

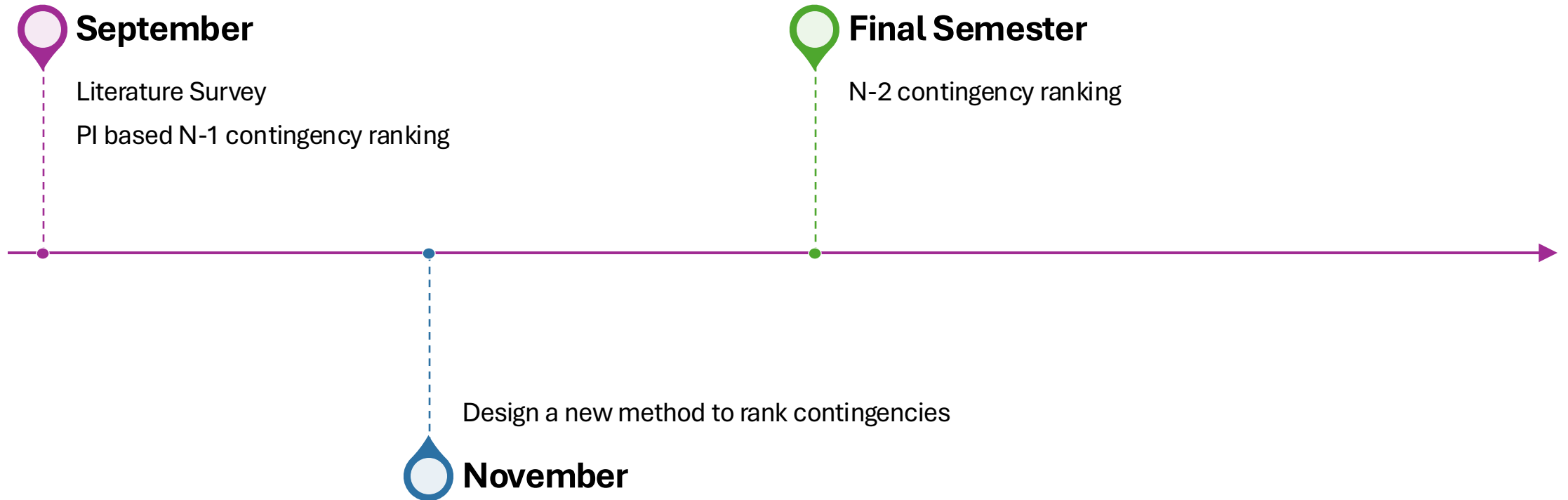
A Novel N-1 Contingency Ranking Scheme

**M.Tech. Project
Presentation
End Semester**

Under the supervision of
Dr. Ranjana Sodhi

Presented by Manish Pant

Timeline



PI based conventional N-1 contingency ranking

- For each line outage, Real power flow performance index:

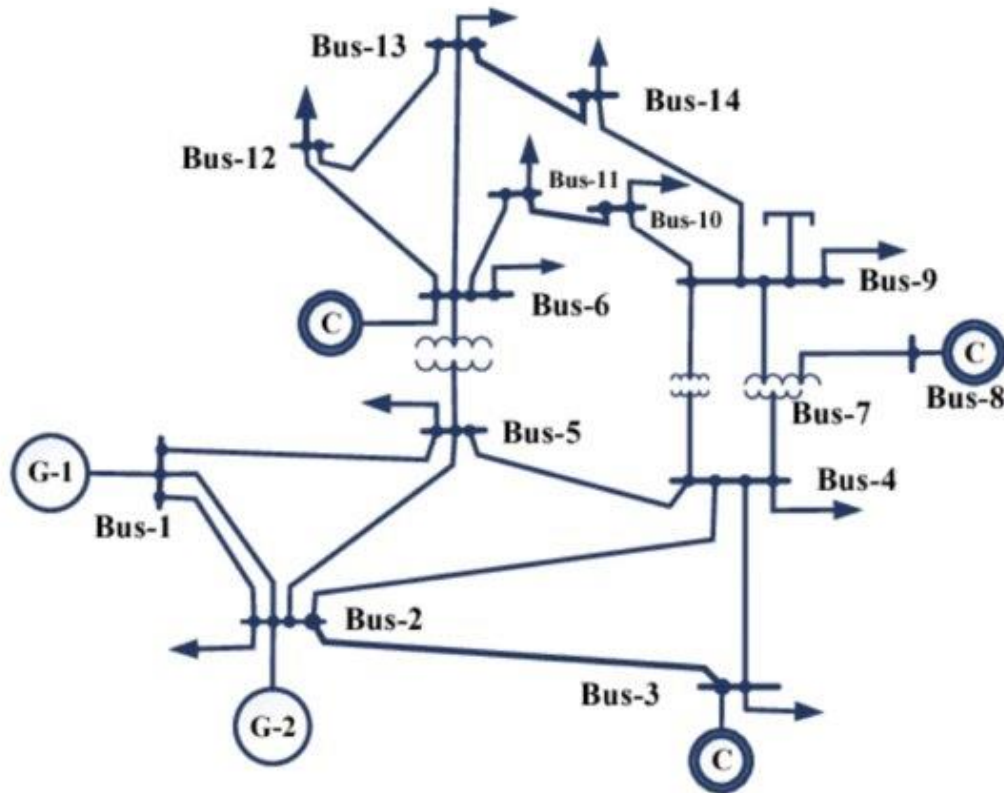
$$PI_l^c = \sum_1^{Nl} \frac{W_{li}}{2n} \left(\frac{P_{li}}{P_{li}^{max}} \right)^{2n}$$

P_{li} : Power flow in i^{th} line

P_{li}^{max} : Power flow limit of i^{th} line

W_{li} : weight of i^{th} line

N : Number of lines



Test System: IEEE 14 Bus System

Drawbacks

- Focus only on severity of contingency
- Misses real world risk factors like age of line and weather conditions
- No integration of historical failure data
- Ignores real time wide area monitoring system capabilities

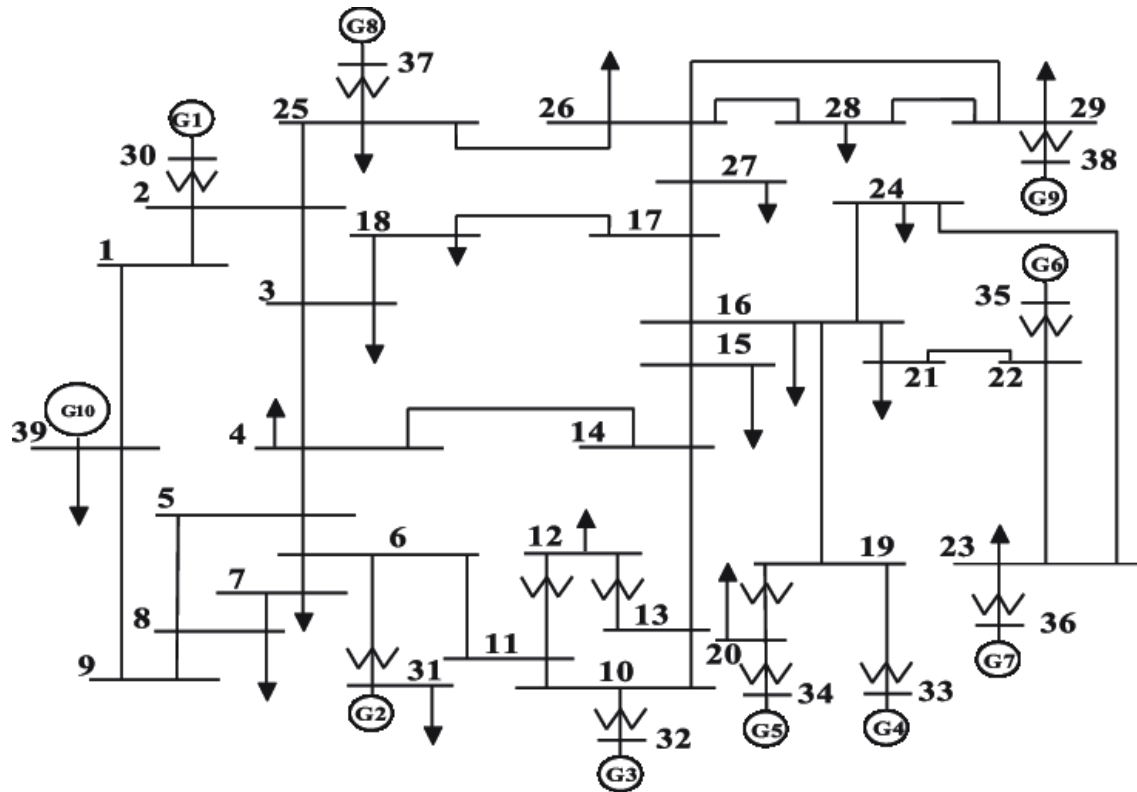
Proposed N-1 contingency ranking method

$$MPI_l^c = S \times O \times D$$

S: Severity of the outage

O: Occurrence of outage

D: Detectability of outage



Test System: IEEE 39 Bus system

Severity table

Percentile range (of PI value)	Score
0-10	1
10-20	2
20-30	3
30-40	4
40-50	5
50-60	6
60-70	7
70-80	8
80-90	9
90-100	10

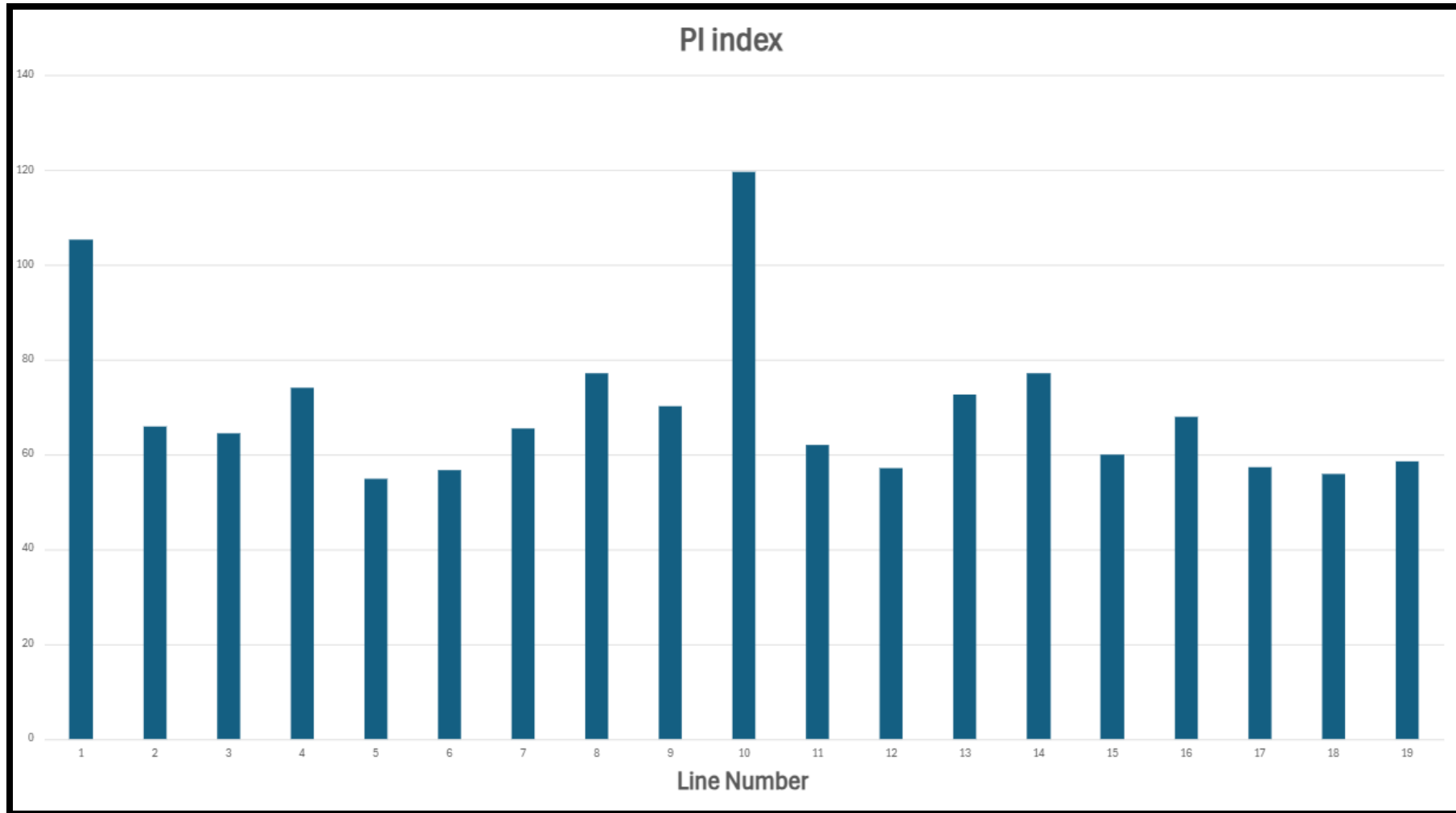
OCCURRENCE TABLE

Outage frequency	Weather condition	Age of line	Score
Low	Normal	New	1
		Old	2
	Bad	New	3
		Old	4
Medium	Normal	New	4
		Old	5
	Bad	New	6
		Old	7
High	Normal	New	7
		Old	8
	Bad	New	9
		Old	10

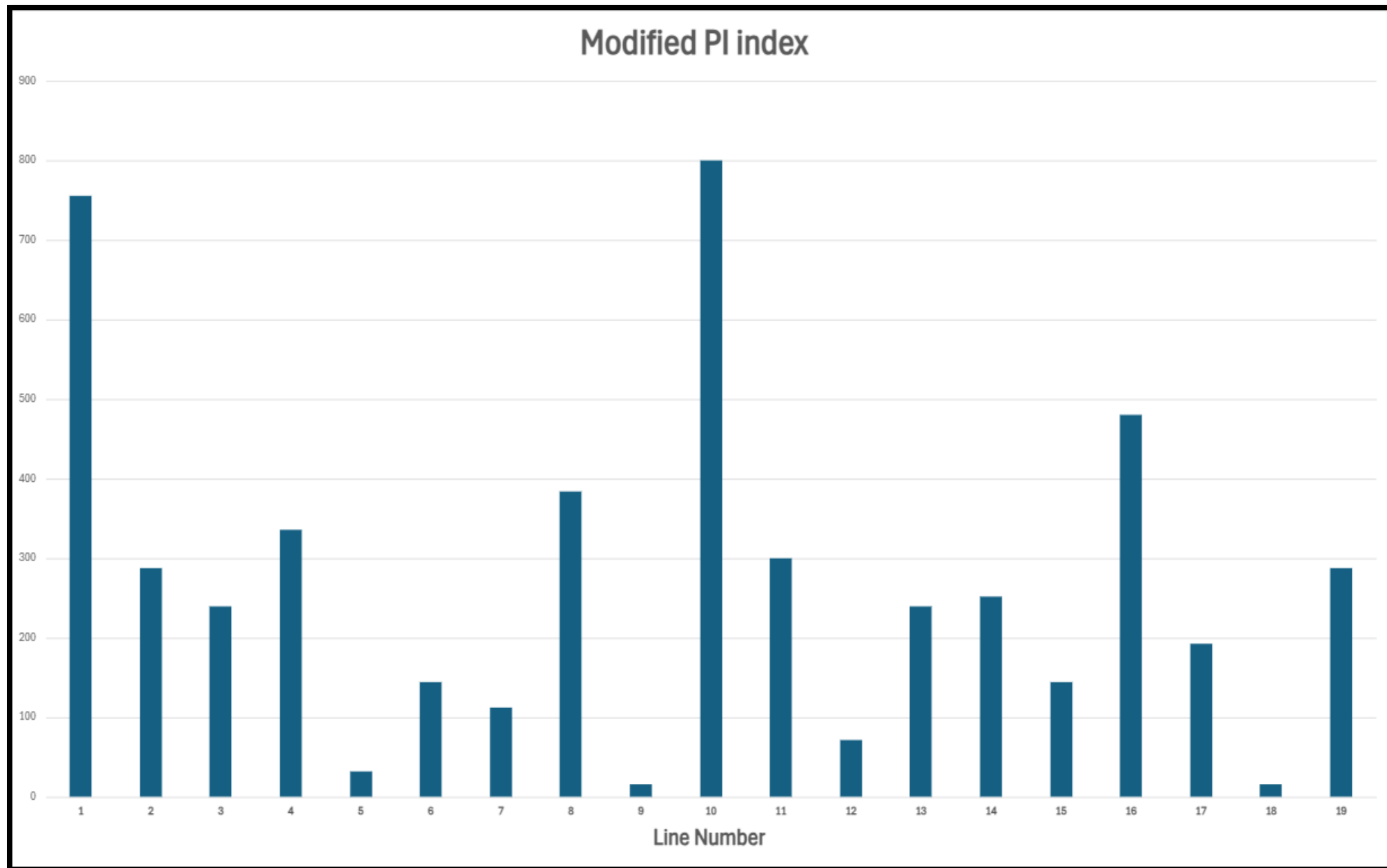
Detection Table

PMU Coverage	Score
PMU on both ends	2
PMU on one end and adjacent bus of other end	4
PMU only on one end	6
PMU on adjacent buses at both end	8
No PMU nearby	10

RESULTS



IEEE 14 Bus System



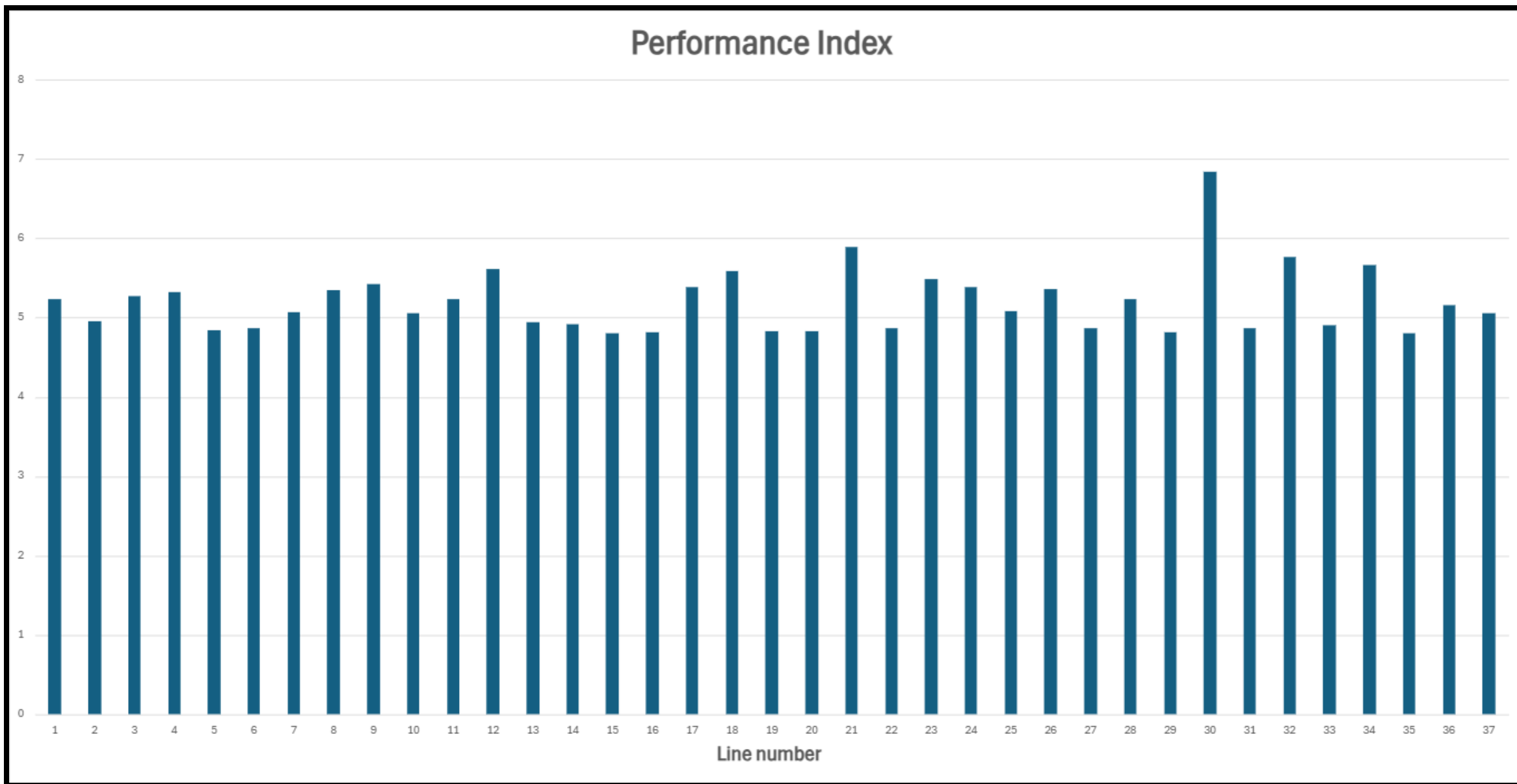
IEEE 14 Bus System

Result Comparison

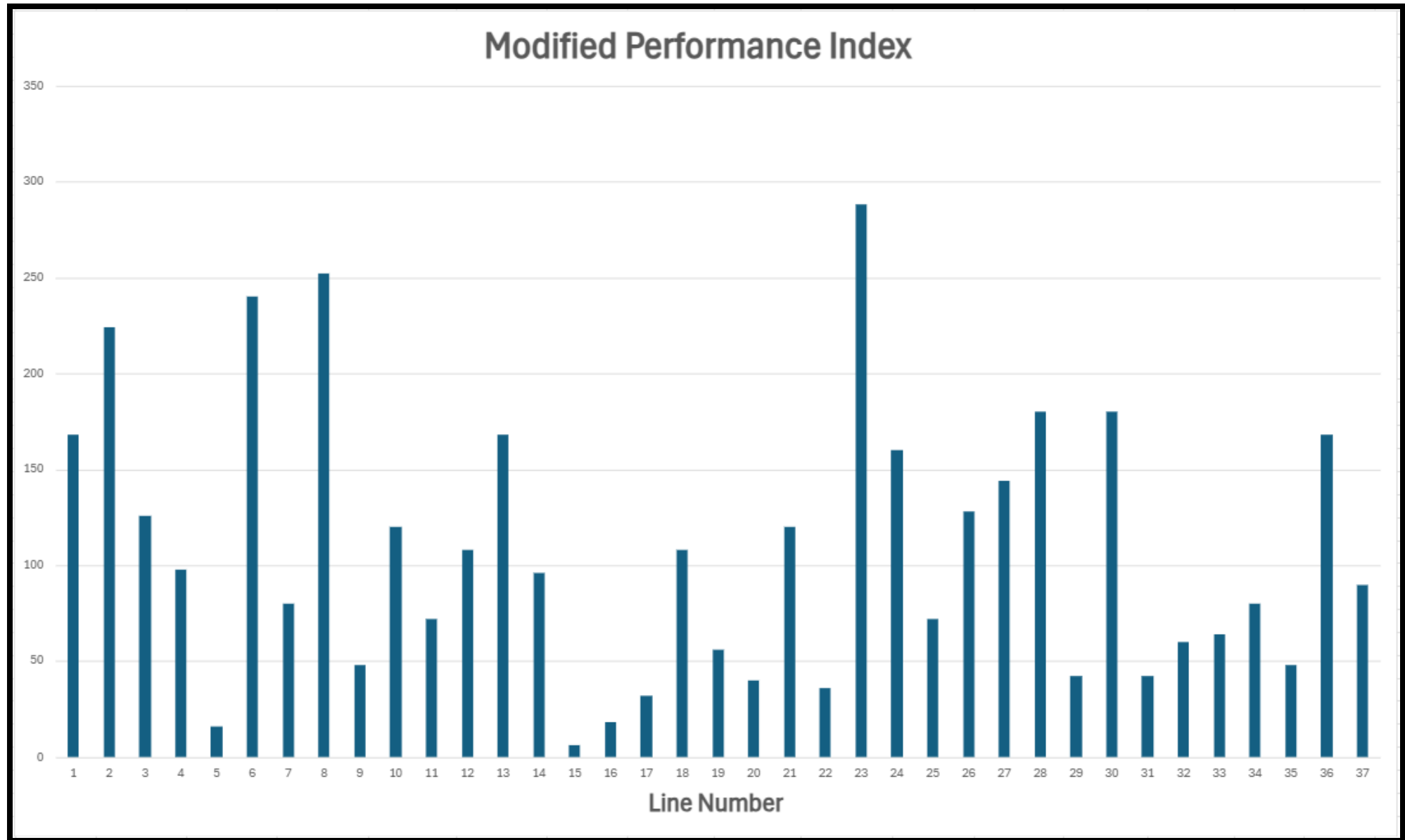
Rank	PI	Branch Participation*	Modal Analysis*	MPI
1	5~6	5~6	1~2	5~6
2	1~2	7~9	5~6	1~2
3	7~9	1~2	7~9	9~14
4	4~7	1~5	13~14	4~7
5	2~4	4~9	6~11	2~4
6	6~13	13~14	6~13	6~11
7	4~9	2~5	9~14	1~5
8	9~14	2~4	10~11	13~14
9	1~5	6~11	4~7	7~9
10	4~5	2~3	9~10	2~3
11	2~3	6~13	4~9	6~13
12	6~11	10~11	6~12	10~11
13	9~10	9~14	2~4	3~4
14	13~14	4~7	2~3	9~10
15	10~11	3~4	4~5	4~5
16	6~12	4~5	3~4	6~12
17	3~4	6~12	2~5	2~5
18	12~13	12~13	1~5	4~9
19	2~5	9~10	12~13	12~13

*Gao, B., Morison, G. K., & Kundur, P. (1992). Voltage stability evaluation using modal analysis. *IEEE transactions on power systems*, 7(4), 1529-1542.

IEEE 39 bus system



IEEE 39 bus system



CONCLUSION

- The proposed index provides a quantitative method to rank contingencies based on severity, occurrence and detection.
- The ranking effectively integrates multiple factors such as power flow, age of line, weather conditions and historical data.
- Incorporates Phasor Measurement Unit coverage in contingency ranking.

THANK YOU

S. No.	Name of Feeder	Unplanned Outage				Brief Reason of Outage	Total no. of times Transmission Line out of service Count
		Date	From	To	Total Outage (in Hrs)		
220 kV Substation, Pantnagar							
1	220 KV Bareilly - Pantnagar Line (81)	6-Aug-2023	00:19	01:06	00:47	Trip	2
2		14-Sep-2023	15:11	15:50	00:39	Trip	
3	220 KV Pantnagar - Kashipur Line Ckt-I (82)	21-May-2023	14:15	14:35	00:20	Trip	6
4		12/01/2023	13:40	13:50	00:10	Trip	
5		12/08/2023	23:17	23:27	00:10	Trip	
6		12/14/2023	21:15	21:41	00:26	Trip	
7		12/24/2023	12:05	12:15	00:10	Trip	
8		12/29/2023	06:14	06:23	00:09	Trip	
9	220 KV Pantnagar - Kashipur Line Ckt- II (88)	25-May-2023	15:56	16:55	00:59	Trip	5
10		9-Jul-2023	12:12	12:39	00:27	Trip	
11		18-Aug-2023	03:15	03:35	00:20	Trip	
12		22-Aug-2023	01:42	01:59	00:17	Trip	
13		09/27/2023	11:18	11:52	00:34	Trip	
14	220 KV Pantnagar - Haldwani Line (83)	14-Jul-2023	14:01	14:17	00:16	Trip	1
15	132 KV Pantnagar - Hindustan Zinc Ltd Line	30-Mar-2024	13:02	14:48	01:46	Trip	1
16	132 KV Pantnagar - Rudrapur Line (71)	02/03/2024	18:29	19:01	00:32	Trip	1
17	132 KV Pantnagar - Haldwani Line (73)	17-May-2023	15:44	16:01	00:17	Trip	8
18		23-May-2023	23:09	00:47	01:38	Trip	
19		5-Jun-2023	13:29	13:38	00:09	Trip	
20		4-Jul-2023	17:45	18:03	00:18	Trip	
21		6-Aug-2023	00:19	01:07	00:48	Trip	
22		09/01/2023	03:23	03:58	00:35	Trip	
23		14-Sep-2023	15:11	15:54	00:43	Trip	
24		14-Sep-2023	20:29	21:26	00:57	Trip	