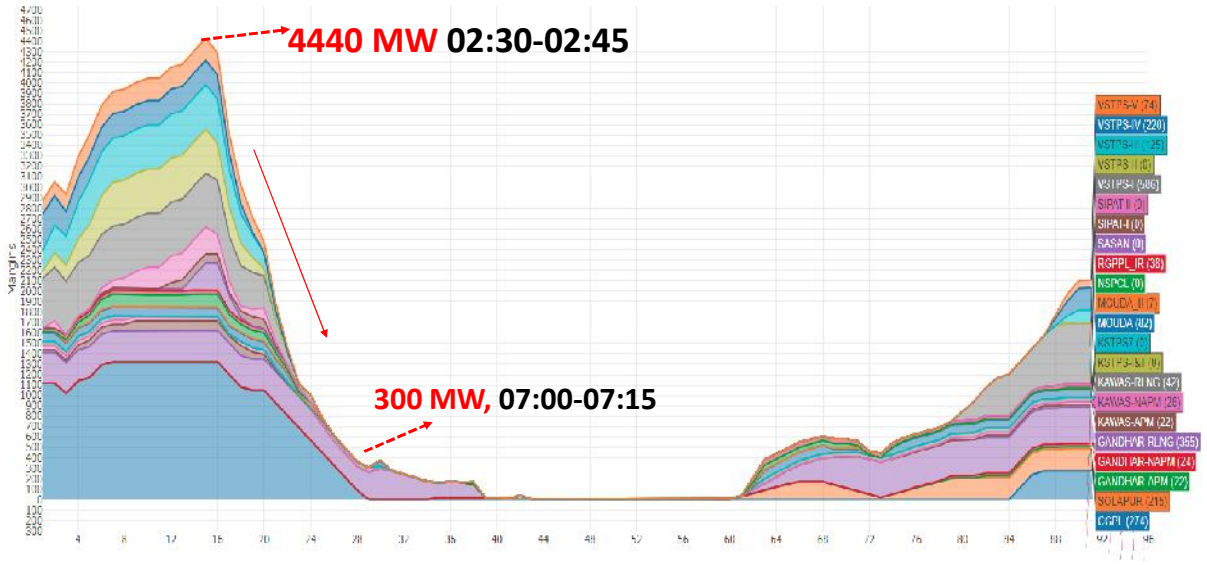
Coal Shortage
- Partial loading in state owned generators
- Private Generators: No coal Stock
- 23,681 MW is not available due to Coal Shortage (4th Oct 17, On All India Basis)
- On 3rd Oct 17
  - Shortage during evening peak was of order 3700 MW. Minimum frequency touched 49.67 Hz

Units Under Coal Shortage in WR

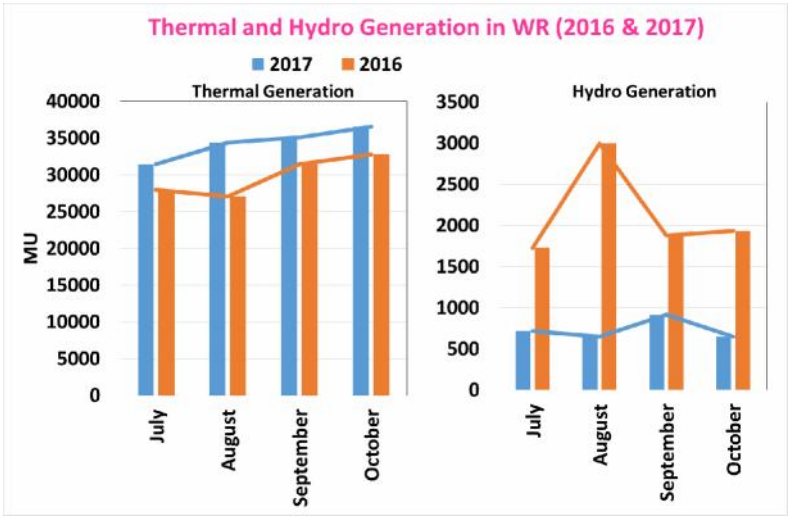
(As on 15th Dec 2017)

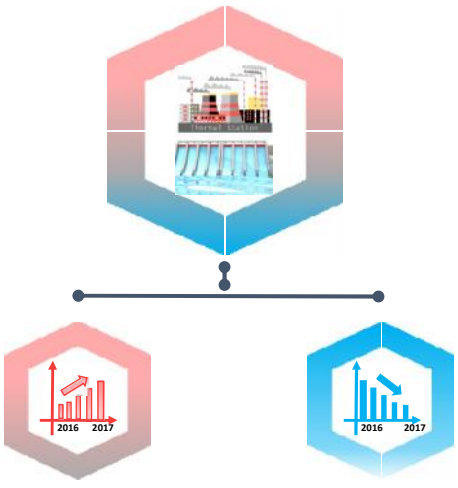
State Sector	Generation Capacity Out (in MW)
Maharashtra	2290
Madhya Pradesh	210
Gujarat	2520
Central Sector	
ISGS	660
IPP	2310
Total	**7990 MW**

Spinning Reserve Margin in WR



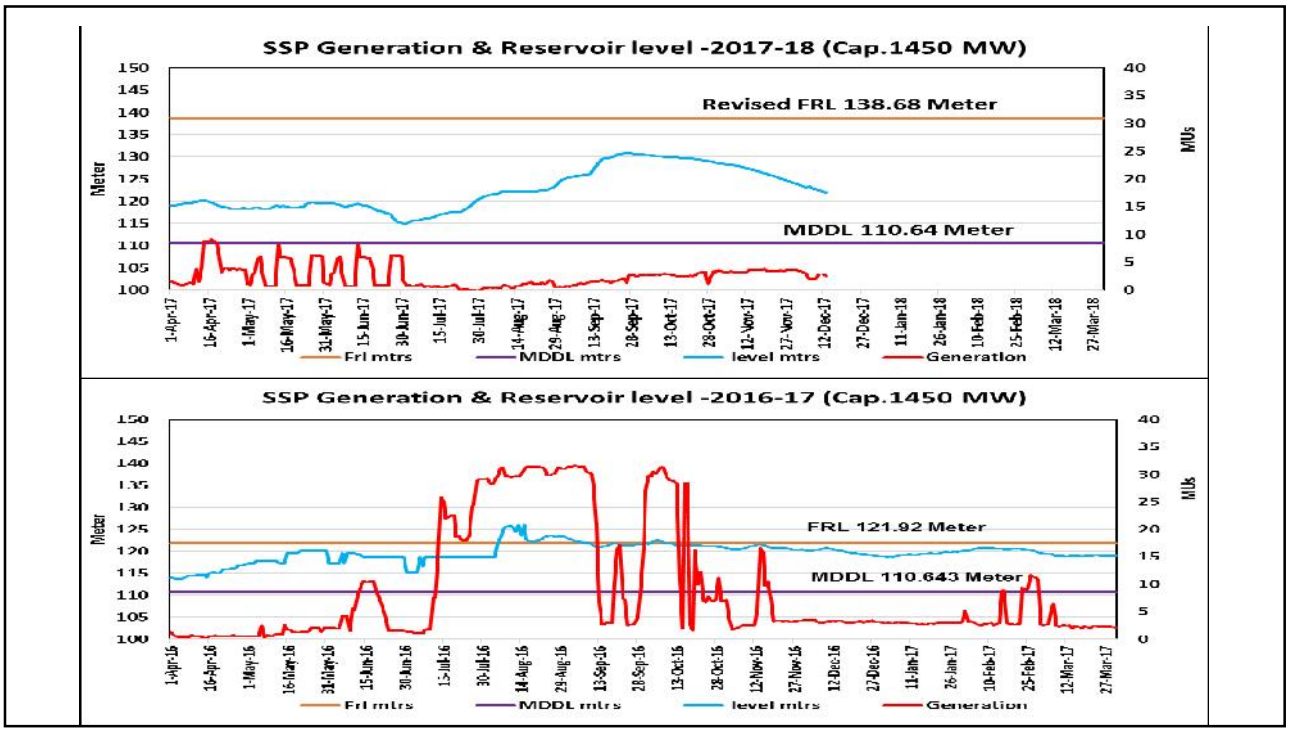
Thermal and Hydro Generation

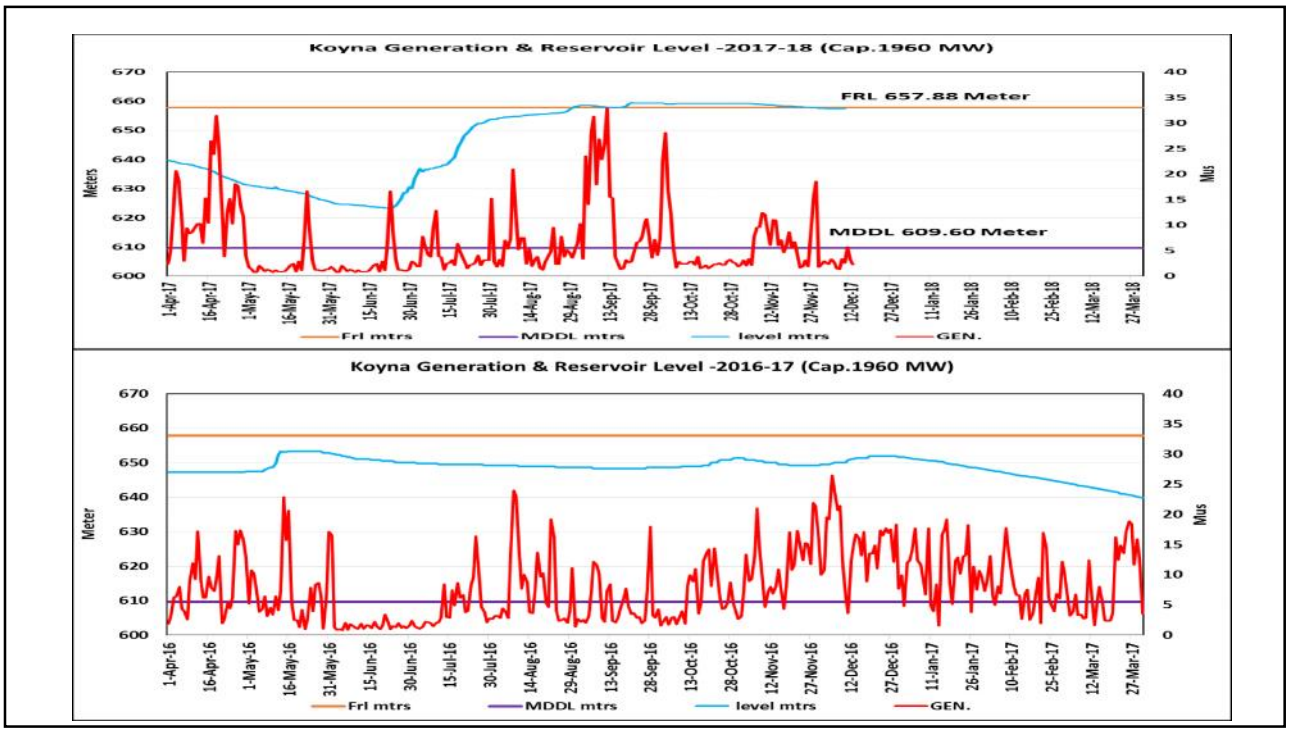


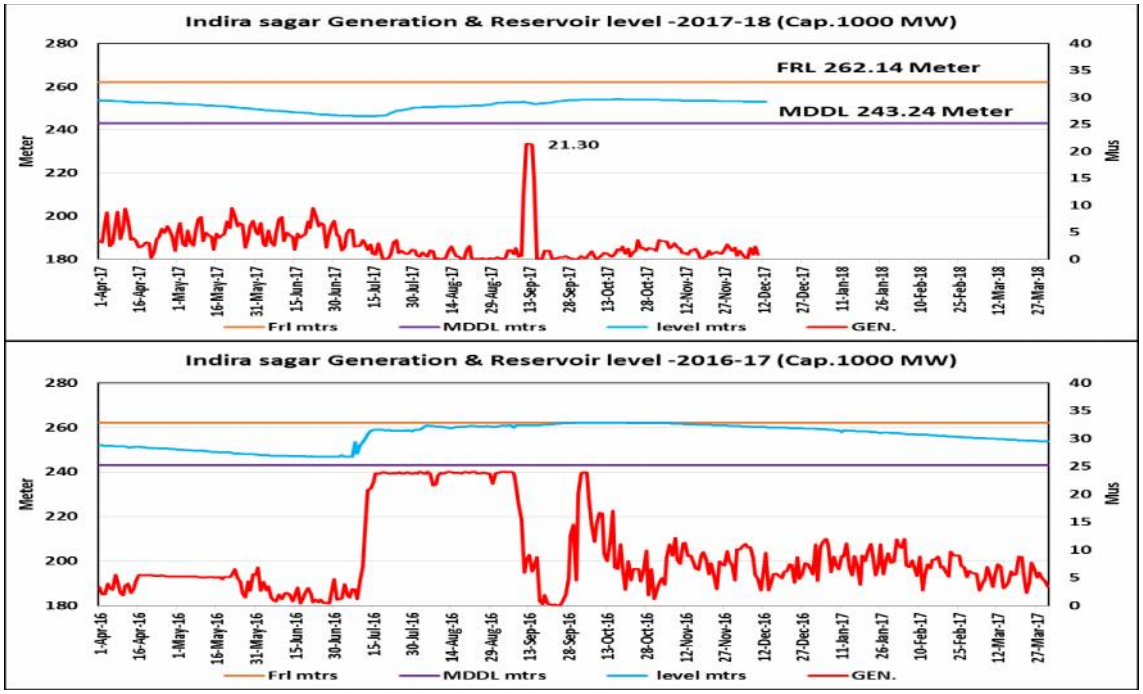


Rise in Thermal Generation

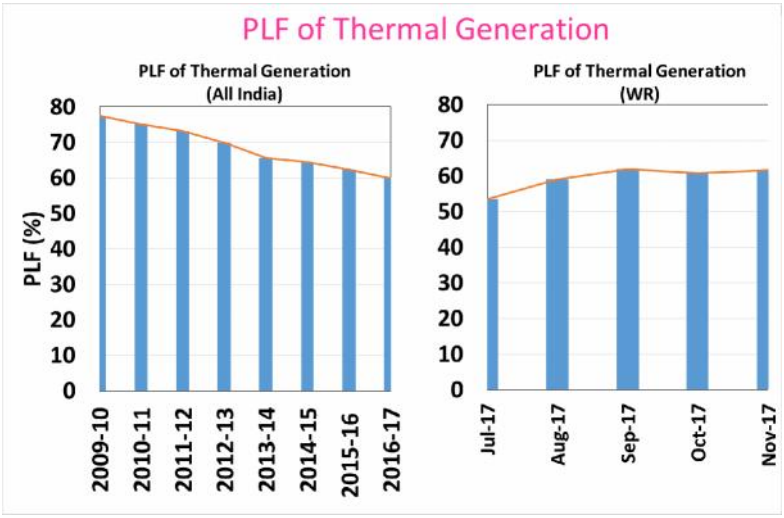
Fall in Hydro Generation

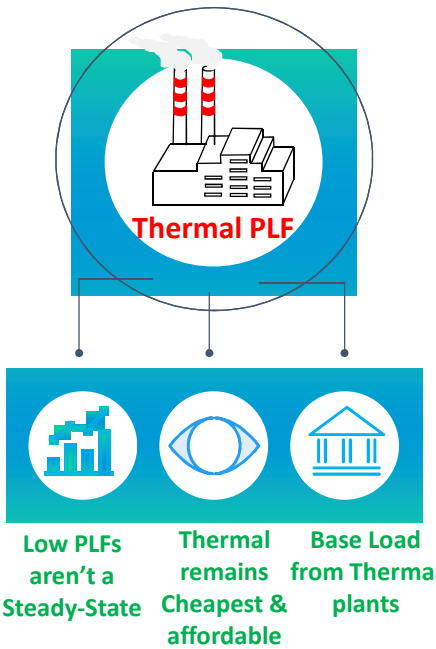

SSP Generation & Reservoir level -2017-18 (Cap.1450 MW)
Revised FRL 138.68 Meter
MDDL 110.64 Meter
Meter
MUs
Frl mtrs
MDDL mtrs
level mtrs
Generation
SSP Generation & Reservoir level -2016-17 (Cap.1450 MW)
FRL 121.92 Meter
MDDL 110.643 Meter
Meter
MUs
Frl mtrs
MDDL mtrs
level mtrs
Generation


Koyna Generation & Reservoir Level -2017-18 (Cap.1960 MW)
FRL 657.88 Meter
MDDL 609.60 Meter
Meters
Mus
Frl mtrs
MDDL mtrs
level mtrs
GEN.
Koyna Generation & Reservoir Level -2016-17 (Cap.1960 MW)
Meter
Mus
Frl mtrs
MDDL mtrs
level mtrs
GEN.

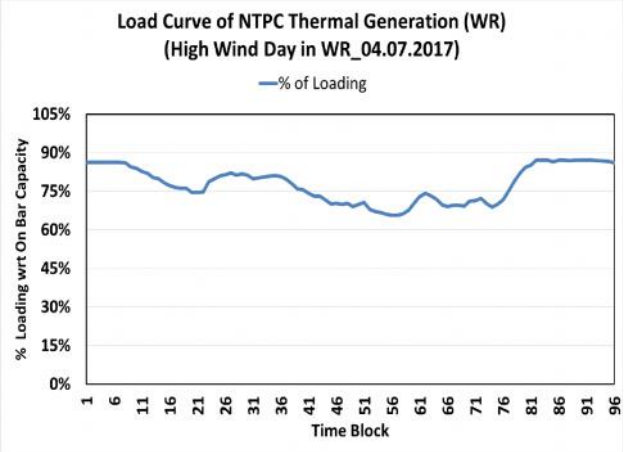


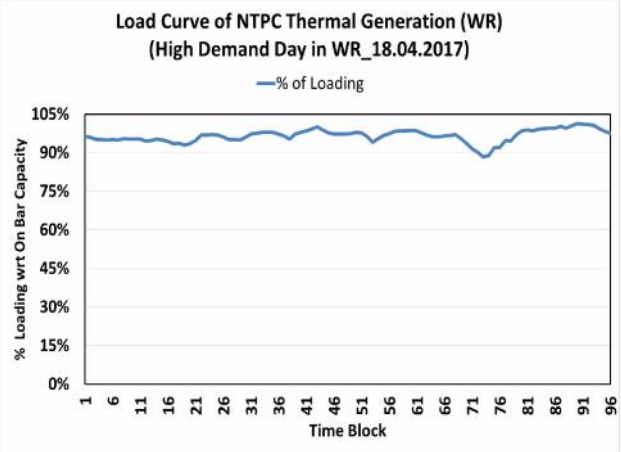
PLFs of Thermal Generation





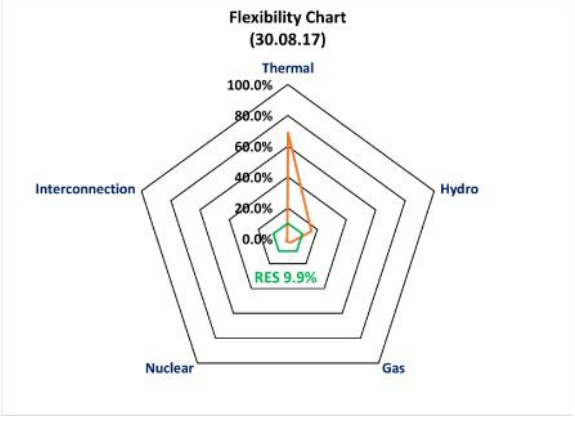
Flexibility of Thermal Generation

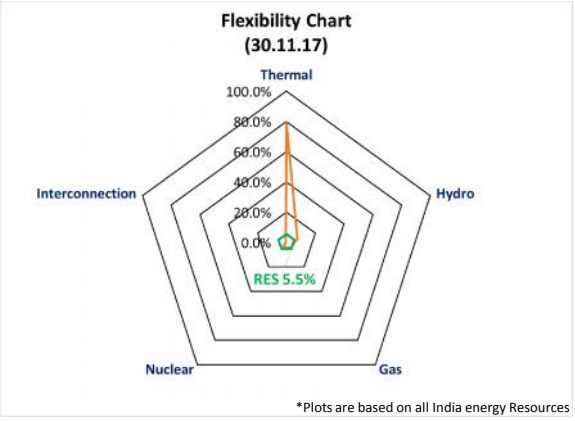




- Comparison of Load curves on thermal generation on high wind day and high demand days
- On High demand day: Loading ~ 90-100% of on bar capacity
- On High wind day: Loading ~ 60-80% of on bar capacity

Flexibility Chart



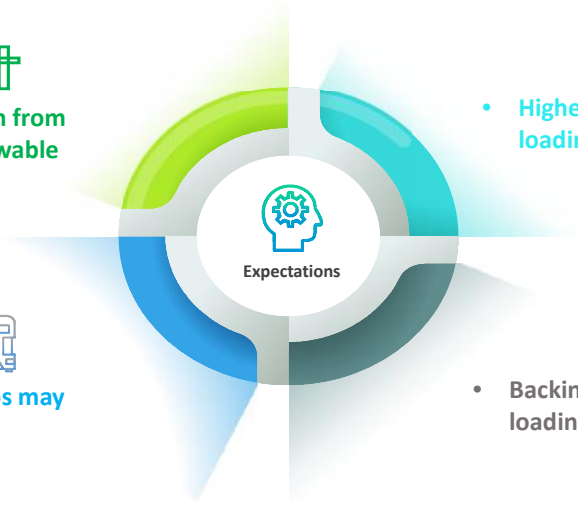


*Plots are based on all India energy Resources

- These charts highlights potential flexibility sources available to handle variability
- Thermal power is the mainstay of electricity generation in India
- Not expected to change drastically in the near future

Expectations and Opportunities

Expectations from Thermal Plants

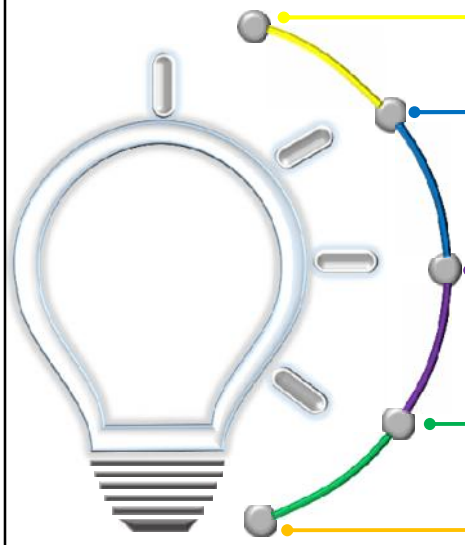


- A bridge for transition from conventional to renewable
- Higher ramping rates during loading and unloading
- Frequent start/stops may be required
- Backing down and cyclic loading

Does coal, the principal source of energy for now, face a dark future? "No, it can't be. If the future of coal is dark, then the future of the country will be dark,"

Partha Bhattacharya, former chairman of Coal India Ltd.

Opportunities Ahead in Future



- Predictive Maintenance
- Enhanced Ramping Capability
- Minimum Technical Limit
- More Efficient and Cleaner Technologies
- Gas Power Plants for Ramping & Balancing

पावर सिस्टम ऑपरेशन
POSOCO

Thank You !

ANNEXURE 28.5

Sharing of Central / State Generating Station Surplus Power

WRPC meeting at Jabalpur on 20.12.2017

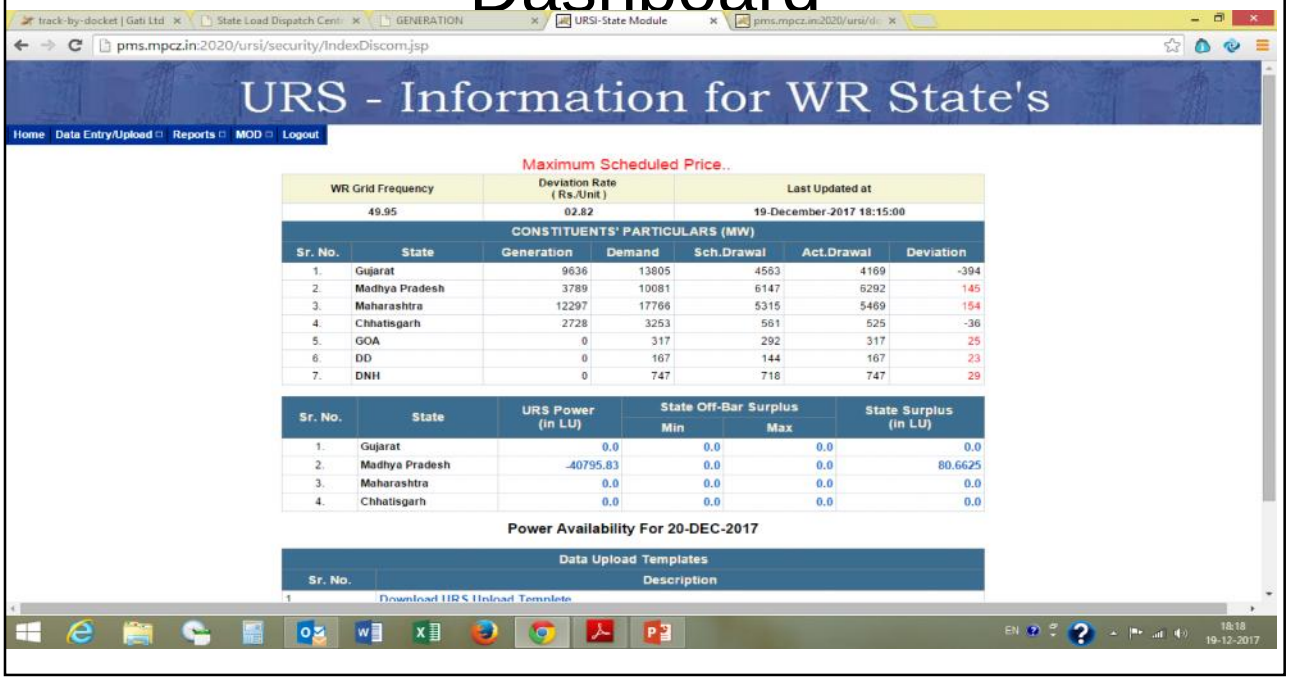
Effective utilization of surplus Power from State Generating Station

- **State Generating Station** is availing the benefit of technical minimum schedule even while not qualifying MOD cut-off.
- This has results in back down of other cheaper power sources and thus increases the power purchase cost.
- Cheaper power available with one utility could be utilized by another utility to save on energy cost.
- MPPMCL has developed a software to provide data of URS power on day ahead and real time basis along with indicative rates.
- Link is given below:

http://pms.mpcz.in:2020/ursi/Home.jsp

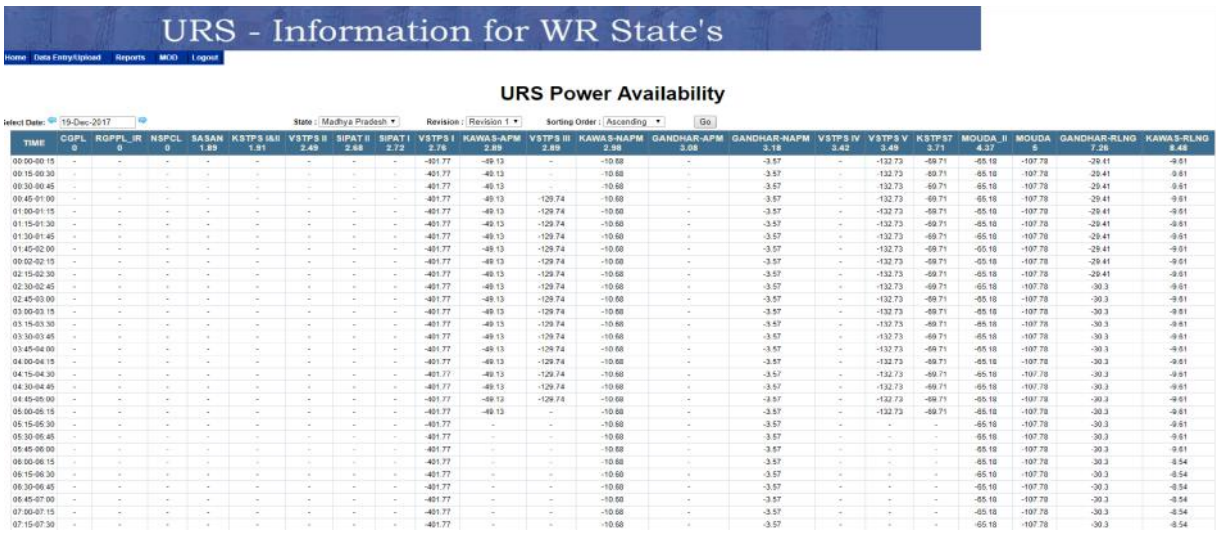
2

Dashboard



Data Upload templates

- URS Upload Template : This template indicates ISGS wise block wise date entry sheet for surplus(MW).



State Surplus Template : The user can upload surplus power directly.

State Surplus Power Availability

elect Date: 19-Dec-2017 State : Madhya Pradesh Revision : Revision 1 Go

Time Block	Time	Upto 100		100-200		Avove 200		Maximum Avail.Power	
		MW	Rs/kWh	MW	Rs/kWh	MW	Rs/kWh	MW	Rs/kWh
1	00:00-00:15	100	2.32	100	2.32	650	2.38	850	2.38
2	00:15-00:30	100	2.32	100	2.32	650	2.38	850	2.38
3	00:30-00:45	100	2.32	100	2.32	650	2.38	850	2.38
4	00:45-01:00	100	2.32	100	2.32	650	2.38	850	2.38
5	01:00-01:15	100	2.32	100	2.32	650	2.38	850	2.38
6	01:15-01:30	100	2.32	100	2.32	650	2.38	850	2.38
7	01:30-01:45	100	2.32	100	2.32	650	2.38	850	2.38
8	01:45-02:00	100	2.32	100	2.32	650	2.38	850	2.38
9	00:02-02:15	100	2.32	100	2.32	790	2.42	990	2.42
10	02:15-02:30	100	2.32	100	2.32	790	2.42	990	2.42
11	02:30-02:45	100	2.32	100	2.32	790	2.42	990	2.42
12	02:45-03:00	100	2.32	100	2.32	790	2.42	990	2.42
13	03:00-03:15	100	2.35	100	2.35	700	2.40	900	2.40
14	03:15-03:30	100	2.35	100	2.35	700	2.40	900	2.40
15	03:30-03:45	100	2.35	100	2.35	700	2.40	900	2.40
16	03:45-04:00	100	2.35	100	2.35	700	2.40	900	2.40
17	04:00-04:15	100	2.35	100	2.35	700	2.40	900	2.40
18	04:15-04:30	100	2.35	100	2.35	700	2.40	900	2.40
19	04:30-04:45	100	2.35	100	2.35	700	2.40	900	2.40
20	04:45-05:00	100	2.35	100	2.35	700	2.40	900	2.40
21	05:00-05:15	100	2.35	100	2.35	410	2.37	610	2.37
22	05:15-05:30	100	2.35	100	2.35	403	2.37	603	2.37
23	05:30-05:45	100	2.35	100	2.37	200	2.37	400	2.37
24	05:45-06:00	100	2.35	100	2.37	100	2.37	300	2.37
25	06:00-06:15	-	-	-	-	-	-	-	-
26	06:15-06:30	100	2.91	60	2.91	-	-	160	2.91
27	06:30-06:45	29	2.91	-	-	-	-	29	2.91
28	06:45-07:00	-	-	-	-	-	-	-	-
29	07:00-07:15	-	-	-	-	-	-	-	-
30	07:15-07:30	-	-	-	-	-	-	-	-
31	07:30-07:45	-	-	-	-	-	-	-	-

Unsold power – Calculated through Day ahead bid and obligation:

Time Blo	FROM	TO	2320	2350	2360	2370	2380	2400	2420	2910	3060	3070	3150	3200	3640	3690	20000
1	0:00	0:15	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
2	0:15	0:30	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
3	0:30	0:45	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
4	0:45	1:00	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
5	1:00	1:15	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
6	1:15	1:30	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
7	1:30	1:45	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
8	1:45	2:00	-390	0	-660	0	-850	0	0	0	0	0	0	0	0	0	-850
9	2:00	2:15	-390	0	-660	0	-850	0	-990	0	0	0	0	0	0	0	-990
10	2:15	2:30	-390	0	-660	0	-850	0	-990	0	0	0	0	0	0	0	-990
11	2:30	2:45	-390	0	-660	0	-850	0	-990	0	0	0	0	0	0	0	-990
12	2:45	3:00	-390	0	-660	0	-850	0	-990	0	0	0	0	0	0	0	-990
13	3:00	3:15	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
14	3:15	3:30	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
15	3:30	3:45	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
16	3:45	4:00	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
17	4:00	4:15	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
18	4:15	4:30	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
19	4:30	4:45	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
20	4:45	5:00	0	-360	0	-610	-780	-900	0	0	0	0	0	0	0	0	-900
21	5:00	5:15	0	-360	0	-610	0	0	0	0	0	0	0	0	0	0	-610
22	5:15	5:30	0	-360	0	-610	0	0	0	0	0	0	0	0	0	0	-610
23	5:30	5:45	0	-200	0	-400	0	0	0	0	0	0	0	0	0	0	-400
24	5:45	6:00	0	-200	0	-300	0	0	0	0	0	0	0	0	0	0	-300
25	6:00	6:15	0	0	0	0	0	0	-170	-330	0	0	0	0	0	0	-330
26	6:15	6:30	0	0	0	0	0	0	-170	-330	0	0	0	0	0	0	-330
27	6:30	6:45	0	0	0	0	0	0	-170	-330	0	0	0	0	0	0	-330
28	6:45	7:00	0	0	0	0	0	0	-100	-220	0	0	0	0	0	0	-220
29	7:00	7:15	0	0	0	0	0	0	0	0	-170	-330	0	0	0	0	-330
30	7:15	7:30	0	0	0	0	0	0	0	0	-170	-330	0	0	0	0	-330
31	7:30	7:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	7:45	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	8:00	8:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	8:15	8:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	8:30	8:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	8:45	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	9:00	9:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	9:15	9:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	9:30	9:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	9:45	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	10:00	10:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	10:15	10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Proposed methodology for sale of URS power from State Generating Stations -1/3

- With the target of supplying 24X 7 Power & considering the load pattern of WR beneficiaries, the state URS power can also supplement the beneficiaries at the time when they are in need apart from the URS of ISGS stations.
- Such URS may be named as State URS (SURS).
- SURS will not be only power from state GENCO power stations above TMM and upto its full capacity, but also upto TMM for the units which are On-Bar for few hours and rest of the time the lower variable rate power is backed down to give them minimum safe operational schedule.
- It is proposed that the SURS be transferred to the requisitioning WR beneficiary on the same variable cost.
- The requisition of the utility intending to schedule SURS in defined time blocks with NOC of surrendering utility may be accepted by WRLDC for scheduling as per regulations.

7

Proposed methodology for sale of URS power from State Generating Stations -2/3

- All the losses and charges upto the state periphery of surrendering utility will be borne by requisitioning beneficiary.
- Once the SURS is scheduled , the surrendering utility will not be permitted to take it back in the time blocks in which this SURS is availed by other beneficiary.
- The surrendering utility will have right to accept / reject the offer of requisitioning utility considering ramping rate and other factors if any.
- Availability of such SURS of state generating stations along-with MOD have to be displayed on SLDC and WRLDC web-sites.

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Proposed methodology for sale of URS power from State Generating Stations -3/3

- Based on information gathered through dashboard transaction may be carried through power exchanges
- Monthly settlement of the accounts based on the data of SURS from WRLDC will be done by utilities.

Discussion:

Suggestions from WR beneficiaries to implement the methodology for transfer of SURS need to be discussed in length.