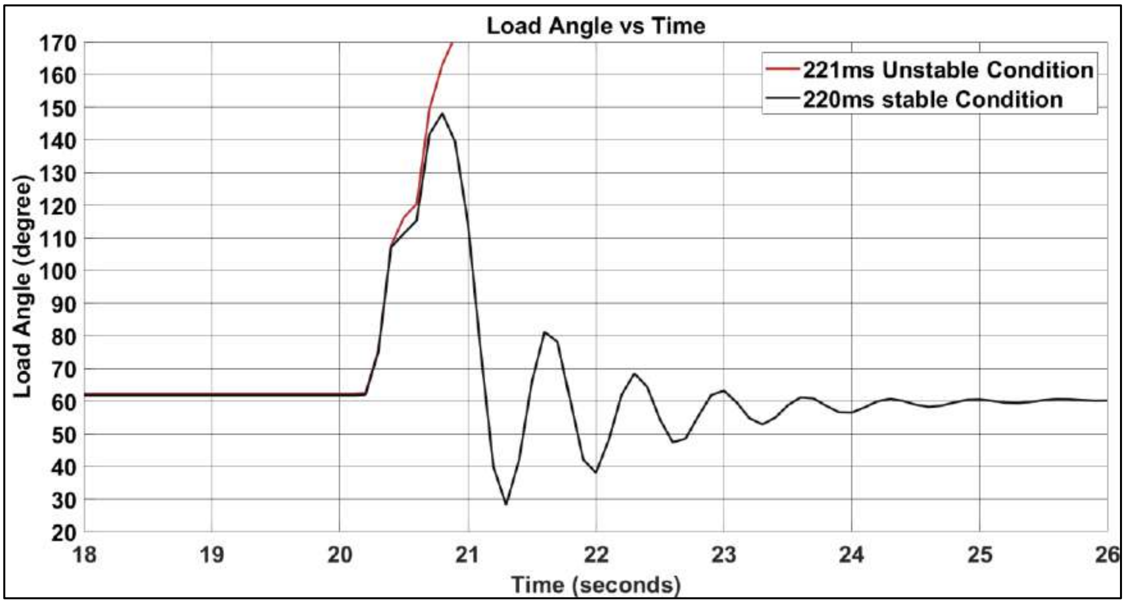


Figure 31: Load angle versus time for the unit under stable and unstable mode of operation resulting from the fault clearance at or beyond the critical clearing time of 220 milliseconds.

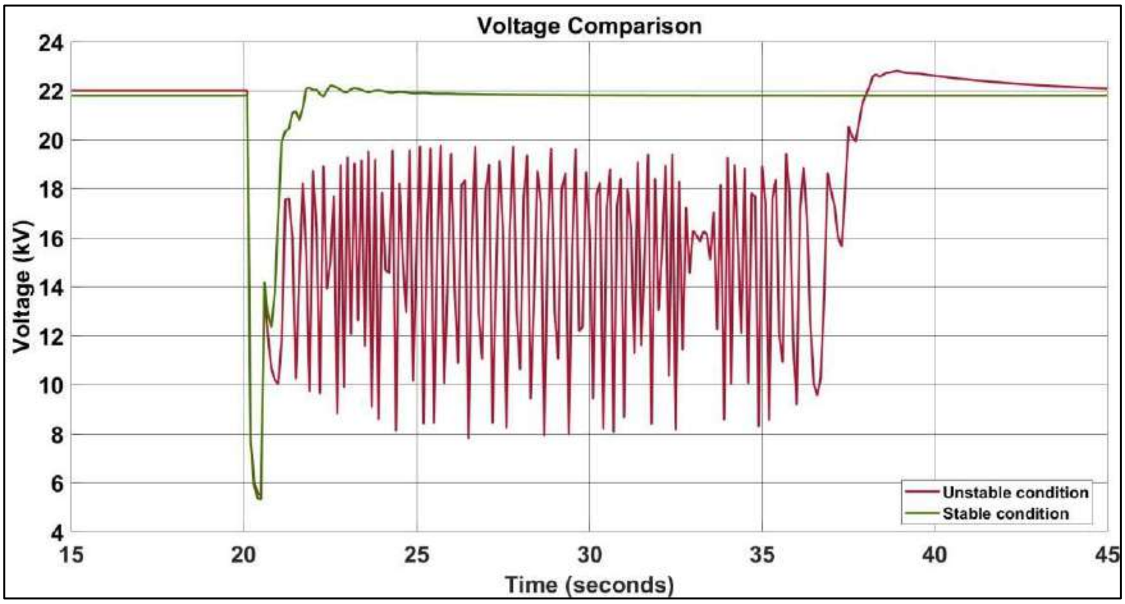


Figure 32: Voltage variation of the unit during the event of fault and clearing in and beyond the critical clearing time of 220 milliseconds.

3.1.6. Case 6: Load increment of 33.25MW post island formation.

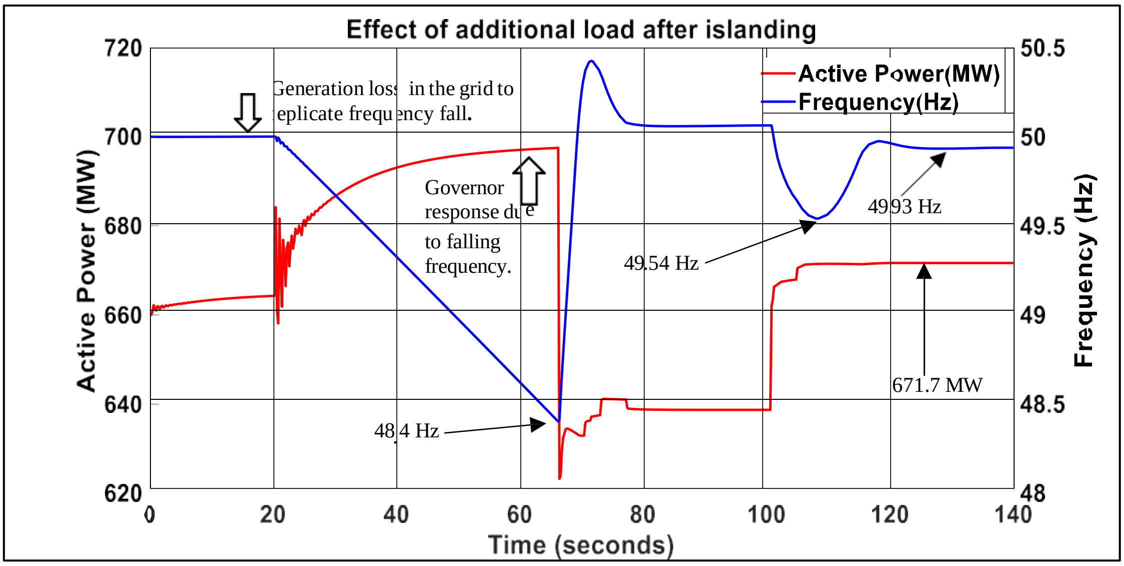


Figure 33: Variation in active power and frequency vs time due to load increment of 33.25 MW after islanding.

In reference to Case 1: (Generation=660MW and Load=640MW) an additional load of 33.25MW has been added into the network post island formation.

Simulation results for this case reveal that with the subsequent inclusion of 33.25MW in the network post-island formation a decrement in frequency of 49.54Hz has been observed for over a duration of 23.8 seconds. With generation increasing to 671.7MW, final frequency of the island stabilizes to 49.93Hz.

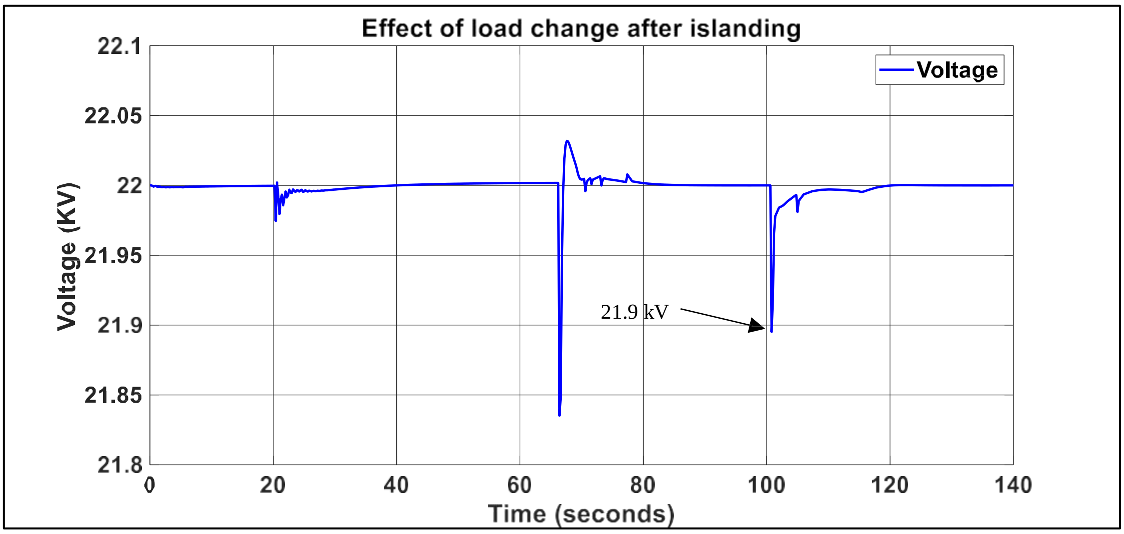


Figure 34: Variation in voltage vs time due to load increment of 33.25 MW after islanding.

Figure 34 shows voltage change due to addition of 5.2% of total island load. The voltage initially experiences a sudden dip from 22 kV to 21.9 kV (0.45%) which further stabilizes to 22kV.

3.1.7. Case 7: Load increment of 42.75MW after island formation.

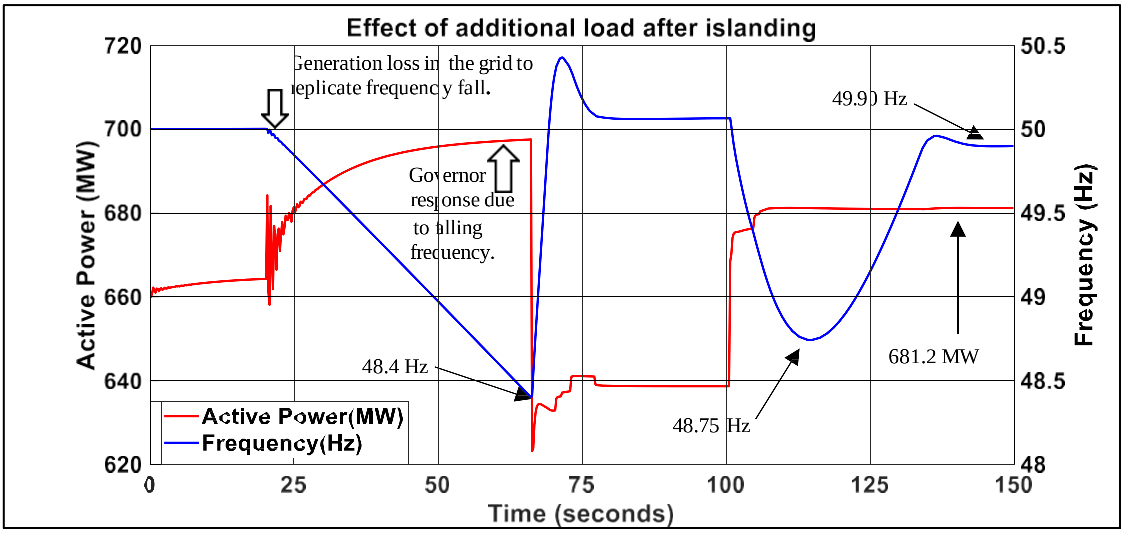


Figure 35: Variation in active power and frequency vs time due to load increment of 42.75 MW after islanding.

In reference to Case:1 (Generation=660MW and Load=640MW) an additional load of 42.75MW has been added into the network post island formation.

Simulation results for this case reveal that with the subsequent inclusion of 42.75MW in the network post-island formation a decrement in frequency of 48.75Hz has been observed over a duration of 41.8 seconds. With generation increasing to 681.2MW, final frequency of the island stabilizes to 49.90Hz.

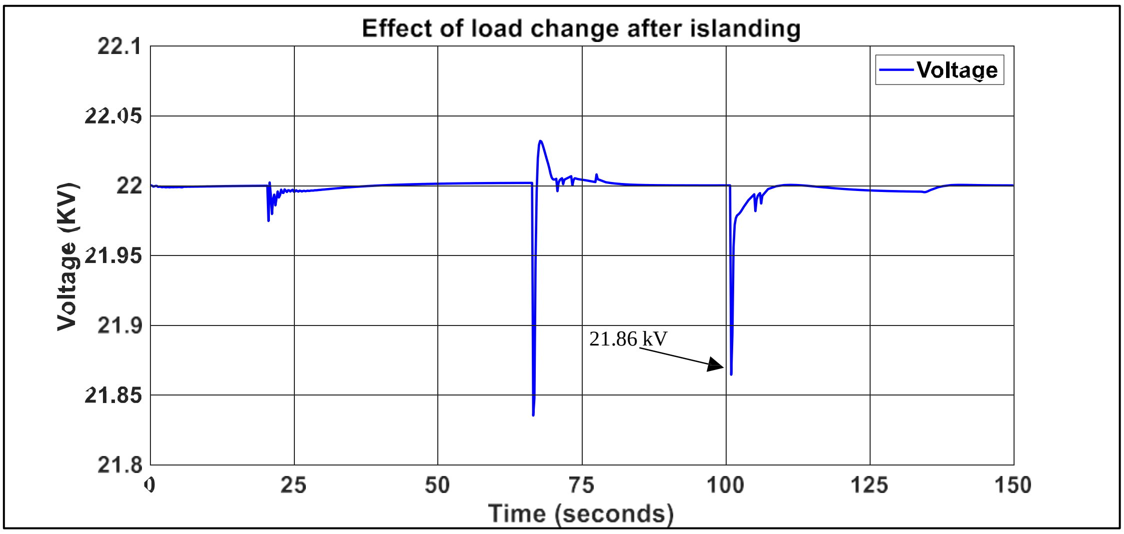


Figure 36: Variation in voltage vs time due to load increment of 42.75 MW after islanding.

Figure 36 shows the voltage change due to the addition of 6.5% of total load. The voltage initially experienced a sudden dip of 21.86kV (0.63%) which further stabilizes to 22kV.

3.1.8. Case 8: Load increment of 52.25MW after island formation.

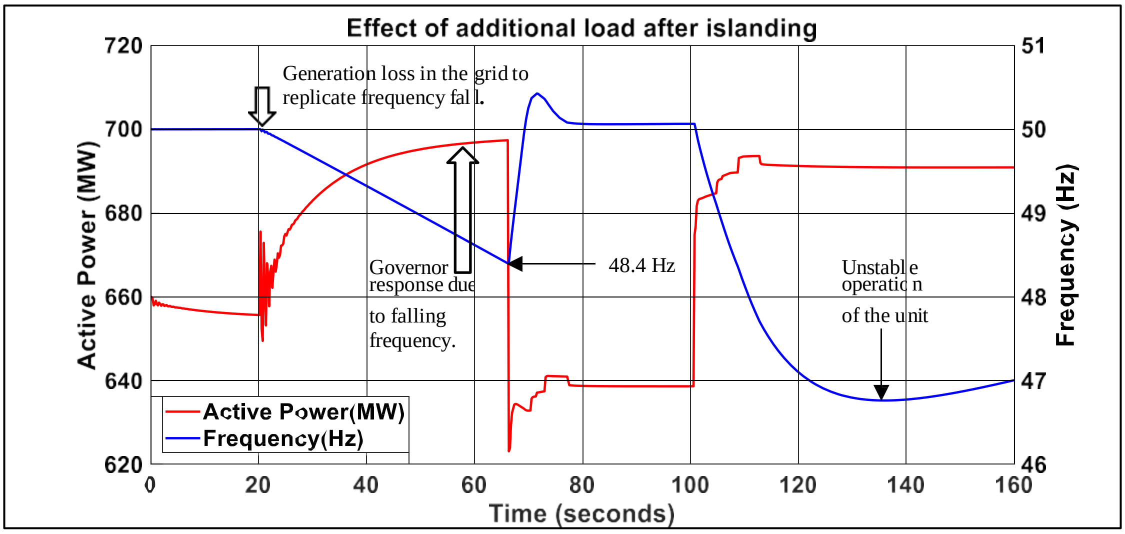


Figure 37: Variation in active power and frequency vs time due to load increment of 52.25 MW after islanding.

In reference to Case:1 (Generation=660MW and Load=640MW) an additional load of 52.25MW has been integrated into the network post island formation.

Simulation results for this case reveal that with the subsequent inclusion of 52.25MW load in the network post-island formation a continuous decline in frequency resulting in tripping of the unit was observed, suggesting that unit couldn't increase the active power for the corresponding increase in load.

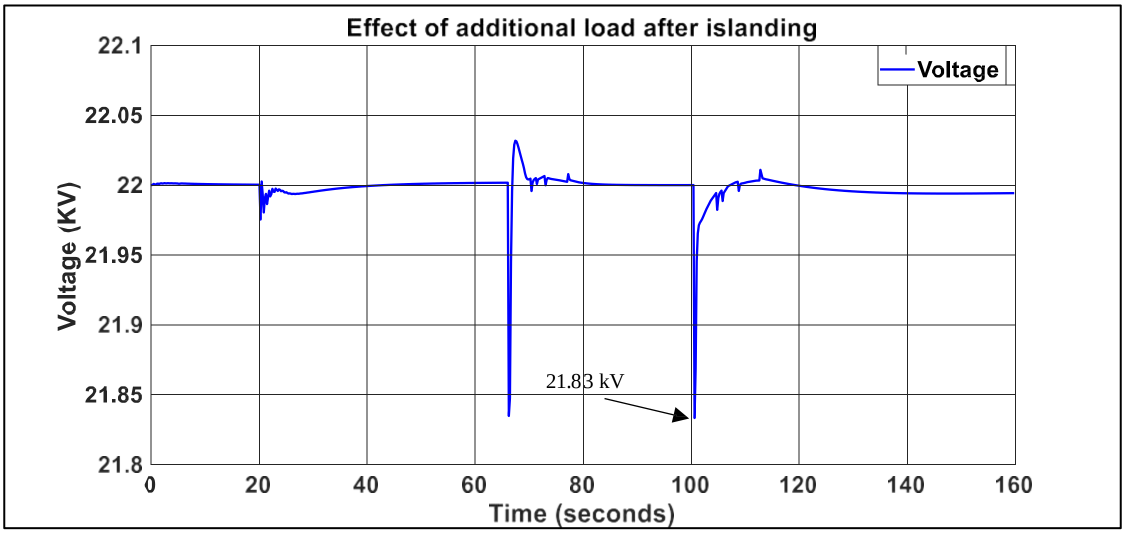


Figure 38: Variation in voltage vs time due to load increment of 52.25 MW after islanding.

Figure 38 shows voltage change due to the addition of 10% of total load. The voltage initially experienced a sudden dip from 22kV to 21.83 (0.77%) which further stabilizes to 22kV.

3.1.9. Case 9: Island formation at 49Hz with f_{rate} = 0.5Hz/s

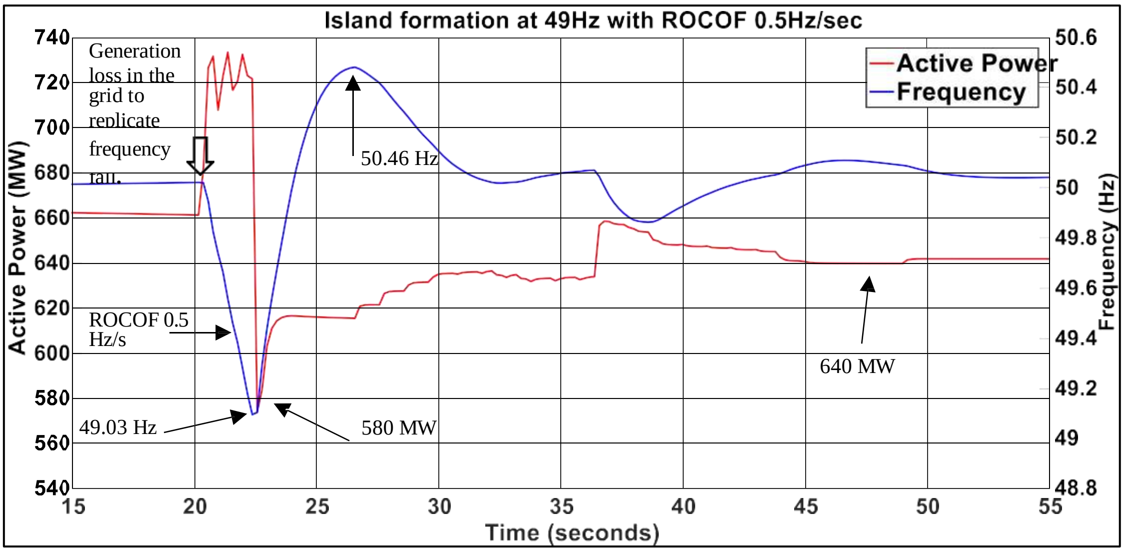


Figure 39: Variation in active power and frequency vs time during island formation at 49 Hz with ROCOF 0.5 Hz/s.

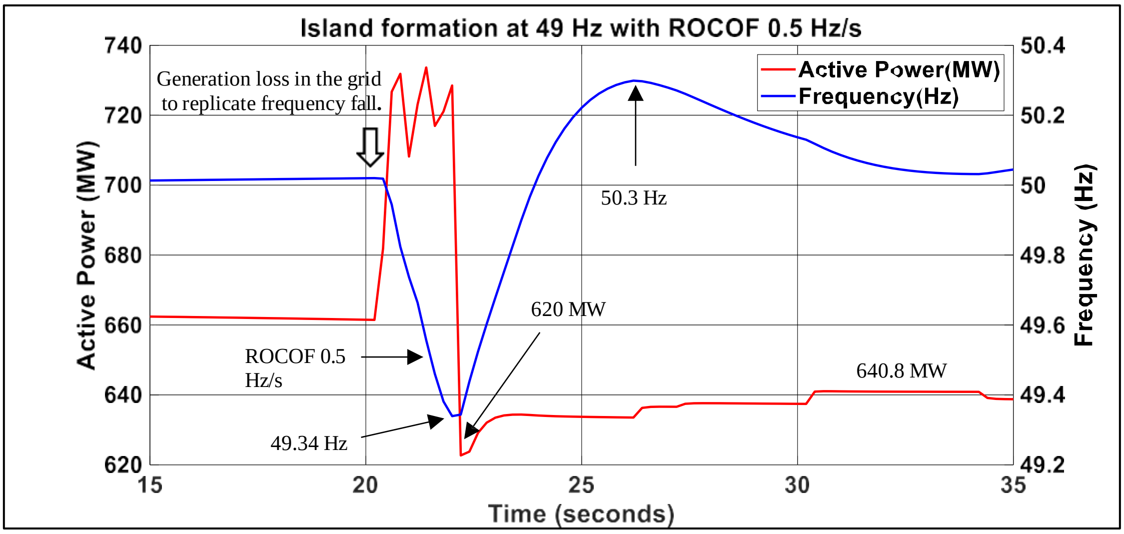


Figure 40: Variation in active power and frequency vs time during island formation at 49.34 Hz with ROCOF 0.5 Hz/s.

In reference to Case:1 (Generation=660MW and Load= 640MW) island was formed at 49Hz frequency with rate of change of frequency is 0.5Hz per seconds.

During an event of grid disturbance, rate of change of frequency (ROCOF) of 0.5Hz /sec was simulated, and the unit was islanded at 49Hz (Figure 39) and 49.34 Hz (Figure 40).

The simulations revealed that when the unit was islanded at 49 Hz a dip of 80 MW was observed and when it was islanded at 49.34 Hz the dip was 40 MW.

Continuous fluctuation in active power from the moment the frequency began to fall was observed. This indicates that the unit would have difficulty sustaining such continuous oscillations till the frequency restores near to 50Hz.

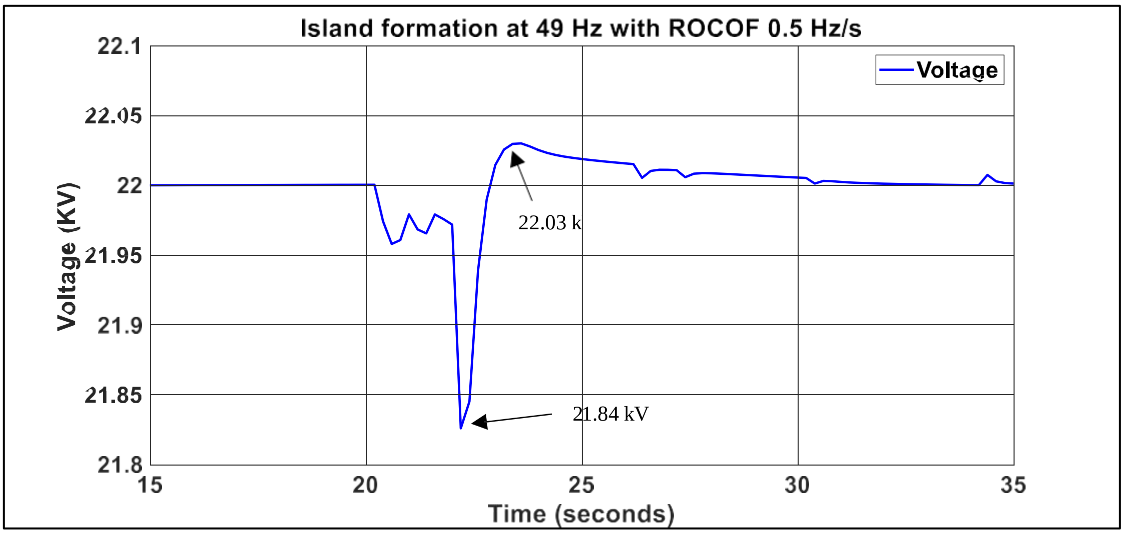


Figure 41: Variation in voltage vs time during island formation at 49 Hz with ROCOF 0.5 Hz/s.

For a ROCOF of 0.5Hz/sec, the decrease in voltage at the instant of islanding (49Hz) was 21.84kV from 22kV. A voltage variation of 0.77% was observed when the unit undergoes islanding.

3.1.10. Case 10: Island formation at 48.4Hz with ROCOF (f_{rate}) = 0.5Hz/s

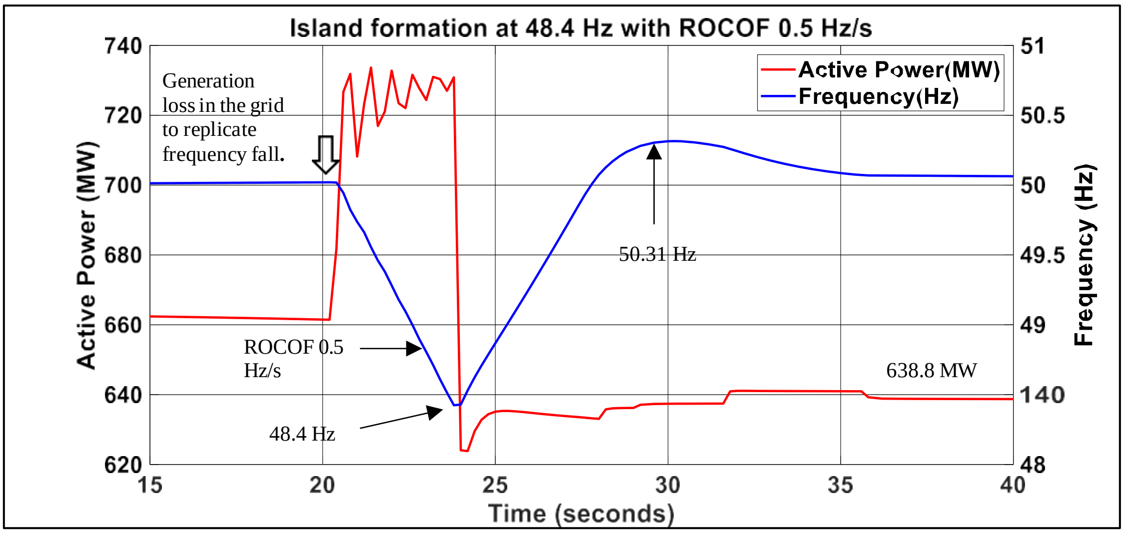


Figure 42: Variation in active power and frequency vs time during island formation at 48.4 Hz with ROCOF 0.5 Hz/s.

In reference to Case:1 (Generation=660MW and Load=640MW) island is formed at 48.4Hz frequency with rate of change of frequency is 0.5Hz per seconds.

During an event of grid disturbance, rate of change of frequency (ROCOF) of 0.5Hz /sec is simulated, and the unit islanded at 48.4Hz. The simulations revealed a continuous fluctuation in active power from the moment the frequency began to fall. This indicates that the unit would have difficulty sustaining such continuous oscillations till the frequency restores near to 50Hz.

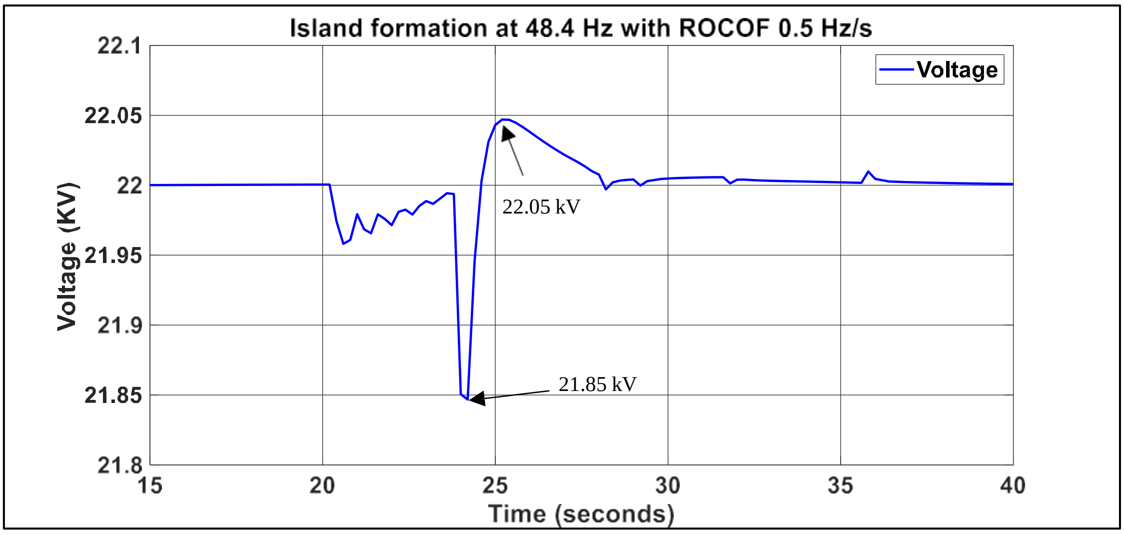


Figure 43: Variation in voltage vs time during island formation at 49 Hz with ROCOF 0.5 Hz/s.

For a ROCOF of 0.5Hz/sec, the decrease in voltage at the instant of islanding (48.4Hz) was 21.85kV from 22kV. A voltage variation of 0.78% was observed when the unit undergoes islanding.

3.1.11. Case 11: Island formation at 48.4Hz with f_{rate} = 0.25Hz/s

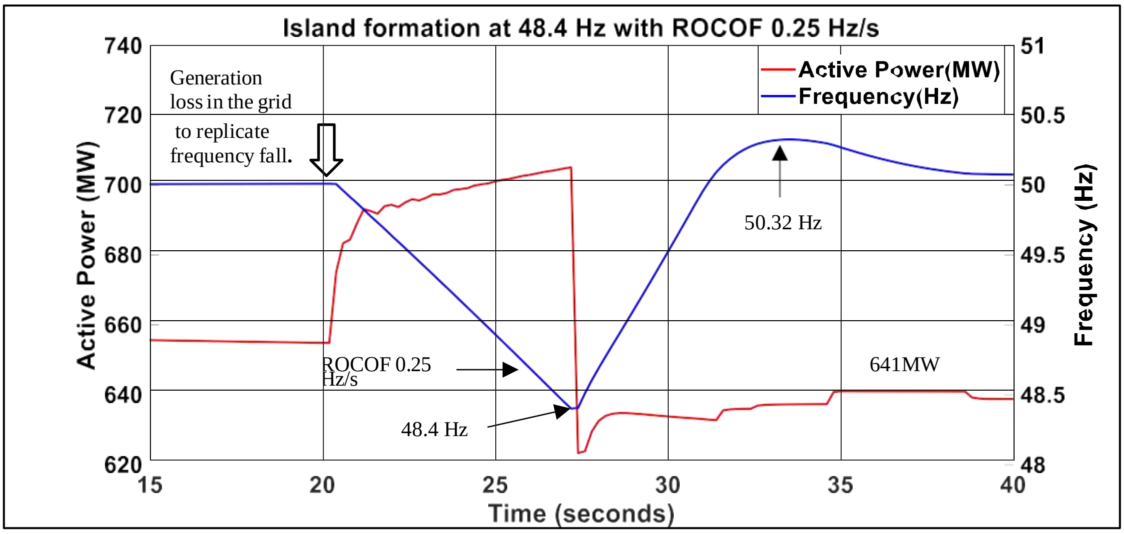


Figure 44: Variation in active power and frequency vs time during island formation at 48.4 Hz with ROCOF 0.25 Hz/s.

In reference to Case:1 (Generation=660 MW and Load=640 MW) island is formed at 48.4Hz frequency with rate of change of frequency is 0.25Hz per seconds.

During an event of grid disturbance, rate of change of frequency (ROCOF) of 0.25Hz /sec is simulated, and the unit islanded at 48.4Hz. The simulations revealed a negligible fluctuation in active power from the moment the frequency began to fall. This indicates that the unit can sustain in island when the rate of change of frequency is 0.25Hz per second.

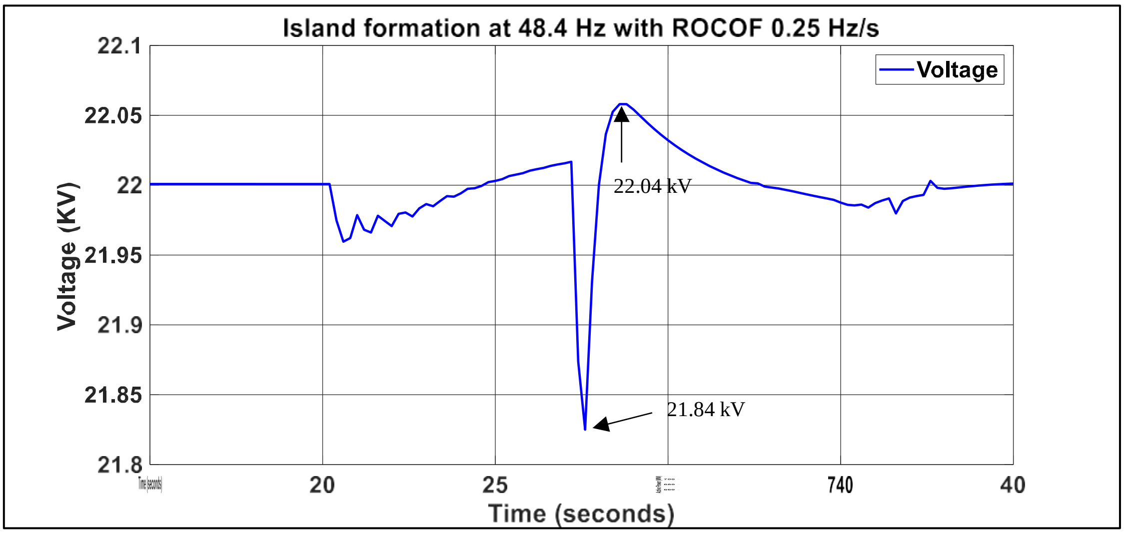


Figure 45: Variation in voltage vs time during island formation at 48.4 Hz with ROCOF 0.25 Hz/s.

For a ROCOF of 0.25Hz/sec, the decrease in voltage at the instant of islanding (48.4Hz) was 21.84kV from 22kV. A voltage variation of 0.77% was observed when the unit undergoes islanding.

3.1.12. Case 12: Optimal load reduction during island formation

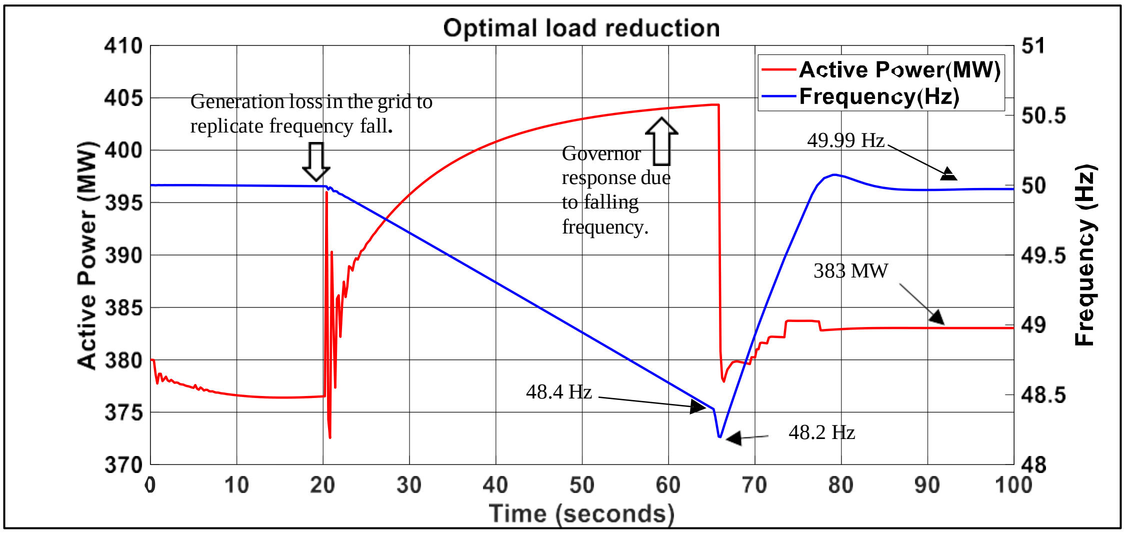


Figure 46: Variation in active power and frequency vs time due to optimal load reduction of 68 MW after islanding.

In reference to Case:3 (Generation=380 MW and Load = 500 MW), a reduction of load shed of 68MW instead of 74MW has been introduced into the network at the instant of 48.2 Hz.

Simulation outcomes for this case reveal that subsequent decrement of 68 MW at 48.2Hz in the network. Frequency stabilizes to its final value of 49.99 Hz corresponding to generation of 383 MW within 9.5 seconds.

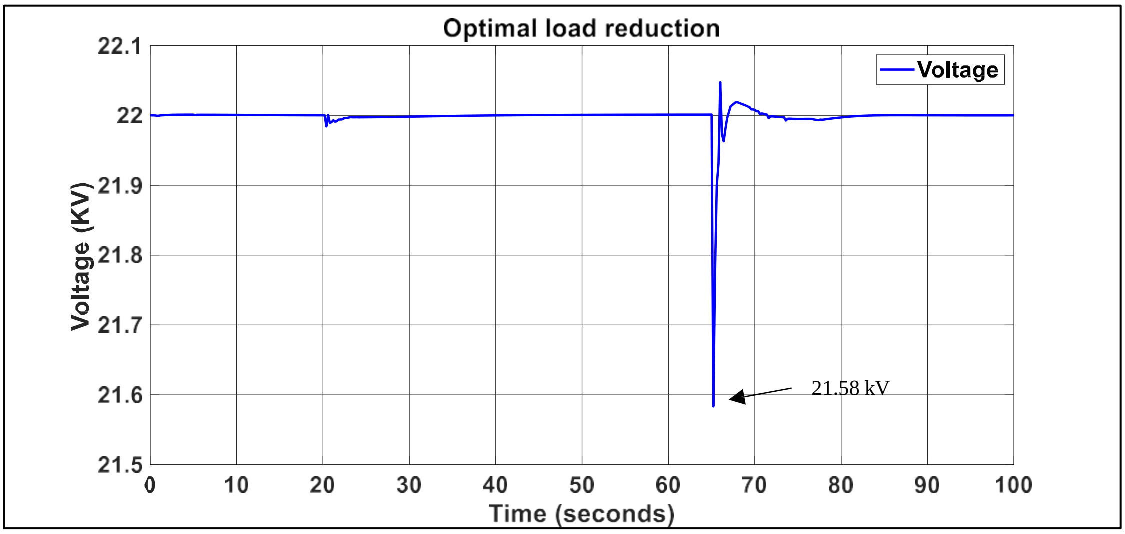


Figure 47: Variation in voltage vs time due to optimal load reduction of 68 MW after islanding.

Generation is at 22kV, when the island formed, the voltage initially experienced a sudden dip from 22kV to 21.58kV (i.e., 1.9%) which further stabilized around 22kV.

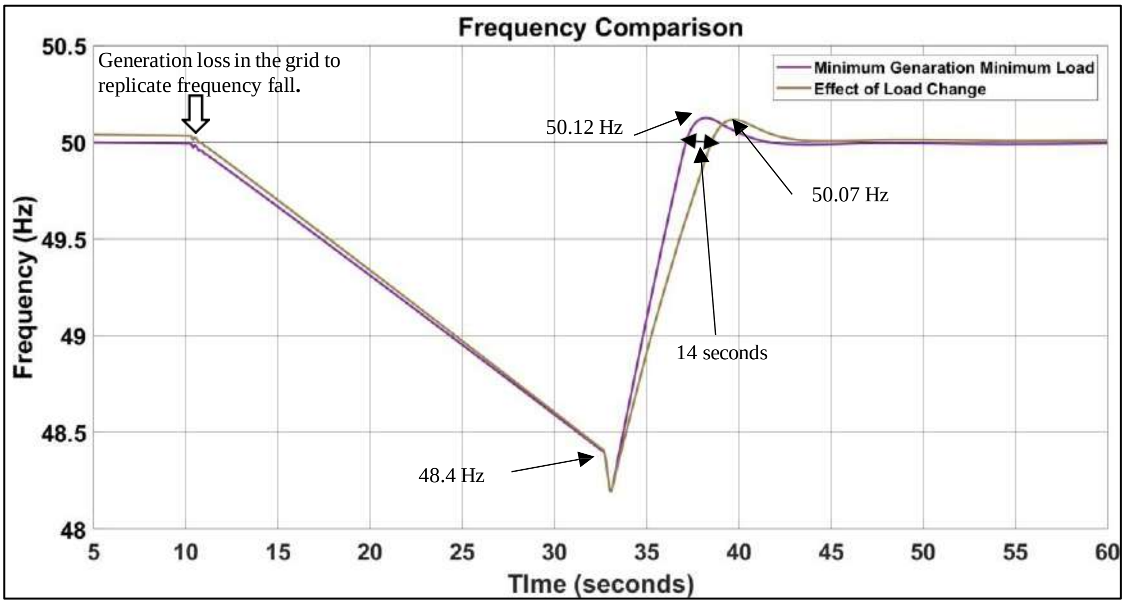


Figure 48: Frequency comparison between Case 3 and Case 13

As seen from the above Figure 48, 14 seconds of time difference is observed while the frequency was stabilizing to its final value. This is observed when simulating a load shed of 68MW compared to 74 MW at the moment of island formation.

3.1.13. Case 13: Load increment of 12.5MW after island formation

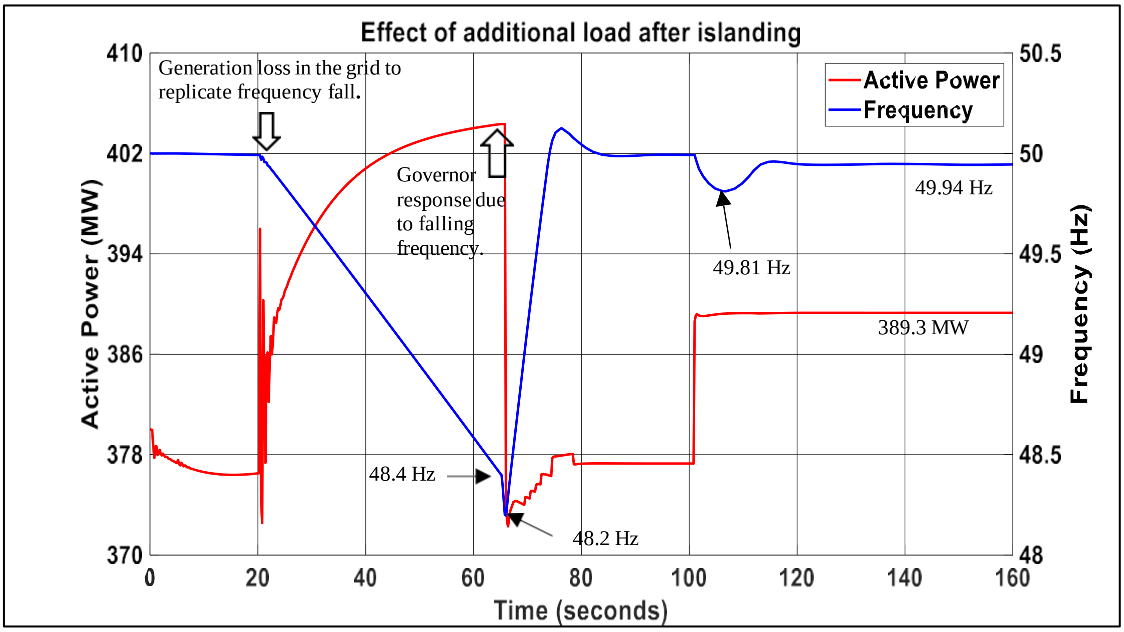


Figure 49: Variation in active power and frequency vs time due to load increment of 12.5 MW after islanding.

In reference to Case:3 (Generation=380 MW and Load = 500 MW), an increment of load of 12.5 MW i.e., 2.5% of the initial load has been added into the network post island formation.

Simulation outcomes for this case reveal that subsequent inclusion of 12.5 MW in the network post-islanding formation a decrement in frequency 49.81 Hz has been observed over a duration of 20.8 seconds. Frequency stabilizes to its final value of 49.94 Hz corresponding to generation of 388 MW.

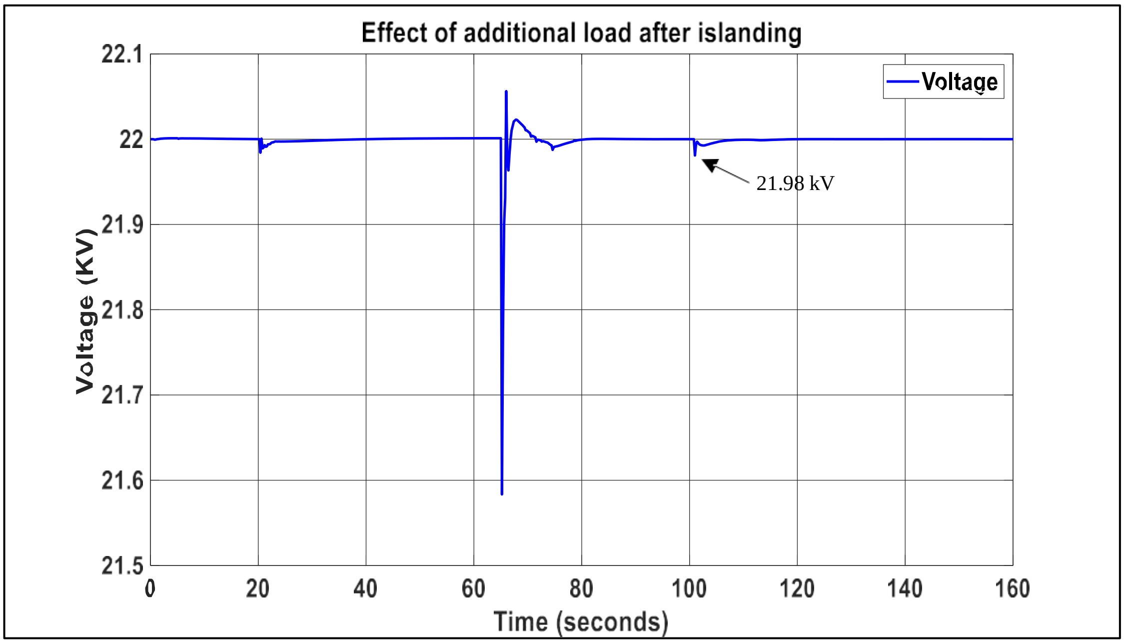


Figure 50: Variation in voltage vs time due to load increment of 12.5 MW after islanding.

Generation is at 22kV, when load added after the island was formed, the voltage experienced a sudden dip from 22kV to 21.98kV (i.e., 0.09%) which further stabilized around 22kV.

3.1.14. Case 14: Load increment of 20 MW after island formation

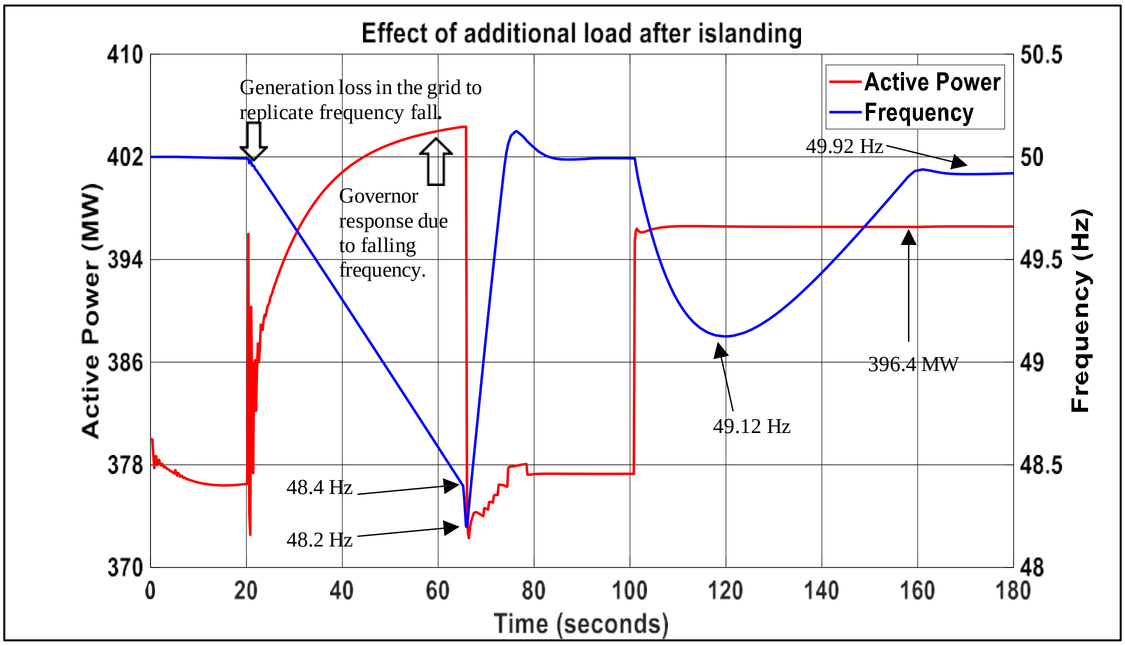


Figure 51: Variation in active power and frequency vs time due to load increment of 20 MW after islanding.

In reference to Case:3 (Generation=380 MW and Load = 500 MW), an increment of load of 20 MW i.e., 4% of the initial load has been integrated into the network post island formation.

Simulation outcomes for this case reveal that subsequent inclusion of 20 MW in the network post-islanding formation a decrement in frequency 49.12 Hz has been observed over a duration of 34.1 seconds. Frequency stabilizes to its final value of 49.92 Hz corresponding to the generation of 396.4 MW.

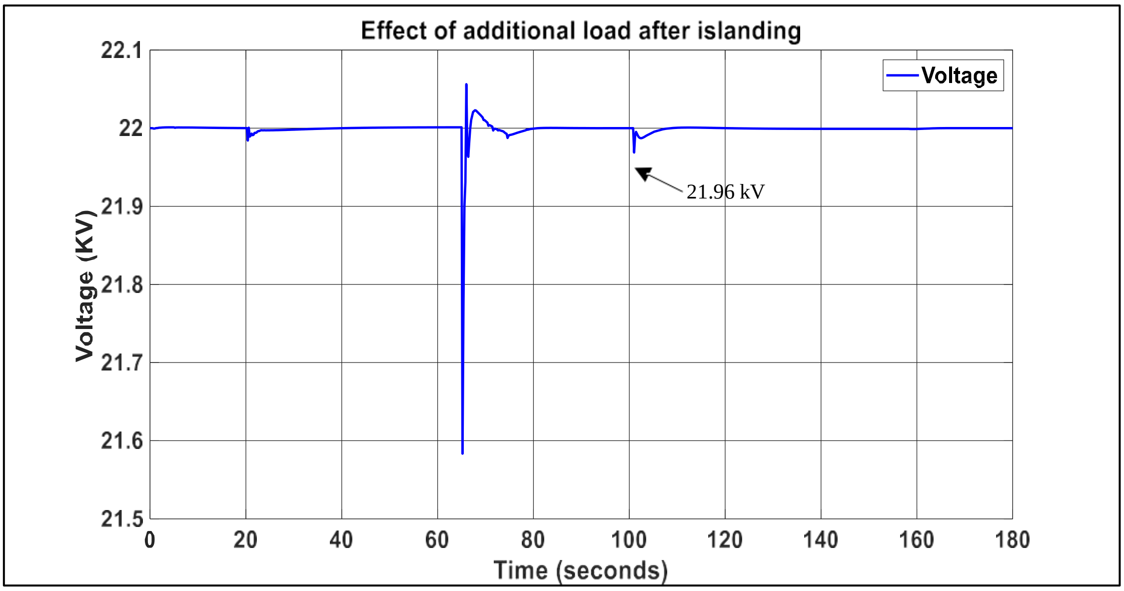


Figure 52: Variation in voltage vs time due to load increment of 20 MW after islanding.

Generation is at 22kV, when load added after the island was formed, the voltage initially experienced a sudden dip from 22kV to 21.96kV (i.e., 0.18%) which further stabilized around 22kV.

3.1.15. Case 15: Load increment of 22 MW after island formation

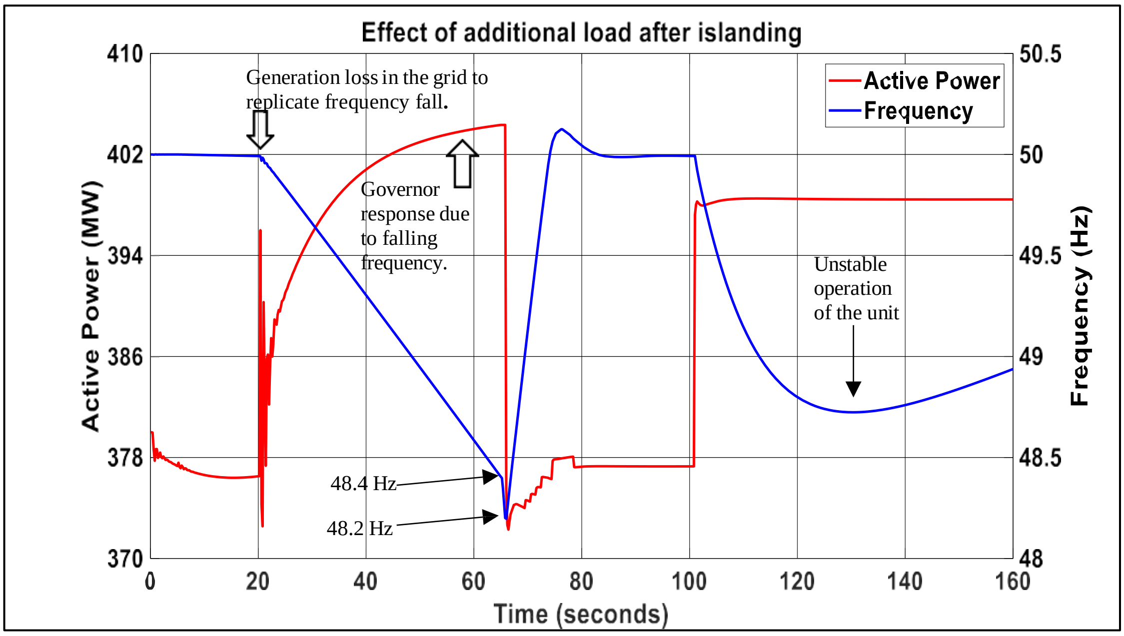


Figure 53: Variation in active power and frequency vs time due to load increment of 22 MW after islanding.

In reference to Case:3 (Generation=380 MW and Load = 500 MW), an increment of load of 22 MW i.e., 4.4% of the initial load has been integrated into the network post island formation.

Simulation outcomes for this case reveal that subsequent inclusion of 22 MW in the network post-islanding formation a decrement in frequency has been observed. With generation increasing to 396.4 MW and final frequency could not get stabilized since the unit was not able to hold the additional load of 22 MW, resulting in in the unstable operation of the unit.

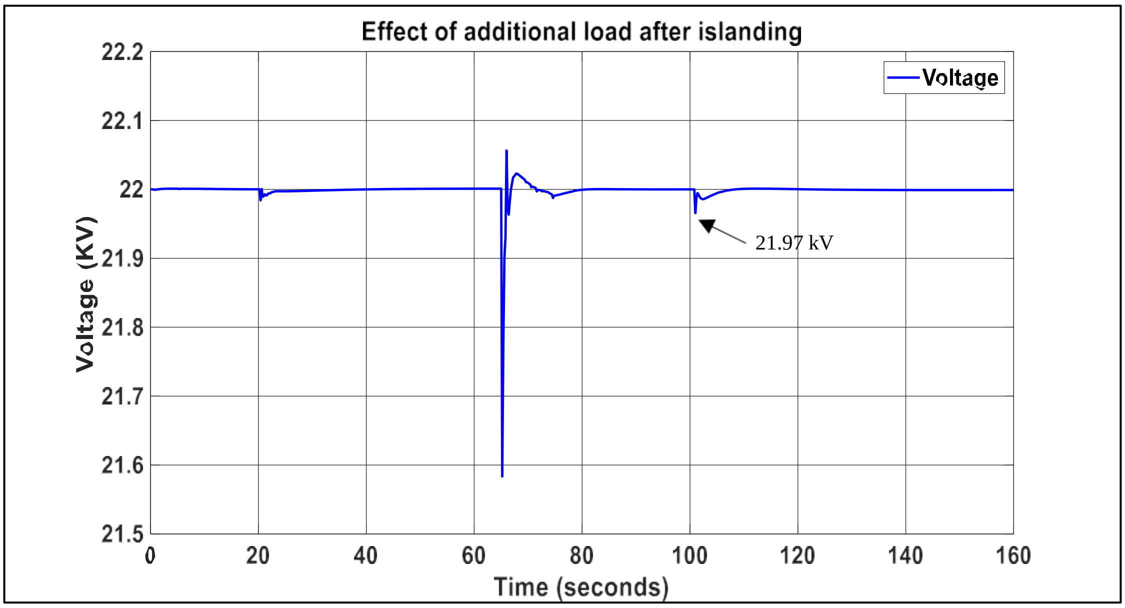


Figure 54: Variation in voltage vs time due to load increment of 22 MW after islanding.

Generation is at 22kV, when load added after the island was formed, the voltage initially experienced a sudden dip from 22kV to 21.97kV (i.e., 0.14%) which further stabilized around 22kV.

3.1.16. Case 16: Load shed time delay.

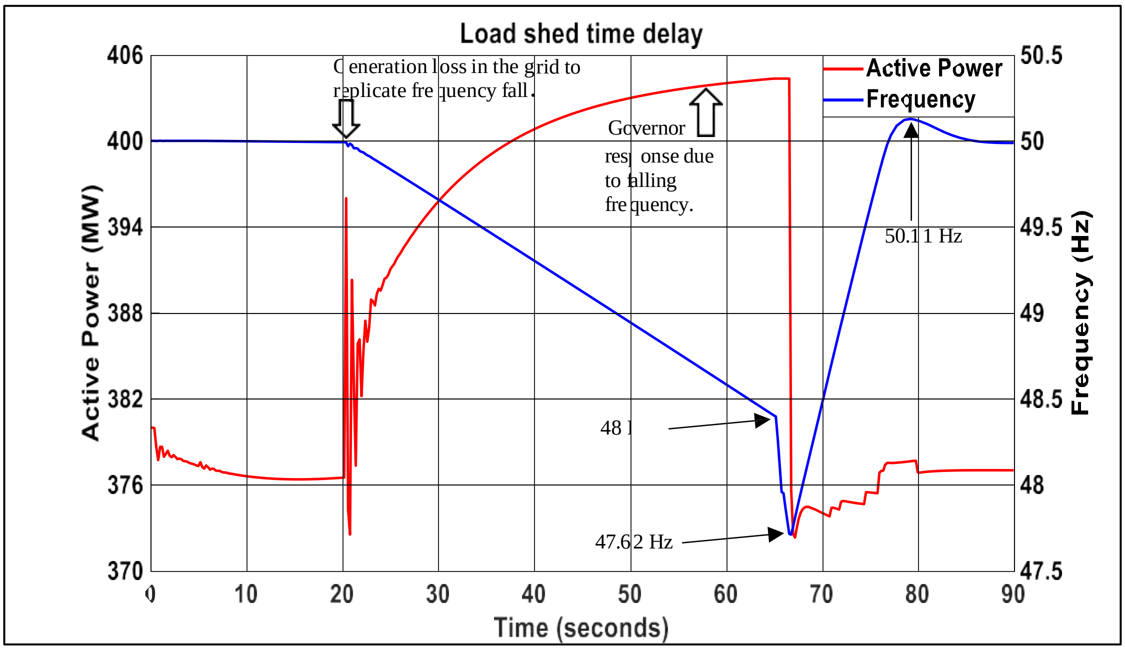


Figure 55: Variation in active power and frequency vs time due to effect of load shed time delay in reference to Case 3.

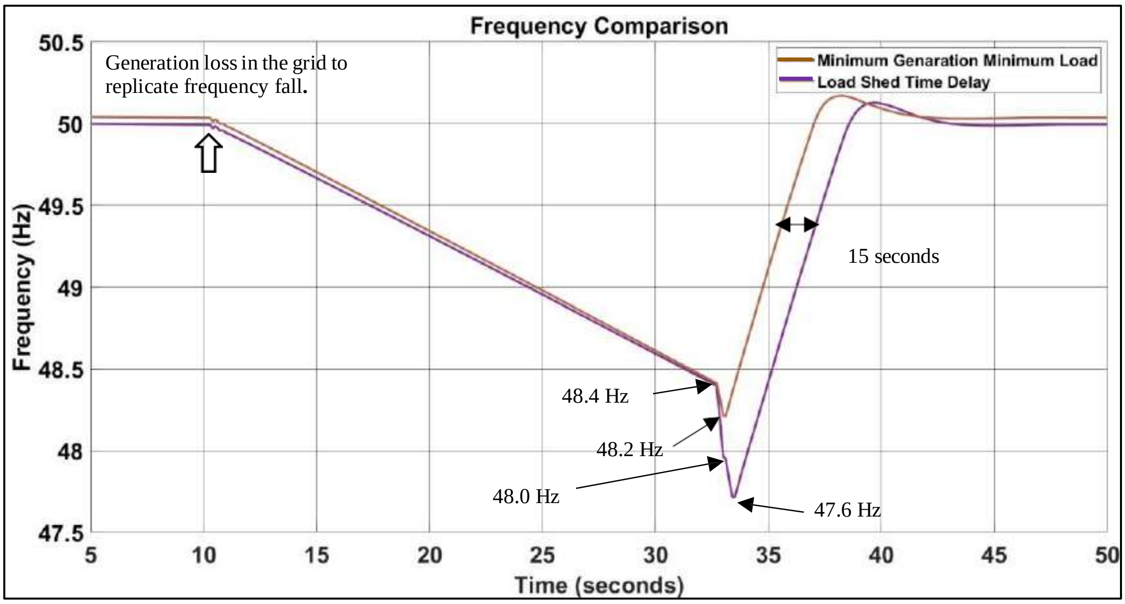


Figure 56 : Frequency comparison between Case 3 and Case 17

In reference to case 3, a delay of 600 milliseconds was introduced in load shedding at the moment of island formation. As compared to case 3, 50 MW load is tripped at 48 Hz. Furthermore, additional load of 74 MW is tripped at 47.62 Hz as shown in Figure 55 and finally the frequency stabilizes to 50 Hz.

The time taken by the frequency to stabilize from the moment of island formation of the unit is 9.8 seconds in case 3 whereas 11.1 seconds is observed for this case.

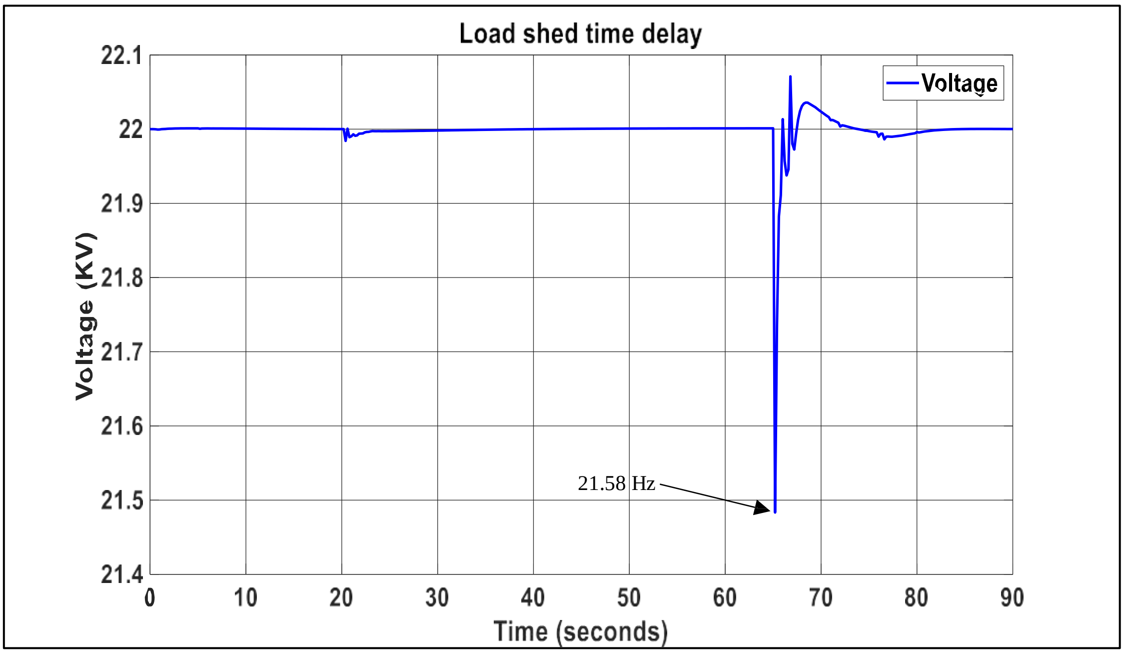


Figure 57: Variation in voltage vs time due to effect of load shed time delay in reference to case 3.

Generation is at 22kV, when the island formed, the voltage initially experienced a sudden dip from 22kV to 21.58kV (i.e., 1.9%) which further stabilized around 22kV.

3.1.17. Case 17: Island Formation (49Hz) with Rate of Change 0.5Hz/s

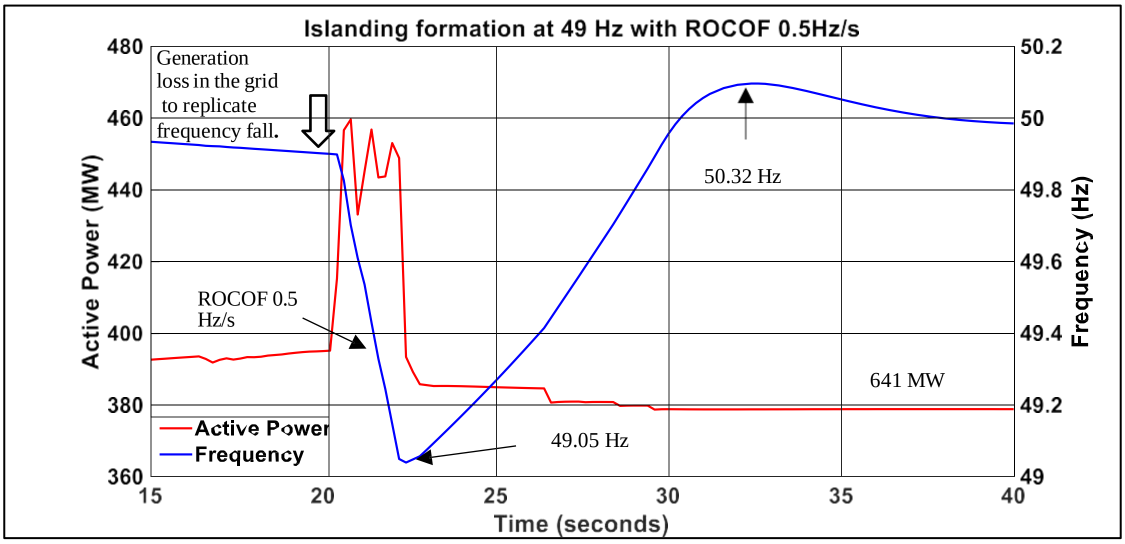


Figure 58: Variation in active power and frequency vs time during island formation at 49 Hz with ROCOF 0.5 Hz/s.

In reference to Case:3 (Generation=380MW and Load=500MW) island is formed at 49.05 Hz frequency with rate of change of frequency is 0.5Hz per seconds.

During an event of grid disturbance, rate of change of frequency (ROCOF) of 0.5Hz /sec is simulated, and the unit islanded at 49.05 Hz. The simulations revealed a continuous fluctuation for 1.8 seconds in active power from the moment the frequency began to fall, to balance the mismatch between the generation and island network load demand, a load shed of 124MW was performed at 49.05 Hz.

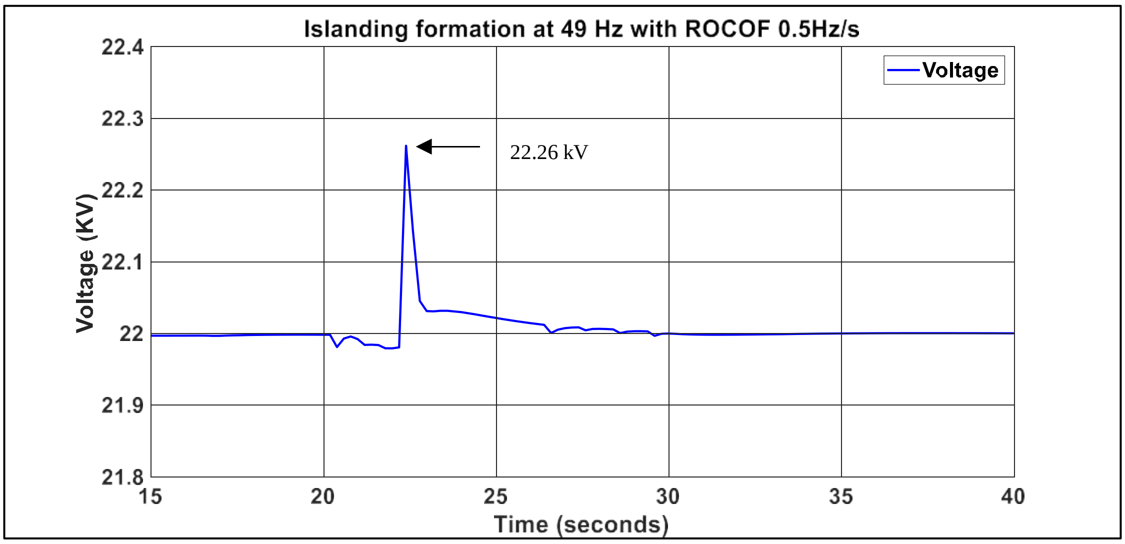


Figure 59 :Variation in voltage vs time during island formation at 49 Hz with ROCOF 0.5 Hz/s.

For a ROCOF of 0.5Hz/sec, a voltage variation of 1.18% was observed when the unit undergoes islanding.

3.1.18. Case 18: Island Formation (48.4Hz) with Rate of Change of frequency 0.5Hz/s

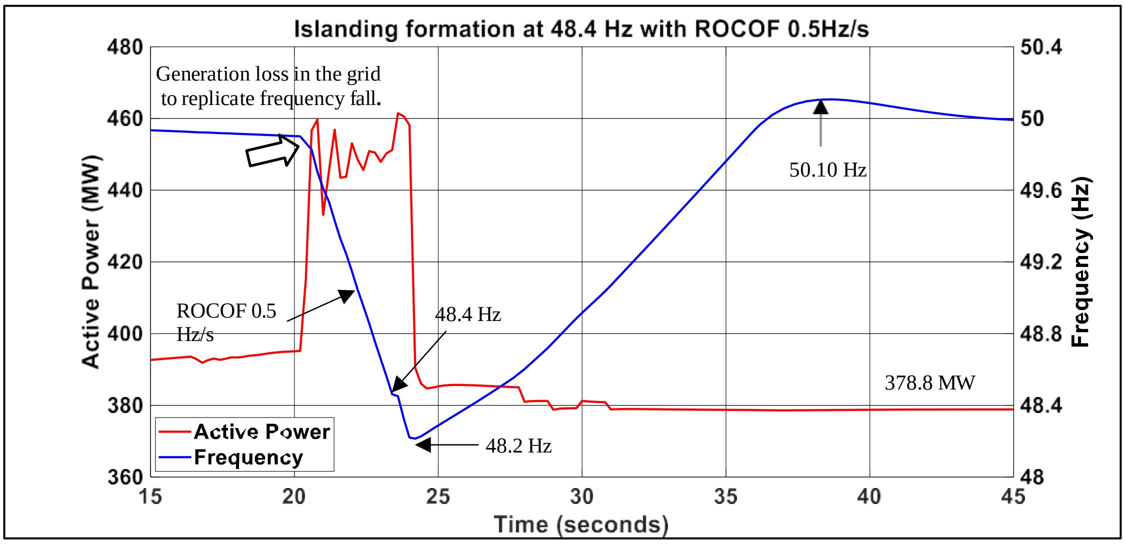


Figure 60 : Variation in active power and frequency vs time during island formation at 48.4 Hz with ROCOF 0.5 Hz/s.

In reference to Case:3 (Generation=380MW and Load=500MW) island is formed at 49.05 Hz frequency with rate of change of frequency is 0.5Hz per seconds.

During an event of grid disturbance, rate of change of frequency (ROCOF) of 0.5Hz /sec is simulated, and the unit islanded at 48.4 Hz, along with the load shed of 50MW at 48.4Hz, further a load shed of 74MW was simulated at 48.2Hz. The simulations revealed a continuous fluctuation in active power for 4.2 seconds from the moment the frequency began to fall to balance the mismatch between the generation and island network load demand. This indicates that the unit would have difficulty sustaining such continuous oscillations till the frequency restores finally to 50Hz.

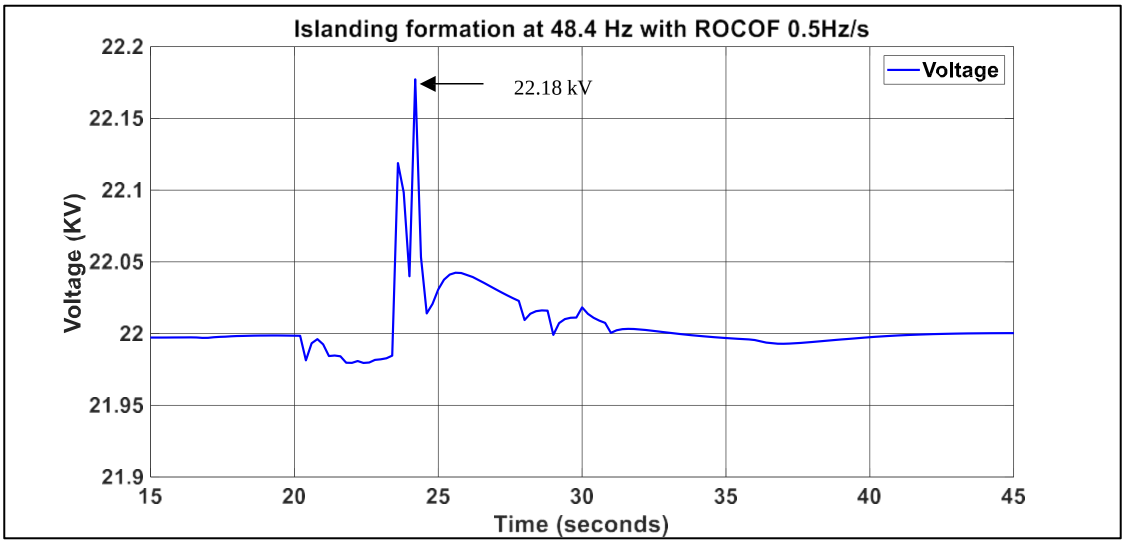


Figure 61 :Variation in active power and frequency vs time during island formation at 48.4 Hz with ROCOF 0.25 Hz/s.

For a ROCOF of 0.5Hz/sec, an increase in voltage at the instant of islanding (49Hz) was 22.26 kV from 22kV. A voltage variation of 1.18% was observed when the unit undergoes islanding.

3.1.19. Case 19: Effect of Linear and Non-Linear Valve behavior on Active Power

In all the above simulation cases performed, a linear relation between the governor output and active power was assumed as shown in Figure 62.

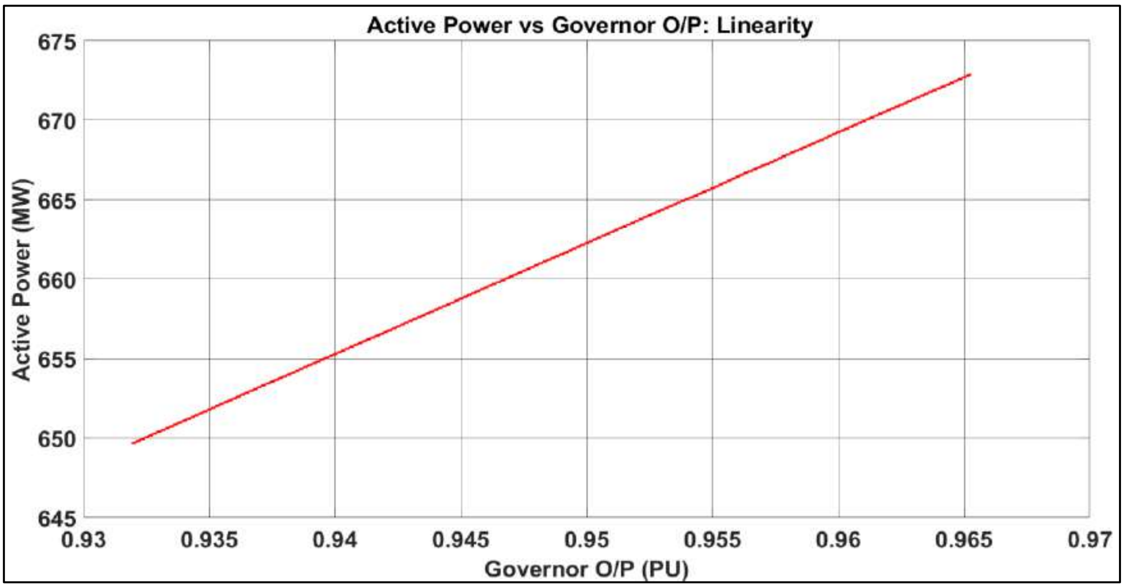


Figure 62:Linear behavior in governor output and Active Power.

Typically, there may be a case where the relationship between governor output and active power is nonlinear among different operating levels. Hence to explore the effect of non-linearity on the stability of island operation a non-linearity between the governor output and active power was introduced in the simulation model in the range of 630 MW to 680 MW as shown in Figure 63. The load variations of 26 MW and 30 MW post island formation is simulated with linear and nonlinear behavior.

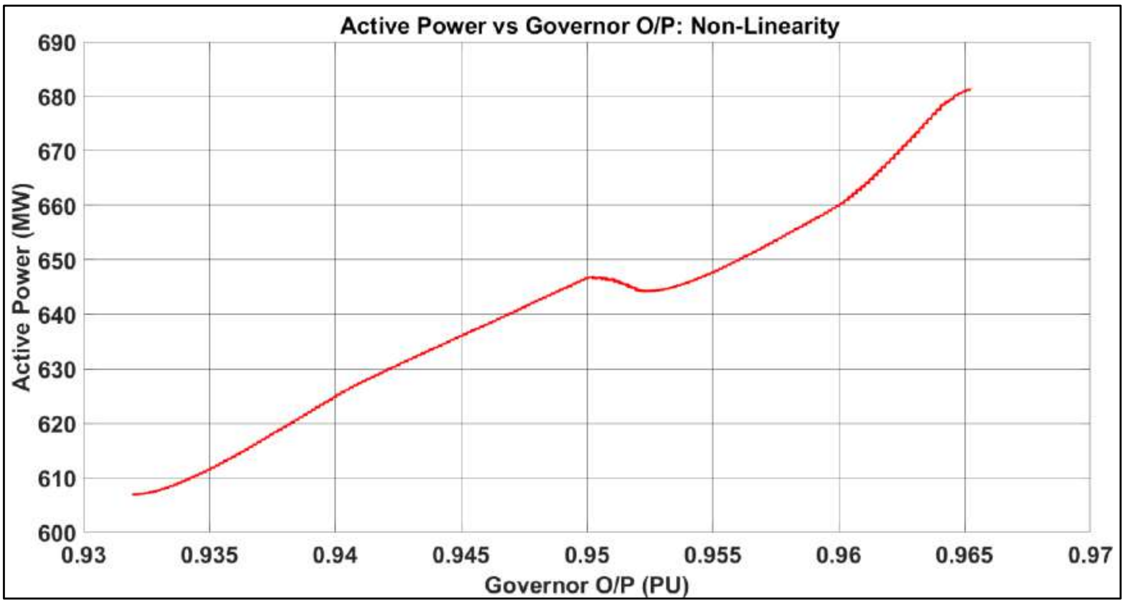


Figure 63:Non- Linear behavior in governor output and Active Power.

To compare the effects of linearity and non-linearity between the governor output and active power, the following simulation cases are conducted and discussed below.

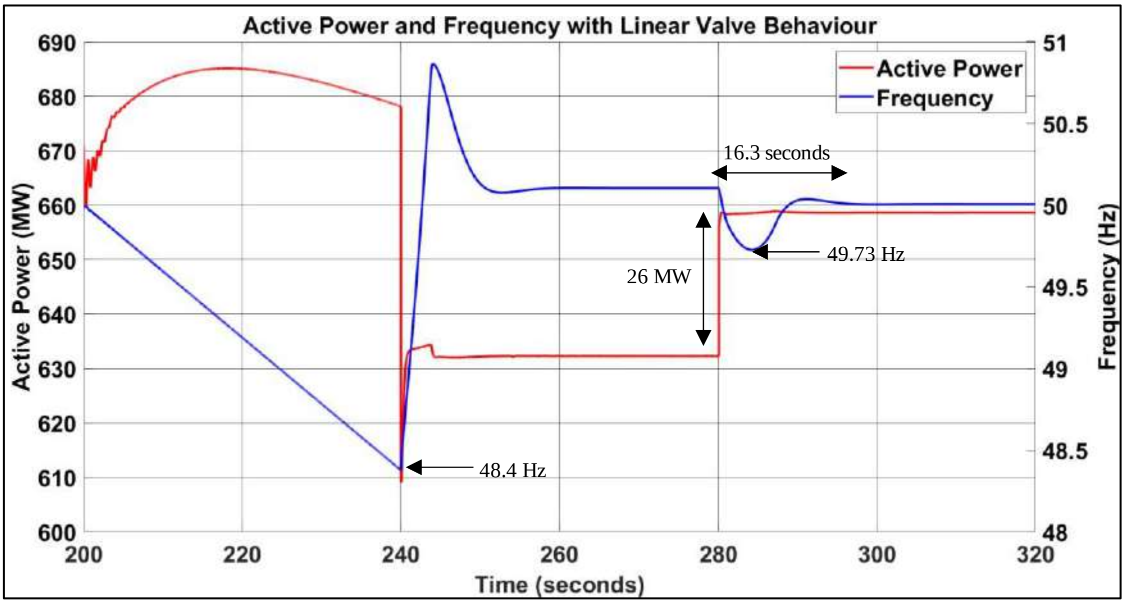


Figure 64:Effect of Linear Valve behavior in increment of 26MW in post island network.

A load increment of 26MW post islanding is simulated taking linear behaviour in that region, while adding 26MW post islanding, it was observed that for linear valve behaviour a frequency dip of 49.72Hz for a time span of 16.35seconds. Later the frequency was stabilized to the final value of 50.08 Hz as shown in Figure 64.

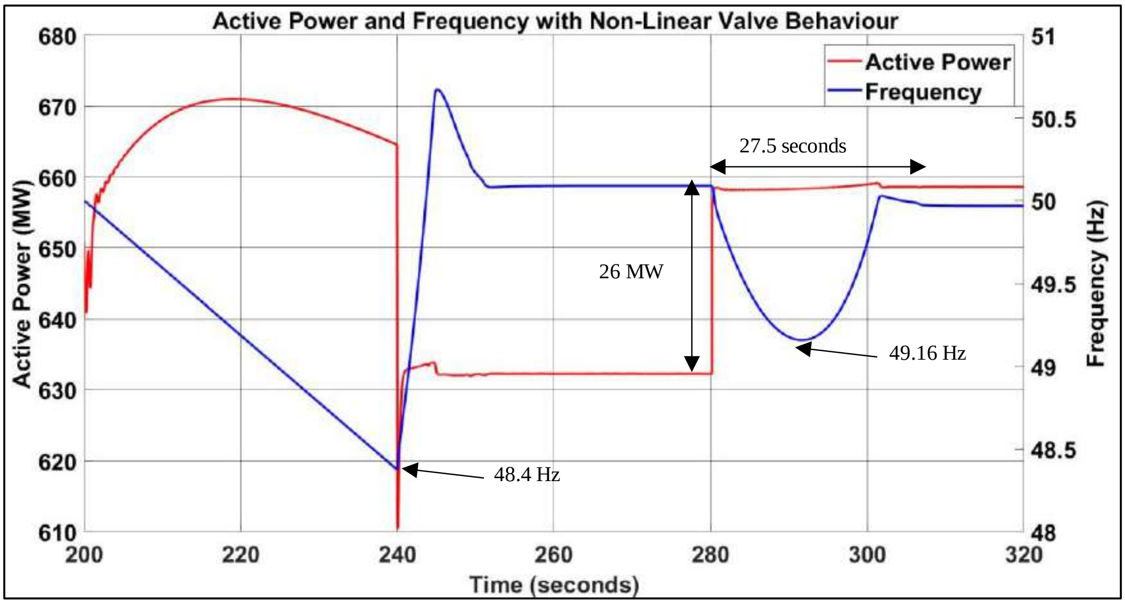


Figure 65: Effect of Non- Linear Valve behavior in increment of 26MW in post island network.

Figure 65, shows the non-linear valve behaviour, with the active power, after a load increment of 26 MW in the post island network, shows a frequency dip of 49.15Hz for a span of 26.94 seconds and final frequency stabilizing to 49.97 Hz.

Thus, it can be concluded that for a load increment of 26 MW post islanding there is large frequency dip for a longer duration in non-linear valve behaviour compared to linear valve behaviour.

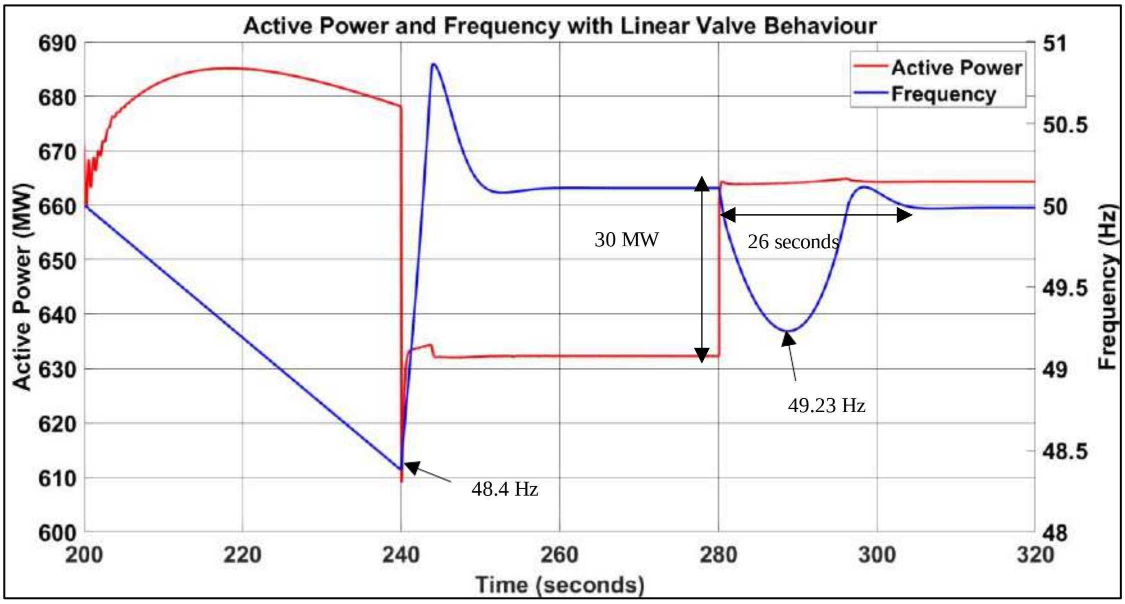


Figure 66: Effect of Linear Valve behavior in increment of 30MW in post island network.

As shown in Figure 66, a load increment of 30 MW in post island network is shown, considering a linear behaviour, between the valve and active power. It was observed that for linear valve behaviour for the increment of 30MW in post island network a frequency dip of 49.22 Hz was observed for a time span of 25.25 seconds in the post island network, and unit finally stabilizing to 49.98 Hz.

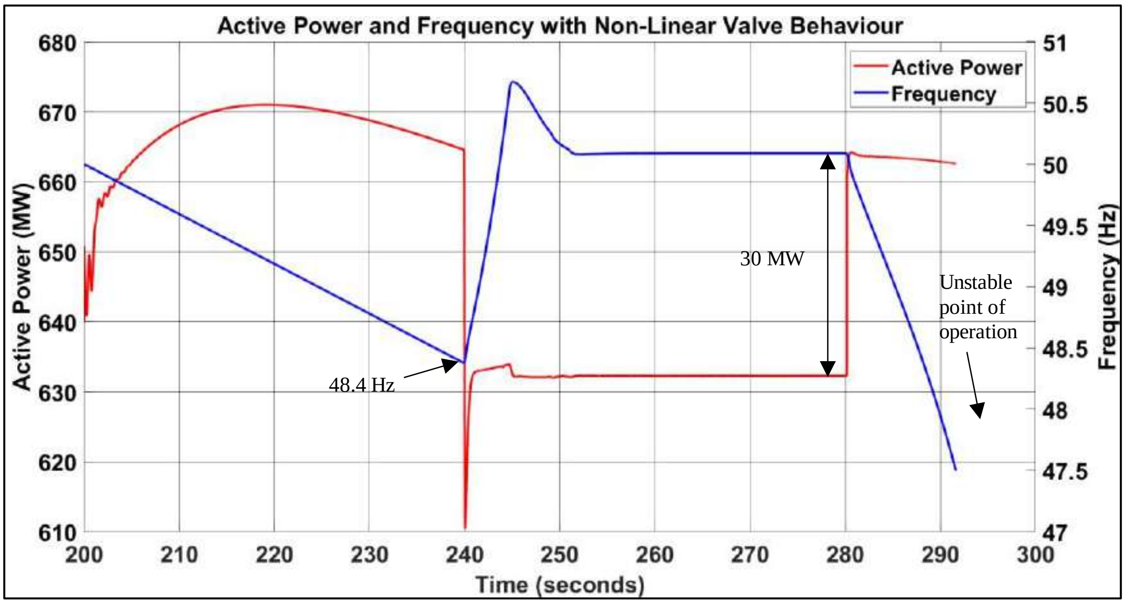


Figure 67:Effect of Non-Linear Valve behavior in increment of 30MW in post island network.

As shown in Figure 67, it was observed that for non-linear valve behaviour, a load increment of 30MW post islanding results in tripping of unit indicating an unsuccessful operation of the unit which earlier showed a successful island operation of the unit due to linear valve behaviour for similar load increment of 30MW.

From the preceding cases, it is evident that the non-linearity between the governor output and active power yields adverse outcomes compared to the linear relationship between them. Hence, to verify the simulation results from cases 1 to 19 (refer to sections 3.1.1 and 3.1.19), it is advisable to conduct online island operation tests for a more comprehensive understanding of unit undergoing islanding.

4. Islanding Scheme:

Based on the simulation performed for the Dynamic Study of Patna Islanding, it was observed that, during the event of grid disturbance unit undergoing islanding should be disconnected from the grid as soon as the grid frequency reaches 48.4Hz taking unit tripping limits of 47.4Hz into consideration OR at 49Hz, if rate of change of frequency (ROCOF) is 0.5Hz/sec (i.e., df/dt ≥ 0.05Hz/sec) (refer section 3.1.9 & 3.1.17). Additionally, the fault at the grid bus should be cleared within 220 milliseconds considering the critical clearing time (refer section 3.1.5).

When there is an excess of generation compared to the island's load demand (refer section 3.1.2), it is crucial to initiate islanding to match the generation with the island network's load demand.

However, at the same time, it’s important to ensure the stable operation of the unit, considering the steam dynamics, bypass control, boiler response etc. Additionally, to validate the simulation results, conducting island testing for scenarios where generation is in surplus and the island network's load demand is low is recommended.

In the event of a generation shortfall relative to its loading conditions, a load shedding of 50MW could be triggered (see section 3.1.3), followed by an additional load shedding of 10% of the island's load demand to balance the mismatch between generation with loading conditions. A load shedding of 150MW (see section 3.1.4) could also be activated along with a load shed of 10% of island load demand, aiming to balance the generation and load demand.

The simulation results (refer to section 3.1.7& 3.1.14) indicate the feasibility of incorporating an additional 4% of island load demand into the post-islanding network. However, based on the simulation results for unit generation at Maximum Continuous Rating (MCR), equivalent to 660MW, an additional load of 6.5% of the island network load demand is achievable.

Simulation studies on both linear and non-linear valves behavior demonstrate the necessity of conducting island operation tests to enhance our understanding of valve operation and control loop interaction of the boiler and turbine within islanded networks.

To ensure the successful operation of the unit during islanding, it is recommended that the governor operates in a free governing mode and gives priority to speed control post islanding.

5. Simulation Observations

Based on the simulations performed for several cases as mentioned in the report, the following observations with subsequent recommendations are listed below:

Case 1 and Case 2: To ensure that island frequency remains within the under-frequency setting of 47.4 Hz, it is recommended to initiate islanding at 48.4Hz. It's essential to balance the island load demand of the network in line with the generating unit undergoing islanding to maintain stable operation.

Case 3 and Case 4: To ensure that island frequency remains within the under-frequency setting of 47.4 Hz, it is recommended to initiate islanding at 48.4Hz. Whenever there is mismatch between the generation and island load demand, load shed should be conducted as necessary, with the extent determined by the criticality of the island load demand.

Case 5: By simulating the three phase to ground fault at the grid bus, it was observed that a clearing time of 220 milliseconds or below would prevent the unit from desynchronizing. Hence any delay larger than 220 milliseconds would will results in loss of synchronism for the unit.

Case 6 to Case 8: With reference to Case 1, when unit goes into island, three cases (case 6 to case 8) of incremental load were carried out post islanding. Based on this it was concluded that an increment of load to 6.5% of the total island load demand constitutes a safe operating limit. Thus, it is recommended that in the scenarios involving post island load addition, an additional load of higher than 6.5% should not be added for stable island operation.

Case 09 to Case 11: In reference to Case 1, during grid events with a high rate of change of frequency (ROCOF) of 0.5Hz/sec, islanding the network at 48.4Hz resulted in continuous oscillations in actual power, indicating difficulty in stabilizing the unit. While, for such high ROCOF events, islanding the unit at 49 Hz shown more suitable, suggesting that for rapid frequency changes, unit islanding should occur with minimum delay. However, for events with relatively slower rate of change of frequency (0.25Hz/sec) (refer case 12), it is suggested that islanding at 48.4 Hz, would give stable island operation. be safe option for the unit.

Case 12: Referring to case 3, if a load shed of 68MW was performed at the moment of islanding instead of 74MW, frequency stabilizes to its final of 50Hz at a slower rate. This implies that if the power plant process could accommodate this slower rate, a load shed of 68MW could be implemented, resulting in 6MW less reduction in the load compared to the typical load shedding scheme of 74MW.

Case 13 to Case 15: In reference to Case 3 effect of load increment post islanding was observed, from simulations it can be concluded that an increment of load to 4% of the total island load demand constitutes a safe operating limit. Thus, it can be suggested that in the scenarios involving post island load addition, an additional load of approximately 4% of the island load demand can be safely accommodated, subjected to boiler response.

Case 16: In reference to Case 3, a time delay of 600 milliseconds in load shedding was introduced while islanding, it was observed that this time delay caused the unit to initiate frequency recovery from 47.6Hz, which is in close proximity to the tripping frequency of 47.4Hz. Thus, suggesting that a delay less than 600 milliseconds is more favourable from the perspective of ensuring unit stability.

Case 17 to Case 18: In reference to case 3**,** During events with a rate of change of frequency (ROCOF) of 0.5Hz/sec, islanding the unit at 48.4Hz resulted in continuous oscillations in actual power, indicating difficulty in stabilizing the unit. While, for such high ROCOF events, islanding the unit at 49 Hz was observed to be more suitable, suggesting that for rapid frequency changes, unit islanding should occur at a frequency higher than 48.4Hz.

Case 19: While performing the simulation studies, to understand the effect of linear and non-linear valve behavior, it was noted that unit exhibits unstable operation when subjected to non-linear valve behavior, leading to tripping of unit during 30MW load increment in the post-island network. Thus, it is recommended to perform the online island operation test to analyze any non -linear valve behavior within the unit and also it will help to gain insights into control loop interaction including the effect of the boiler and turbine.

6. Recommendations

In all the simulation cases performed, the following assumptions were made:

- Main steam pressure was constant.
- Linear control valve behavior was considered.
- Response of the boiler along with turbine was assumed to be linear.

However, in practical situations, the results might vary from the findings of simulations.

To address the objectives outlined in scope item (3), Solvina had proposed conducting islanding testing at one of the units of NTPC Nabinagar in the kickoff meeting held on 01-12-2023. This test would have not only fulfilled the requirements of scope (3) but also would have provided an opportunity for NTPC Nabinagar to gain insights into governor behavior under varying load conditions.

Hence to assess the response during any contingency situations considering the above-mentioned assumptions, it is recommended to perform simulated online island operation test. By performing simulated island operation test, the actual behavior of the unit would be known, making the islanding scheme more reliable. It will further validate the findings from the simulation studies. The results of simulated island operation test shall give the following:

- Load handling capability of the turbine undergoing islanding.
- Effect of valve linearity in the entire operating range.
- Boiler response and other related control loop along with turbine.
- Identify the system bottlenecks.
- To validate the simulation results performed in this report.

The simulated online test method and benefits are described in Annexure 7.

7. References

[1] Patna islanding Revised.pdf

[2] PO-Detailed Dynamic Study of Patna Islanding Scheme with one unit of 3X660 MW at NTPC Nabinagar.pdf

[3] 2023-10-06-1.0-Input Data Validation Report for Dynamic studies of Patna Islanding.pdf

[4] Assessment-of-Inertia-in-Indian-Power-System.pdf

[5] MASTER ELECTRICAL SLD NPGC.pdf

[6] Generator data sheet and curves_0370-110-PVE-Y-0195-0A.pdf

[7] Governor model.pdf

[8] Generator Stability Study report_0370-110-PVE-W-0159-00.pdf

[9] 2020006-ER-09-01-2.0 PFR test and model validation report of Unit 1 at NPGCL Nabinagar.pdf

[10] MOM Kick-off meeting_Patna Islanding Scheme_NTPC Nabinagar.pdf

List of Annexures

Annexure 1: Generator datasheet

Generator datasheet as shared by NTPC Nabinagar Island network can be accessed using the link mentioned below:

https://drive.google.com/open?id=1L4eVKdCi9ZQgAI0GKt0A54whfNeNUcL_&usp=drive_fs

Annexure 2: Governor and turbine datasheet

Governor datasheets shared by NTPC Nabinagar Island network can be accessed using the link mentioned below:

https://drive.google.com/open?id=1LJPml_osa6gvROBP-lw6TvmLV0Og0XkZ&usp=drive_fs

Annexure 3: Turbine datasheet

Turbine datasheet shared by NTPC Nabinagar Island network can be accessed using the link mentioned below:

https://drive.google.com/open?id=1LU8Tvnb4_GCuNWgLcCyX5EqR7kGJNhuq&usp=drive_fs

Annexure 4: Transmission line data

Transmission line data shared by NTPC Nabinagar Island network can be accessed using the link mentioned below:

https://drive.google.com/open?id=1LYZihUe2xTG9po_5odS-VTdEMzWcPAhg&usp=drive_fs

Annexure 5: MOM_Kick-off meeting_Patna Islanding Scheme_NTPC Nabinagar

https://drive.google.com/open?id=1Lg6WC6NUOtIbMHAmnVCamzCtt9RJEdnf&usp=drive_fs

Annexure 6: Generator voltage variations in all simulation cases performed.

Table of voltage variation of NTPC Nabinagar generator for different simulations scenarios

Cases	Simulation Scenario	Initial voltage (kV)	Final voltage (kV)	Change in voltage(kV)	Percentage change in voltage
1	Maximum Generation and Maximum Load	22	21.83	-0.17	-0.77%
2	Maximum Generation and Minimum Load	22	21.7	-0.3	-1.36%
3	Minimum Generation and Minimum Load	22	21.6	-0.4	-1.81%
4	Minimum Generation and Maximum Load	22	21.44	-0.56	-2.54%
6	Load increment of 33.25MW post island formation (in reference to case 1)	22	21.9	-0.1	-0.45%
7	Load increment of 42.75MW after island formation (in reference to case 1)	22	21.86	-0.14	-0.63%
8	Load increment of 52.25MW after island formation (in reference to case 1)	22	21.83	-0.17	-0.77%
9	Island formation at 49Hz with f_{rate} = 0.5Hz/s (in reference to case 1)	22	21.84	-0.16	-0.72%
10	Island formation at 48.4Hz with ROCOF (f_{rate}) = 0.5Hz/s (in reference to case 1)	22	21.85	-0.15	-0.68%
11	Island formation at 48.4Hz with f_{rate} = 0.25Hz/s (in reference to case 1)	22	21.84	-0.16	-0.72%

12	Optimal load reduction during island formation (in reference to case 3)	22	21.58	-0.42	-1.91%
13	Load increment of 12.5MW (2.5% of island load) after island formation (in reference to case 3)	22	21.98	-0.02	-0.09%
14	Load increment of 20MW (4% of island load) after island formation (in reference to case 3)	22	21.96	-0.04	-0.18%
15	Load increment of 22MW (4.4% of island load) after island formation (in reference to case 3)	22	21.97	-0.03	-0.14%
16	Load shed time delay (in reference to case 3)	22	21.58	0.42	-1.9%
17	Island Formation (49Hz) with Rate of Change 0.5Hz/s (in reference to case 3)	22	22.26	0.26	+1.18%
18	Island Formation (48.4Hz) with Rate of Change of frequency 0.5Hz/s (in reference to case 3)	22	22.18	0.18	+0.81%

Annexure 7: Simulated online island operation test.

The purpose of the tests is to investigate the generator's capability to control the frequency in island operation, in a simulated grid similar to the real island grid. Furthermore, the linearity test (load sweep) & governor's open loop step response test will be performed to assess steam valve response linearity and to ensure governor's correct function in island operation respectively.

The following goals shall be reached when the tests are carried out:

- Verify correct function of droop and response to frequency changes.
- Clarify how large electric load changes can be managed during island operation without exceeding the frequency limits and within the capability of the steam system.
- Assessment of the steam valve response linearity.
- Suggestion for tuning the governor speed control if required.
- Impact of various control loop interactions (including influence from the boiler and turbine side).

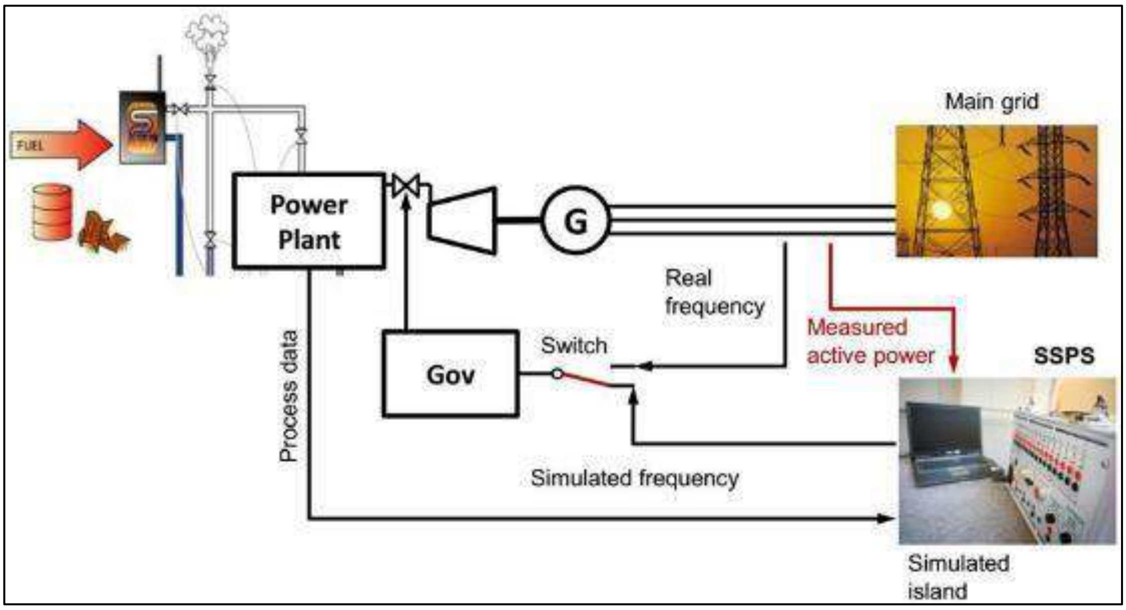
The benefits of conducting island operation test:

- Optimization during testing (Parameter tuning)
- Determine operation limits.
- Find malfunctioning equipment.
- Correct improper settings.
- Validation of dynamic model with the test results
- Control loop interaction form boiler & turbine side during islanding.

Method of Island operation test

Solvina has developed a method and test equipment for testing the capability of a turbine to keep the frequency stable in island operation while still keeping the generator synchronized to the main grid. The equipment is called SolvSim Power Station, SSPS.

The test method uses the principle of "HardWare In the Loop", meaning that a simulator, which is simulating an island grid, is connected to the speed governor of a turbine and sends a simulated frequency signal to the frequency input of the governor. The simulated frequency is calculated in real time from the balance between turbine power (which is measured as the corresponding generator power since the actual frequency is mainly constant) and the simulated electric load of the island. The speed controller will then act as if it is actually running in island operation.



Method for island operation testing.

This method allows testing the island's operation capability in a safe manner and without risking a blackout. If the simulated frequency becomes unstable due to the power plant response, then the simulation is simply stopped, and the governor returns to normal operation.

At the same time, it is a complete test since it requires the same action of the steam valve and other equipment as in real islanded operation. The capability of the boiler to keep the steam pressure stable in islanded operation is tested at the same time. The governor can be tuned during the test for best frequency stability.

During the test, the governor must be set up so that it operates in the same control mode (speed control with droop) as it would in real islanding, despite that the islanding breaker remains closed. This can be done by simulating the breaker position open.

Models of loads as well as other power producers can be included in the model of the electric island.

Detailed Project Report (DPR) for Procurement of Precision Air Conditioner(PAC) for Data Center under SCADA Upgradation Ph-III at BREDA Bhawan

Background

Bihar is undertaking a significant modernization of its power grid through the implementation of **SCADA Upgradation – Phase-III**, aimed at enhancing real-time monitoring, grid reliability, and decision-making capabilities. This initiative forms a critical component of the national **Unified Load Despatch and Communication (ULDC)** program, ensuring seamless integration and compliance with the Eastern Regional Load Despatch Centre (ERLDC) and the National Load Despatch Centre (NLDC). The project, executed in coordination with PowerGrid and awarded to M/s GE T&D India Ltd, builds upon prior SCADA phases to address the growing complexity and capacity of Bihar's transmission network.

The upgrade focuses on deploying advanced Supervisory Control and Data Acquisition (SCADA) and Energy Management System (EMS) technologies. It includes transitioning from legacy communication infrastructure to fiber-optic and SCADA-grade IP networks, thereby enabling lower latency and higher bandwidth telemetry. Enhanced EMS functionalities such as state estimation, contingency analysis incorporated to optimize grid control and dispatch efficiency. Additionally, the system introduces faster fault detection and automated restoration mechanisms, including automated fault location, sectionalizing, and rapid islanding/reclosure protocols, significantly improving system resilience.

Cybersecurity has been prioritized through compliance with international standards including IEC-62443. The system features role-based access controls, secure remote maintenance, comprehensive logging, and a multi-layered cybersecurity stack to safeguard critical infrastructure against emerging threats. Operational effectiveness is further supported by sophisticated dashboards, alarms rationalization, and operator training simulators.

To ensure operational continuity and redundancy, two control centres have been established: the primary centre at SLDC Breda Bhawan and a backup centre at Chandauti, Gaya. The upgrade is expected to facilitate faster fault management, reduce human error, enhance regulatory compliance. Ultimately, Phase-III modernizes Bihar's grid operations, fostering a shift towards proactive, data-driven grid management that strengthens reliability, safety, and market readiness in alignment with evolving national and regional energy frameworks.

Award of work

The existing SCADA system, which has been implemented in 2016 by M/s Chemtrols. This existing SCADA needs to be upgraded to the next version. The tender for upgradation of SCADA phase-III had been executed by M/s PGCIL for all Eastern Region(ER) states and the work has been awarded to M/s GE T&D India Ltd vide NOA no **CC/NT/W-SCADA/DOM/A06/23/05954/NOA-1/24-109875/01** dated **02/08/2024**.

Responsibility of the Constituents

As per the para 3.1 of Memorandum of Understanding (MoU) signed between Constituents of Eastern Region and M/s PowerGrid, The Constituents are responsible for "Construction/Renovation of building for State Load Despatch Centre, **air conditioning**, power

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supply arrangement and all related works pertaining to establishment of Load Despatch Centres at State/ Constituent level".

Accordingly, The Precision Air Conditioner (PAC) to be installed at SCADA Data Center (DC) needs to be procured and commissioned by BSPTCL. The PAC needs to be commissioned before the starting of erection/commissioning work of servers.

Requirement of Precision Air Conditioner (PAC)

- Data centres contain high-density electronic equipment that generates substantial heat during operation.
- Maintaining precise temperature and humidity control is critical to ensure equipment reliability and optimal performance.
- Climatic conditions—characterized by high ambient temperatures and seasonal humidity variations—pose challenges for stable environmental control.
- Precision needed to maintain narrow temperature and humidity tolerances required by sensitive IT equipment.
- PAC systems provide consistent and accurate control of temperature and relative humidity, preventing thermal stress, condensation, and electrostatic discharge.
- Effective heat removal by PAC reduces risks of equipment overheating, failures, and unplanned downtime, ensuring high service availability.
- Advanced control mechanisms in PAC optimize energy consumption, supporting cost efficiency and sustainability goals.
- PAC units include advanced filtration to maintain clean air quality, protecting sensitive components from particulate contamination.
- Implementing PAC is essential for operational resilience, extending equipment lifespan, and supporting uninterrupted data center services.

Infrastructure and Components of SCADA Data Centre

The data centre accommodates various SCADA (Supervisory Control and Data Acquisition) servers which are being supplied under SCADA upgradation Phase-III by M/s GE T&D. The data centre also accommodate a comprehensive range of critical infrastructure components, including the SAMAST, ABT servers and associated network devices, which are essential for advanced energy management and automation functions. Additionally, the facility supports SDH (Synchronous Digital Hierarchy) equipment, ensuring high-capacity, reliable communication links vital for network synchronization and data transmission. Together, these servers and devices form an integrated ecosystem that supports efficient operations, robust data processing, and seamless communication across multiple systems, thereby enhancing the overall reliability and performance of the control infrastructure.

Implementation Plan for installation and Commissioning of PAC

1. **Site Assessment**

- Survey the server room to determine heat load, size, and layout.
- Identify existing cooling arrangements and electrical constraints.
- Measure room dimensions, cable pathways, and airflow patterns.
- Finalize the capacity of PAC based on heat load calculations.

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2. Design & Planning

- Prepare the PAC installation layout (location, ducting, airflow direction).
- Identify placement of indoor units, outdoor units, condensate drain, and sensors.
- Finalize electrical load requirement, power backup, and stabilizer needs.
- Determine civil modifications, if any (mounting locations, openings for pipes).
- Obtain approvals from the concerned authority/PAC.

3. Procurement of Equipment

- Prepare technical specifications for PAC.
- Float tender and select vendor.
- Receive and inspect all the supplied items.

4. Site Preparation

- Clean and clear the server room installation area.
- Prepare mounting platforms for the indoor and outdoor units.
- Create wall openings for copper piping and wiring (if required).
- Ensure electrical cabling, MCB, proper earthing, UPS backup/isolated supply.

5. Installation of PAC Unit

Indoor Unit Installation:

- Mount the precision AC indoor unit as per design.
- Install sensors (temperature, humidity) and return air pathways.
- Connect drain line with proper slope and insulation.

Outdoor Unit Installation:

- Install the outdoor condensing unit on a stable platform/stand.
- Connect copper pipes, refrigerant lines, and electrical wiring.
- Install vibration absorbers and weather protection.

6. Electrical Integration

- Connect PAC to dedicated electrical panel.
- Integrate with existing Generator backup if required.
- Ensure cable routing is neat and labelled.

7. Testing & Commissioning

- Charge refrigerant (if needed) and verify leakage-free piping.
- Test cooling performance, airflow, humidity control, and alarms.
- Run the PAC for at least 6–8 hours continuously to observe stability.
- Configure temperature threshold alarms and remote monitoring (if available).
- Provide operation manual, warranty documents, and AMC details.
- Submit final installation report with performance test results.

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8. **Maintenance Plan**

- The PAC will be under maintenance contract for 07 years including 01 year of Warranty period.
- Atleast Monthly cleaning and inspection of filters and coils.
- Minimum Quarterly preventive maintenance by vendor.
- Atleast Annual deep servicing and performance test.

Implementation Team

The over all work will be executed by ULDC and IT team of BSPTCL. The detailed responsibility has been mentioned below:-

Work Incharge: EEE, ULDC & DBA will be the work incharge. AEE, ULDC& ITM will check and admit the bills raised under this project and the same will be duly verified by Work Incharge. Work completion certificate shall be issued after duly signed by Work Incharge.

Engineer Incharge: ESE, ULDC will be Engineer-In-Charge (Nodal Officer) of the overall project and countersign the invoices raised and shall issue the taking over certificate of the project after satisfactory operational report.

The over all projected will be monitored by Chief Engineer (System Operation).

Heat Load calculation

Accurate heat load calculations are essential for designing efficient Precision Air Conditioning (PAC) systems in a data centre. These calculations ensure that the cooling infrastructure is properly matched to the actual thermal output of the equipment. Without this accuracy, systems may be under-sized, leading to insufficient cooling, overheating, and potential damage to critical IT hardware. By basing PAC design on precise heat load data, data centres can maintain optimal environmental conditions, improve energy efficiency, and ensure reliable operation of all equipment. The heat load for the equipment to be installed at said Data Centre has been given below: -

Summary Sheet for Heat load of SCADA, SAMAST & Ewatch		
Sl.No.	Name of Servers	KW (100% rated power)
1	SCADA	33
2	Ewatch (ABT)	15.58
3	SAMAST	4.5
Total KW (100% rated power)		53.08
Total BTU/Hr		181002.8
Total Tons		15.08356667
Total BTU/Hr(Considering 25% additional for future panels)		226253.5
Total Tons (Considering 25% approximate additional for future panels)		**18.85445833**

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Size of Data Centre

As per the current situation the size of server room/ Data centre to accommodate all the servers, Network devices, SDH and other related equipment has been mentioned below: -

Length	19.9 meters
Width	4.30 meters
Height	2.86 meters
Total size	**244.7302 m³**

- 02 Nos. of wall are direct sun facing and the floor of data centre is made up of pre-fabricated material.
- Drawing of the Data centre has been attached for reference as Annexure.

Technical Design Criteria

S.No.	PARAMETERS	DESIGN CRITERIA
1.	Site Type	Data Centre / Server Room
2.	Operating Hours	24×7 continuous
3.	Redundancy Requirement	N+1 configuration
4.	Indoor Temperature	24 ± 1 °C
5.	Relative Humidity	50% ± 5%
6.	Type of PAC System	Direct Expansion, Air Cooled, Downflow
7.	Refrigerant	R-410A
8.	Control System	Microprocessor-based Controller with BMS compatibility
9.	Power Supply	415V ±10%, 3 Phase, 50Hz±5%,

Estimation of Project

The estimation of the supply, installation, testing and commissioning of Precision AC (PAC) has been prepared by analysing the BoQ received from M/s Vertiv Energy Private Limited and M/s Schenider Electric Infrastructure Limited.

I	**Total SUPPLY, INSTALLATION, TESTING AND COMMISSIONING**	79,53,419.00
	Supply Cost (85%)	67,60,406.15
	Installation, Testing and Commissioning (15%)	11,93,012.85
II	**Freight Charges (4% of average supply rate)**	2,70,416.246
III	**SERVICES**	
	6 years AMC Charges (From 2nd to 7th years)	30,39,450.00
IV	**TAXES AND DUTIES**	
(i)	GST @ 18% on I	14,31,615.42
(ii)	GST @ 18% on II	48,674.92
(iii)	GST @ 18% on III	5,47,101
	Sub Total of IV.(i)-(iii)	**20,27,391.34**

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	TOTAL (I-IV)	₹ 1,32,90,676.59
	GRAND TOTAL	**₹ 1,32,90,677.00**

The estimated amount is **₹ 1,32,90,677.00 (Rupees One Crore Thirty Two Lakh Ninety Thousand Six Hundred Seventy Seven Only)** including GST @18%. The Maintenance period is of 7 years including 1 year of warranty period. The fund will be allocated under IRF (Internal Resource Fund) for the project.

Time line

The timeline of the project shall be 6 months from the date of issuance of NOA for the supply, installation, testing and commissioning of Precision AC at Server Room of Breda Bhawan of Main SLDC.

Conclusion

The proposed Precision Air Conditioning (PAC) system has been designed in accordance with the technical requirements and relevant national and international standards. The system ensures precise temperature and humidity control, ensuring long-term performance and minimal downtime suitable for mission-critical applications such as data centres, control rooms, and IT facilities operating 24×7.

02/12/2025
Khushboo Gupta
Assistant Executive Engineer
ULDC, BSPTCL, PATNA

02/12/25
EEE/ULDC

Bihar State Power Transmission Company Limited, Patna
(A subsidiary company of Bihar State Power (Holding) company Limited, Patna)
CIN-U74110BR2012SGC018889
(Save Energy for Benefit of Self & Nation)
Head Office: 4th Floor, Vidyut Bhawan, Bailey Road, Patna- 800001
Email Id: so.dept@bsptcl.bihar.gov.in

Name of Work: - Supply, Installation, Testing, Commissioning and AMC of Precision AC for SLDC Server Room at 6th Floor of Breda Bhawan.

S.No.	Item Description	Total Amount on Estimated Average Rate for 04 Nos. of Precision AC. (in ₹)
		INR
	SUPPLY, INSTALLATION, TESTING AND COMMISSIONING	
A	**Microprocessor DX based (Air Cooled) Precision Air conditioning units (PAC Units)**	
B	PX033(4 Nos.) PAC Machine HCR M, Server Room at 6th Floor	44,14,200.00
	Refrigerant Piping & Refrigerant Gas	
1.1	-Liquid line (7/8")	3,79,960.00
1.2	-Discharge line (7/8")	3,79,960.00
2	Refrigerant Gas & Oil , R410A	2,45,635.00
C	**Power and communication cabling for PAC units from indoor to outdoor unit including termination and all accessories required**	
1.1	3C X 2.5 Sq. mm Copper Armored cable (Polycab)	99,710.00
1.2	Power Cabling from MCB to Indoor Units incl. gland and Lugs- 4CX 16Sqmm , insl. Single earthing from nearest point.	75,260.00
1.3	Sequencing/ control cabling for looping all PAC inclusive of sequencing switch . All cables FRLS type	23,776.00
1.4	Main Power Cabling from Panel to DC Room,incl. gland and Lugs- insl. earthing from nearest point	3,65,750.00
1.5	Local Isolator MCB 4P 100 A with Box	1,72,300.00
1.6	Flexible Earthing Cable 1C x 16 Sqmm (Polycab)	1,08,000.00
D	**Refrigerant pipe tray (18 G) including supporting structure, bends, Tees etc and other accessories for the laying refrigerant pipes and control cables, power cables as per requirement**	
1.2	Ladder Cable tray provision cabling	1,74,775.00
1.3	Perforated Cable tray provision cabling cover	1,34,900.00
E	**Drain Piping (50 mm dia)**	**44,077.50**
F	**Ball valves (25 mm)**	18,000.00
G	**Humidifier Piping**	
1.1	32 mm dia	41,770.00
1.2	25 mm dia	10,465.00
H	**Humidifier Ball Valve**	
1.1	32 mm dia	5,250.00
1.2	25 mm dia	17,670.00
I	**Indoor unit & Outdoor unit Stand**	
1.1	Indoor unit stand	59,900.00
1.2	Outdoor MS structure (at 7flr)	2,38,270.50
J	**Extended Piping kit NRV**	97,300.00
K	**Insulation**	
1.1	Nitril Rubber Floor Insulation sheet 19 mm thick with Al foil	2,68,955.00

S.No.	Item Description	Total Amount (Ex.) Estimated Average Rate for 04 Nos. of Precision AC. (in ₹)
		INR
1.2	Ceiling Insulation TWIGA Acoustic Insulation -25mm thick (48kg/cum density) + Al sheet	2,85,455.00
L	**Misc & Floor grill**	1,79,580.00
M	**Scaffolding from ground to 7th floor**	1,12,500.00
I	**Total SUPPLY, INSTALLATION, TESTING AND COMMISSIONING**	79,53,419.00
	Supply Cost (85%)	67,60,406.15
	Installation, Testing and Comimissioning (15%)	11,93,012.85
II	**Freight Charges (4% of average supply rate)**	2,70,416.246
III	**SERVICES**	
	6 years AMC Charges (From 2nd to 7th years)	30,39,450.00
IV	**TAXES AND DUTIES**	
(i)	GST @ 18% on I	14,31,615.42
(ii)	GST @ 18% on II	48,674.92
(iii)	GST @ 18% on III	5,47,101
	Sub Total of IV ((i)-(iii))	**20,27,391.34**
	TOTAL (I-IV)	**₹ 1,32,90,676.59**
	GRAND TOTAL	**₹ 1,32,90,677.00**

28/11/2025 **A.Ex.E. ULDC** 28/11/2025 **E.Ex.E. ULDC** 28.11.2025 **ESE, ULDC**

Estimate No. 06 **Dated** 01-12-2025

TECHNICALLY SANCTIONED

For **₹ 1,32,90,677.00** (Rupees One Crore Thirty-Two Lakh Ninety Thousand Six Hundred Seventy-Seven Only) including GST@ 18% for the work of Supply, Installation, Testing, Commissioning and Maintenance (1 year warranty and 6 years AMC) of Precision AC at SLDC Server Room at 6th Floor of Breda Bhawan.

01/12/25
A.K. Chaudhary
Chief Engineer (System Operation)

Annexure-E

DETAILED PROJECT REPORT

FOR

APPOINTMENT OF AGENCY FOR TURNKEY CONTRACTS FOR DESIGN, SUPPLY, ERECTION, TESTING AND COMMISSIONING FOR ESTABLISHMENT OF EWATCH SERVER FOR ABT METER AT BACKUP SLDC AT CHANDAUTI GSS AND FOR SHIFTING OF EXISTING EWATCH SERVER FROM EXISTING SLDC AT VIDYUT BHAWAN TO BREDA BHAWAN.

Bihar State Power Transmission Company Limited, Patna.
October-2025

PREAMBLE

This proposal covers the Detailed Project Report for Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA BHAWAN under SCADA Upgradation Phase-III and Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS including all related works.

The estimated cost of the project is based on prevailing market rate.

Details are furnished below:

(Rs. In Crs.)		
Total Cost		
Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS and Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA BHAWAN		
A.	**Supply & Service Portion for Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS**	
Sl. No.	**Description**	**Total Value (Rs.) (Incl. 18% GST)**
1	Total price for Supply of all items involved in Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS.	**2,94,85,205.86**
2	Installation and Service Cost involved in Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS including 3 years of AMC and Security Audit.	**2,92,68,648.39**
B	**Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA Bhawan**	
1	Installation and service cost for shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA Bhawan.	**11,50,500.00**
	Total	**5,99,04,354.25**
	Grand Total	**5,99,04,354.00**

Note:- *As the project is envisaged to be financed from "**Internal Resource Fund (IRF)**".*

CONTENTS

Sl. No.	Description
1	**Context and Background; Justification**
2	**Scope of Work**
3	**Project Cost Estimate and Funding Arrangement**

BACKGROUND:

Bihar State Power transmission Co. Ltd (BSPTCL) a wholly Owned corporate entity under Bihar Government was incorporated under the Companies Act 1956 on 1st Nov 2012 after re-organisation of erstwhile Bihar State Electricity Board (BSEB).

Bihar State Transmission Company Limited (BSPTCL) is a State Transmission Utility under BSP(H)CL formed under the Company Act 1956 to carry out the activities related with Intra State Transmission and wheeling of electricity in the State. BSPTCL is a Deemed transmission licensee in the State of Bihar.

EXECUTIVE SUMMARY

As per **Ministry of electronics and Information Technology guidelines for Indian government websites and applications, ver. 3.0, clause 5.3.2**-

"Department to ensure the HSP is providing DC, BCP and DR environments with state-of-the-art secure infrastructure configured in high availability (HA) mode for hosting the Websites, Web Applications, Web Portals or Mobile Apps and their respective Content Management System (CMS). The HSP must ensure that the Primary Data Centre (DC), Disaster Recovery Centre (DRC) are geographically located far from each other in different seismic zones."

The SCADA system and the scheduling module of SAMAST have been declared as **Critical Information Infrastructure (CII)** by the **National Critical Information Infrastructure Protection Centre (NCIIPC)** and notified as **Protected Information Infrastructure (PII)** in the Bihar Gazette.

A **Regional Disaster Management Group (RDMG)** has been constituted in accordance with the **Disaster Management Plan for Power Sector (2022)** formulated by the Central Electricity Authority (CEA) and approved by the **Ministry of Power, Government of India**, in compliance with the **Disaster Management Act, 2005**. The status of **Emergency Operation Centers (EOCs)** / Control Rooms and their corresponding Backup EOCs / Control Rooms in the power sector is being regularly reviewed in the meetings of the **Eastern Regional Disaster Management Group (RDMG)**.

Presently, more than **4200 ABT meters** have been installed across various **Grid Sub-Stations (GSS)** of BSPTCL, BGCL and other utilities of Bihar. All these meters communicate with SLDC through **Automatic Meter Reading (AMR)** via the **eWatch server** located at the SLDC Control Room. The data fetched from these ABT meters are used for Energy Accounting, State Transmission Loss computation, real time load monitoring and generation of various analytical reports.

In view of the critical nature of these data, there is a need to establish a **Disaster Recovery Centre (DRC)** to ensure the security and continuity of ABT meter data of BSPTCL. As per MeitY guidelines (Version 3.0, Clause 5.3.2), the **Primary Data Centre (DC)** and **Disaster Recovery Centre (DRC)** must be geographically distant and situated in different seismic zones. Accordingly, **Gaya** has been identified as the suitable location for developing the **Backup SLDC**, where the **DRC** will be established, being geographically distant from the **Primary Data Centre at Patna**.

SCOPE OF WORK

The proposal for Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA BHAWAN under SCADA Upgradation Phase-III and Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS including all related works.

Sl. No.	***Proposed Schemes***
1.	Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS including all related works and AMC & Audit for 3 Years.
2.	Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA BHAWAN

SUMMARY OF THE ESTIMATED COST

Estimate for the Establishment of a Backup eWatch Server at the Backup SLDC, Chandauti GSS, including Annual Maintenance Contract (AMC), Security audit, and all associated works, as well as the shifting of the existing eWatch Server from SLDC, Vidyut Bhawan to BREDA Bhawan under SCADA Upgradation Phase–III.		
A.	**Supply & Service Portion for Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS**	
Sl. No.	**Description**	**Total Value (Rs.) (Incl. 18% GST)**
1	Total price for Supply of all items involved in Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS.	**2,94,85,205.86**
2	Installation and Service Cost involved in Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS including 3 years of AMC and Security Audit.	**2,92,68,648.39**
B	**Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA Bhawan**	
1	Installation and service cost during shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA Bhawan.	**11,50,500.00**
	Total	**5,99,04,354.25**
	Grand Total	**5,99,04,354.00**

Detail sheet of Estimated Cost has annexed.

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Cost of AMC & Audit for Backup eWatch at Gaya Ji	
AMC Cost for 3 Years (in Rs.)	
AMC Charges per lot for Year -1	3760000
AMC Charges per lot for Year -2	4211200
AMC Charges per meter lot Year -3	4716544
Cyber security audit (annualy)	
Audit -year-1st	3500399
Audit -year-2nd	3780430.92
Audit -year - 3rd	4082865.394
Total	**24051439.31**
GST @18 %	**4329259.076**
Grand Total	**28380698.39**

Details of eWatch Server

Price Breakup for Establishment of eWatch server at Backup SLDC, Chandauti GSS and Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA BHAWAN Patna under SCADA Upgradation Phase-III as per approved Technical Estimate vide this office estimate no. 04 dated 18.09.2025: -

Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS and Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA BHAWAN, Patna			
A.	**Supply & Service Portion for Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS**		
SL No.	**Description**	**Total Value (Rs.) (Incl. 18% GST)**	**Remarks**
1	Total price for Supply of all items involved in Establishment of Backup eWatch server at Backup SLDC at Chandauti GSS.	2,94,85,205.86	Capex
2	Installation and commissioning of eWatch server at Backup SLDC at Chandauti GSS.	8,87,950.00	
3	AMC for the eWatch Server at Backup SLDC and Security Audit of the eWatch Server at Chandauti GSS for a period of 3 (Three) years.	2,83,80,698.39	R&M
B	**Shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA Bhawan, Patna**		
1	Installation and service cost for shifting of eWatch Server from existing SLDC at Vidyut Bhawan to BREDA Bhawan.	11,50,500.00	
	Total	**5,99,04,354.25**	
	Grand Total	**5,99,04,354.00**	