

2021 IEEE-NASPI Oscillation Source Location Contest

Solution Key

Case #	Frequency (Hz)	Oscillation Source(s) Information				Notes
		Area Name	Bus #	Asset Type (choose)	Controller (choose)	
		3 pt.	+3 pt. – correct +1 pt. – within 1 bus +0 pt. – other	+1 pt. – correct +0 pt. – N/A -1 pt. – wrong	+1 pt. – correct +0 pt. – N/A -1 pt. – wrong	In all cases, forced oscillations are introduced at t=30s.
1	0.82	1 – SOUTH	1431	Generator	Governor	<ul style="list-style-type: none"> Max oscillation amplitude in MW flow is not at the source.
2	1.19	2 – CALIFORNIA	2634	Generator	Governor	<ul style="list-style-type: none"> The forced oscillation resonates with a natural local mode at 1.19Hz with low damping ratio. Max oscillation amplitude in MW flow is not at the source. The natural mode is excited by a fault at bus 1131 at t=30s.
3	0.379	1 – SOUTH	1131	Generator	Exciter	<ul style="list-style-type: none"> The forced oscillation resonates with the lowest frequency inter-area mode. Max oscillation amplitude in MW flow is not at the source, in a different area. Fault at bus 2503 added at t=30s. Bus 1131 is not monitored by a PMU.
4	0.379	2 – CALIFORNIA	3831	Generator	Governor	<ul style="list-style-type: none"> The forced oscillation resonates with the lowest frequency inter-area mode. Max oscillation amplitude in MW flow is not at the source. Fault at bus 6103 added at t=26s. Bus 3831 is not monitored.
5	0.68, 0.76	3 – NORTH	4231	Generator	Governor	<ul style="list-style-type: none"> Forcing frequency is 0.68Hz before t=58s, 0.76Hz after t=61s, and is transitioning in the 3-sec interval.

						<ul style="list-style-type: none"> System has modes at: 0.614Hz, 0.708Hz, 0.741Hz and 0.78Hz. Bus 4231 is not monitored by a PMU.
6	1.27	3 – NORTH	7031	Generator	Governor	<ul style="list-style-type: none"> The forced oscillation resonates with a local mode in the NORTH area. Line 2604-6404_1 tripped at t=70s. Max oscillation amplitude in MW flow is not at the source, in a different area. Voltage at bus 7031 is monitored by PMU, besides the other PMUs in the California and South areas.
7	0.379	2 – CALIFORNIA	2634	Generator	Exciter	<ul style="list-style-type: none"> The forced oscillation resonates with the lowest frequency inter-area mode. Fault at bus 2503 added at t=27s.
8	0.614	3 – NORTH	6333	Generator	Governor	<ul style="list-style-type: none"> The forced oscillation resonates with a regional inter-area mode. Max oscillation amplitude in MW flow is not at the source. Fault at bus 6103 added at t=27s.
9	0.762	3 – NORTH	6533	Generator	Governor	<ul style="list-style-type: none"> The forced oscillation (at bus 6533) resonates with a natural mode whose damping is reduced by adjusting PSS gain (Ks=-2) in generator 4131_H creating negative contribution into damping from that generator. Max oscillation amplitude in MW flow is not at the source.
9	0.762	3 – NORTH	4131	Generator	Exciter	
10	1.218	2 – CALIFORNIA	3931	Generator	Governor	<ul style="list-style-type: none"> There are two forced oscillations, each resonates with a natural mode. Max oscillation amplitude in MW flow is not at the source. Fault at bus 1131 added at t=28s. Bus 3931 is not monitored by a PMU.
10	0.614	3 – NORTH	6335	Generator	Governor	
11	0.614	3 – NORTH	4009	Load	Other	<ul style="list-style-type: none"> The forced oscillation resonates with a regional inter-area mode. The source is close to a HVDC and a generator (neither is a source).

						<ul style="list-style-type: none"> Fault at bus 4104 added at t=29s.
12	0.37 0.74 1.11 1.48	3 – NORTH	6335	Generator	Governor	<ul style="list-style-type: none"> Rectangular forcing signal (at 0.37Hz) has harmonics: 0.74Hz, 1.11Hz and 1.48Hz, etc. The second harmonic resonates with a natural mode and produces the largest oscillation amplitude in MW flow that is not at the source. Fault at bus 6333 added at t=26s.
13	0.614	3 – NORTH	4010	HVDC	Other	<ul style="list-style-type: none"> The forced oscillation resonates with a regional inter-area mode. The source is in the HVDC controls at California side.
13	0.614	2 - CALIFORNIA	2619	HVDC	Other	<ul style="list-style-type: none"> Both terminal buses of HVDC 4010 and 2619 may look as the sources in the AC network.
A1	0.379 0.614 0.725	3 – NORTH	6333	Generator	Governor	<ul style="list-style-type: none"> Forcing frequency is 0.379Hz before t=30s, 0.614Hz from t=35s-60s, and 0.725Hz after t=65s. A mix of P/M class PMU, P/M class assignment is different from the first 13 cases.
A2	0.379 0.614 0.725	3 – NORTH	6333	Generator	Governor	<ul style="list-style-type: none"> Same as A1, but with 100% P class PMU.
A3	0.379 0.614 0.725	3 – NORTH	6333	Generator	Governor	<ul style="list-style-type: none"> Same as A1, but with 100% M class PMU.