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PREFACE

Pakistan Meteorological Department (PMD) has been recording the intensity and magnitude of earthquakes since 1951, at seismic Observatory Quetta. In the beginning, the instruments namely Sprinter were being used. Later on, the Sprenter instruments were replaced by WWSSN as part of global seismic network till 2006. After 2006, the digital seismic monitoring equipments known as GURALP system were installed across Pakistan including Quetta, Islamabad, Peshawar, Lahore, Zhob, Turbat, Gilgit. Since then, the GURALP Instruments are regularly being used to record the earthquake events across the country and the neighboring countries.

Earthquake activity in Pakistan is mainly concentrated in the north and western sections of the country, along the conjunctions of Indian plate with the Iranian and Afghan micro-plates. The Chaman Fault runs along Pakistan's western frontier with Afghanistan from Kalat, in the northern Makran range, past Quetta and then on to Kabul, Afghanistan. A fault also runs along the Makran coast and is believed to be of the same nature as the West Coast fault along the coast of Maharashtra, An active subduction zone exists off the Makran coast.

This zone forms the boundary between the Arabian and the Iranian micro-plate, where the former subducts or dives beneath the latter. Thrust zones run along the Kirthar, Sulaiman and Salt ranges. There are four faults in and around Karachi and other parts of deltaic Indus, and Makran coast. The first is the Allah Bund fault that passes through Shahbunder, Jah, Pakistan Steel Mills, and runs through eastern parts of the city and ends near Cape Monz record depicts that fault, in fact, has caused extensive damage in the past many centuries in the deltaic areas. The destruction of Bhanbhor in the 13th century and damage to Shahbunder in 1896 were caused by this fault. The other one emanates from the Rann of Kutchh. The third one is the Pubb fault which ends into Arabian sea near Makran coast and the last one is located in the lower Dadu district near Surajani and falls in the vicinity of Karachi. Tsunamis or tidal waves have also affected the coast of Pakistan. The worst case was in 1945 when an earthquake of magnitude 8 struck the Makran coast, generating Tsunami washing away the town of Gwadar, waves as high as 12 meters.

The 1935 Quetta earthquake occurred on 31 May between 2:33 am and 3:40 am at Quetta, Balochistan. The earthquake had a magnitude of 7.7 and more than 30,000, people died from the impact. This ranked as the deadliest earthquake that hit South Asia until the October 08, 2005 Kashmir earthquake that devastated most parts of Kashmir and adjoining areas with death toll of more than 70,000 and millions homeless.

Pakistan Meteorological Department
Regional Meteorological & Geophysical Centre, Quetta
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Particulars of Stations

Sr. No.	Station	Symbol	Latitude °N	Longitude °E	Height (a. s. l.) in meters	Equipment Installed	Remarks
01.	QUETTA(Brewery)	Que	30.1887	66.9497	1721	Analog D.S.E.	Long period. Short period
02.	QUETTA (RSMC) (Sheikhmanda)	Que	30.2333	66.9833	1640	D.S.E.	Broadband
03.	KARACHI (NSMC)	Khi	24.9167	67.1333	38	D.S.E.	Broadband
04.	ISLAMABAD NSMC (Backup)	Isb	33.6800	73.0600	543	D.S.E.	Short period
05.	KHUZDAR	Khz	27.7833	66.6012	1248	D.S.E.	Broadband
06.	ZHOB	Zhb	31.3375	69.4511	1421	D.S.E.	Broadband
07.	TURBAT	Tur	25.9833	63.0166	141	D.S.E.	Broadband
08.	PESHAWAR (RSMC)	Psh	34.0200	71.5600	392	D.S.E. D.S.E.	Broadband. Short period
09.	LAHORE	Lhr	31.5500	74.3300	210	Analog D.S.E.	Short period Short period
10.	BALAKOT	Blk	34.5333	73.3333	995	D.S.E.	Broadband
11.	CHITRAL	Cht	35.8833	71.7833	1498	D.S.E.	Broadband
12.	UMERKOT	Umk	25.3333	69.7166	33	D.S.E.	Broadband
13.	MUZAFFARABAD	Muz	34.3646	73.4938	1169	D.S.E.	Broadband
14.	BAHAWALNAGAR	Bng	29.9500	73.2500	161	D.S.E.	Broadband

Abbreviations:

H	=	Origin Time.
ep, es & ex	=	emergence of primary-wave and emergence of shear wave and Unidentified wave
Mb	=	Body wave magnitude on Richter scale.
Mw	=	USGS magnitude on Richter scale.
H, M, S	=	Hours, Minute and Second in GMT.
Ipc	=	impulsive phase compression.
Ipd	=	impulsive phase dilatation.
N.S.M.C	=	National Seismic Monitoring Centre.
R.S.M.C	=	Regional Seismic Monitoring Centre.
D.S.E	=	Digital Seismic Equipment.

SUMMARY

The Seismic Monitoring Network of Pakistan Meteorological Department is working round the clock to record and monitor seismic activities all over the world, especially Pakistan, the South-Asia and neighboring countries.

In the month of September 2019, total numbers of events recorded by PMD Seismic network were 62. The frequency analysis based on magnitude of events depicts that 07 events were Minor (03-3.9), 25 events were of mild magnitude (04-4.9). The network also recorded 26 events of moderate magnitude (05-5.9) and 04 events of severe magnitude (06-6.9). No event of violent was reported by PMD Seismic network in the month of September, 2019 as depicted in the Figure 1.

Figure 1: Frequency Analysis of the Magnitude of the Seismic Events Recorded by PMD Seismic Network

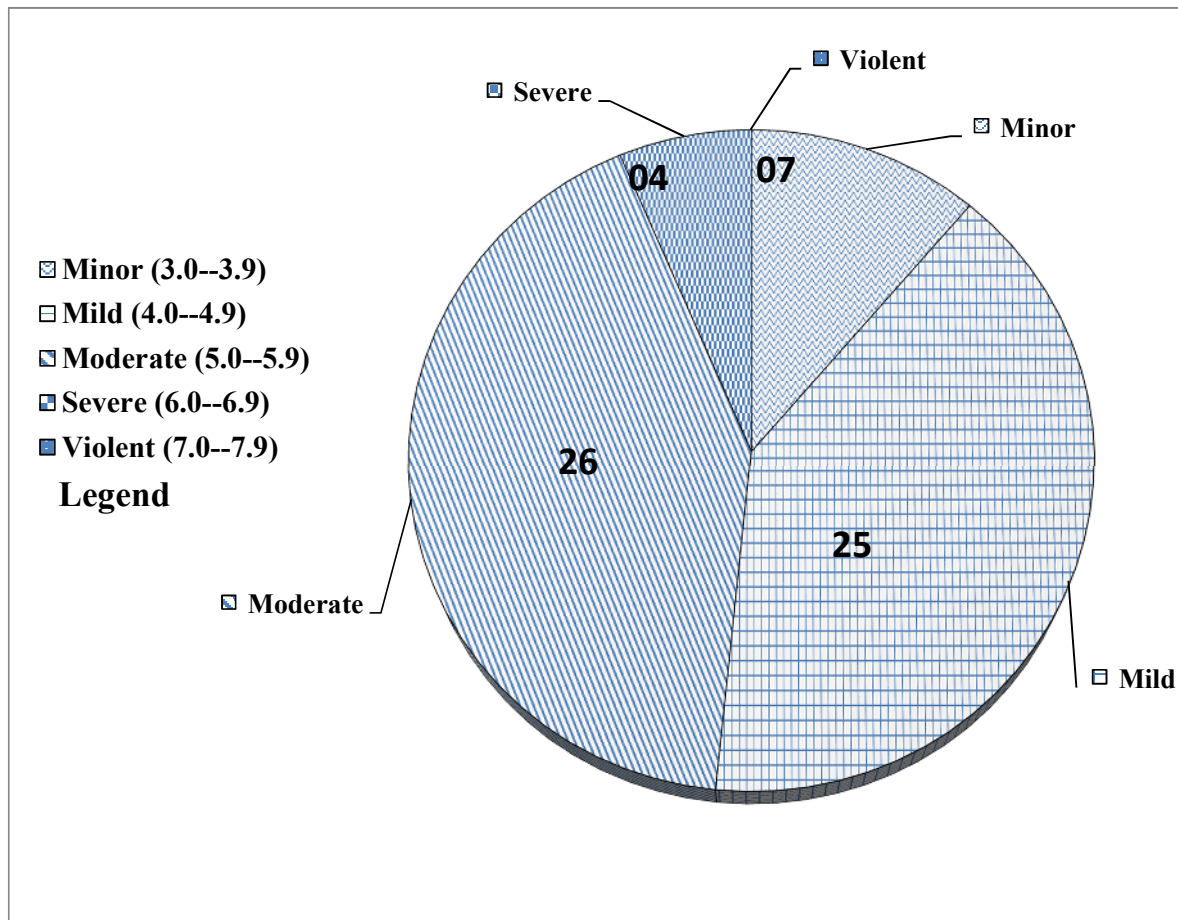


Figure01: shows the number of events recorded during the month of September, 2019 for different categories of severity.

FOCAL DEPTH

The frequency analysis based on focal depth of Seismic events for the month of September, 2019 was carried out. In the month of October, 2019 PMD Seismic network recorded totally 30 numbers of Major Seismic events.

The analysis depicts that the frequency of Shallow focal depth (0-70 km) seismic events was maximum with 25 numbers. Shallow focal depth earthquakes are also known as crustal earthquakes.

The Intermediate focal depth (70-300 km) seismic events were 03 numbers and 02 number of deep focal depth (>700 km) seismic events recorded by PMD Seismic network. Deep focal depth earthquakes also known as Intra-Plate earthquakes.

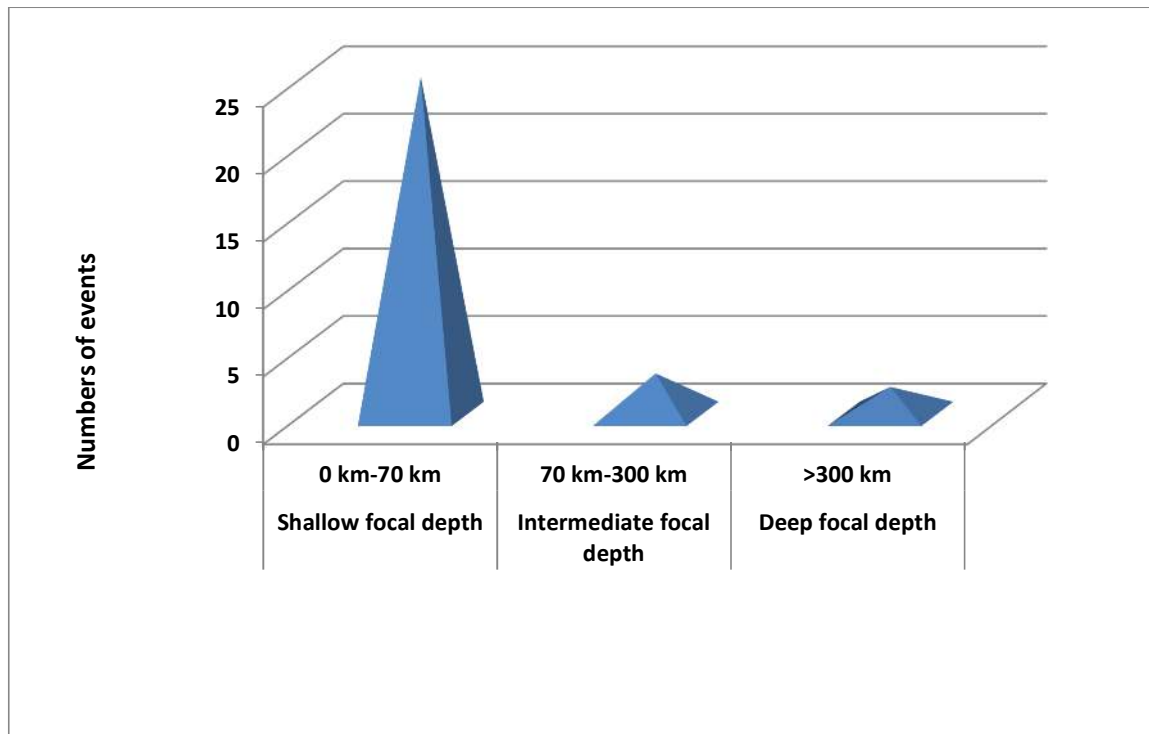


Figure2: Frequency analysis of major earthquakes based on focal depth during the month of September, 2019.

September 2019					Major Shocks			
Date	Station	Phase	H:M:S	Depth	Magnitude	Lat	Long	Country
5	Qta	ep es	- -	28 Km	-	46.65 ° N	152.6 ° E	Kuril Islands
	Isb	-	3:23:31		5.2			
	Pwr	ep es	3:33:36 3:41:51		5			
	Lhr	ep es	3:32:26 -		5.2			
	Usgs	-	3:23:26		5.4			
5	Qta	ep es	- -	36 Km	-	6.43 ° E	103.6 ° E	Southwest of Sumatra, Indonesia
	Isb	-	11:56:14		5.2			
	Pwr	ep es	12:04:01 12:10:11		5.1			
	Lhr	ep es	12:02:46 -		5.2			
	Usgs	-	11:56:18		5			
5	Qta	ep es	- -	10 Km	-	14.71 ° N	116.2 ° E	South China Sea
	Isb	-	13:58:34		5.4			
	Pwr	ep es	14:06:46 14:13:18		5.3			
	Lhr	ep es	14:05:16 -		5.4			
	Usgs	-	13:58:34		5.3			
6	Qta	ep es	- -	10 Km	-	0.1 ° S	130.7 ° E	Irian Jaya Region, Indonesia
	Isb	-	21:14:29		5.2			
	Pwr	ep es	21:25:05 21:33:40		5.1			
	Lhr	ep es	21:23:36 -		5.2			
	Usgs	-	21:14:26		5			
7	Qta	ep es	- -	63 Km	-	41.62 ° N	142 ° E	Irian Jaya Region, Indonesia
	Isb	-	9:35:46		5			
	Pwr	ep es	9:45:16 9:52:50		5.1			
	Lhr	ep es	9:43:59 -		5			
	Usgs	-	9:35:51		5.2			

May 2019					Major Shocks			
Date	Station	Phase	H:M:S	Depth	Magnitude	Lat	Long	Country
8	Qta	ep es	- -	50 Km	-	6.11 ° N	125.6 ° E	Mindanao, Philippines
	Isb	-	13:49:13		5.1			
	Pwr	ep es	13:59:05 14:06:57		5			
	Lhr	ep es	13:57:36 -		5.1			
	Usgs	-	13:49:18		5			
9	Qta	ep es	- -	10 Km	-	6.48 ° S	30.73 ° E	Lake Tanganyika Region
	Isb	-	0:38:44		5.3			
	Pwr	ep es	0:48:19 0:55:57		5.5			
	Lhr	ep es	0:47:12 -		5.3			
	Usgs	-	0:38:43		5.4			
9	Qta	ep es	- -	17 Km	-	32.97 ° N	76.1 ° E	Kashmir-India Border Region
	Isb	-	6:40:42		5			
	Pwr	ep es	6:41:33 6:42:20		5			
	Lhr	ep es	6:40:00 -		5			
	Usgs	-	6:40:30		5			
9	Qta	ep es	- -	10 Km	-	50.31 ° N	177.2 ° W	Andreanof Islands, Aleutian Islands
	Isb	-	21:24:19		5.2			
	Pwr	ep es	21:36:09 21:45:51		5			
	Lhr	ep es	21:34:58 -		5.2			
	Usgs	-	21:24:19		5.3			
10	Qta	ep es	- -	52 Km	-	6.76 ° N	126.5 ° E	Mindanao, Philippines
	Isb	-	5:39:29		5.6			
	Pwr	ep es	5:49:06 5:56:57		5.6			
	Lhr	ep es	5:47:31 -		5.6			
	Usgs	-	5:39:23		5.7			

September 2019					Major Shocks			
Date	Station	Phase	H:M:S	Depth	Magnitude	Lat	Long	Country
10	Qta	ep es	- -	28 Km	-	4.1 ° N	126.7 ° E	Talaud Islands, Indonesia
	Isb	-	23:32:21		5.6			
	Pwr	ep es	23:42:22 23:50:24		5.6			
	Lhr	ep es	23:40:46 -		5.6			
	Usgs	-	23:32:23		5.6			
11	Qta	ep es	- -	10 Km	-	47.62 ° N	152.4 ° E	Kuril Islands
	Isb	-	20:59:09		5			
	Pwr	ep es	21:09:07 21:17:09		5			
	Lhr	ep es	21:09:49 -		5			
	Usgs	-	20:58:58		5.1			
12	Qta	ep es	- -	10 Km	-	27.97 ° S	74.16 ° E	Mid Indian Ridge
	Isb	-	15:36:33		5.1			
	Pwr	ep es	15:46:51 15:55:12		5.1			
	Lhr	ep es	15:45:16 -		5.1			
	Usgs	-	15:36:33		5.2			
13	Qta	ep es	- -	36 Km	-	14.95 ° N	122.3 ° E	Luzon, Philippines
	Isb	-	8:28:12		5.2			
	Pwr	ep es	8:37:03 8:44:08		5.2			
	Lhr	ep es	8:34:35 -		5.2			
	Usgs	-	8:28:15		5.2			
14	Qta	ep es	- -	10 Km	-	95 ° S	128.6 ° E	Halmahera, Indonesia
	Isb	-	16:21:30		5.9			
	Pwr	ep es	16:32:00 16:40:33		5.9			
	Lhr	ep es	16:30:20 -		5.9			
	Usgs	-	16:21:29		5.8			

September 2019					Major Shocks			
Date	Station	Phase	H:M:S	Depth	Magnitude	Lat	Long	Country
16	Qta	ep es	- -	11 Km	-	38.56 ° N	100.3 ° E	Gansu, China
	Isb	-	12:48:40		5.2			
	Pwr	ep es	12:53:51 12:57:58		5.2			
	Lhr	ep es	12:52:13 -		5.2			
	Usgs	-	12:48:40		5			
17	Qta	ep es	- -	185 Km	-	11.06 ° S	166.3 ° E	Santa Cruz Islands
	Isb	-	14:10:21		5.4			
	Pwr	ep es	14:03:49 14:14:02		5.4			
	Lhr	ep es	14:28:29 -		5.4			
	Usgs	-	14:10:23		5			
18	Qta	ep es	- -	77 Km	-	3.9 ° S	151.2 ° E	New Ireland Region, P.N.G
	Isb	-	6:22:50		5			
	Pwr	ep es	6:38:35 6:48:54		5.1			
	Lhr	ep es	6:42:25 -		5			
	Usgs	-	6:22:56		5			
18	Qta	ep es	- -	33 Km	-	5.42 ° N	126.4 ° E	Mindanao, Philippines
	Isb	-	7:00:58		5.4			
	Pwr	ep es	7:10:52 7:18:50		5.5			
	Lhr	ep es	7:09:09 -		5.4			
	Usgs	-	7:01:01		5.5			
19	Qta	ep es	- -	625 Km	-	6.02 ° S	111.8 ° E	Java, Indonesia
	Isb	-	7:06:34		6.1			
	Pwr	ep es	7:15:08 7:16:51		6.2			
	Lhr	ep es	7:15:16 -		5.9			
	Usgs	-	7:06:34		6.1			

September 2019					Major Shocks			
Date	Station	Phase	H:M:S	Depth	Magnitude	Lat	Long	Country
19	Qta	ep es	- -	630 Km	-	6.02 ° S	111.9 ° E	Java, Indonesia
	Isb	-	7:32:00		6			
	Pwr	ep es	7:40:36 7:47:31		6			
	Lhr	ep es	7:38:48 -		5.9			
	Usgs	-	7:32:58		5.8			
21	Qta	ep es	- -	19 Km	-	41.43 ° N	19.71 ° E	Albania
	Isb	-	14:04:27		5.6			
	Pwr	ep es	14:12:11 14:18:31		5.6			
	Lhr	ep es	14:11:08 -		5.6			
	Usgs	-	14:04:26		5.6			
21	Qta	ep es	- -	25 Km	-	41.37 ° N	19.5 ° E	Albania
	Isb	-	14:15:59		5.6			
	Pwr	ep es	14:23:47 14:30:09		5.1			
	Lhr	ep es	14:22:36 -		5.6			
	Usgs	-	14:15:55		5.4			
21	Qta	ep es	- -	78 Km	-	6.54 ° S	130.4 ° E	Banda Sea
	Isb	-	19:53:15		5.9			
	Pwr	ep es	20:04:09 20:13:05		5.9			
	Lhr	ep es	20:02:21 -		5.9			
	Usgs	-	19:53:14		5.8			
24	Qta	ep es	- -	10 Km	-	33.04 ° N	73.8 ° E	5 Km North of Jhelum, Pakistan
	Isb	-	11:01:53		5.8			
	Pwr	ep es	11:02:31 11:03:01		5.8			
	Lhr	ep es	11:01:56 -		5.8			
	Usgs	-	11:01:55		5.3			

September 2019					Major Shocks			
Date	Station	Phase	H:M:S	Depth	Magnitude	Lat	Long	Country
24	Qta	ep es	- -	10 Km	-	33.69 ° S	56.39 ° E	Southwest Indian Ridge
	Isb	-	21:19:15		5.9			
	Pwr	ep es	21:30:53 21:39:50		6.1			
	Lhr	ep es	21:30:29 -		5.8			
	Usgs	-	21:19:48		6			
25	Qta	ep es	- -	10 Km	-	3.56 ° S	128.5 ° E	Seram, Indonesia
	Isb	-	23:46:44		6.4			
	Pwr	ep es	23:57:23 0:06:03		6.5			
	Lhr	ep es	23:55:30 -		6.4			
	Usgs	-	23:46:44		6.4			
26	Qta	ep es	- -	10 Km	-	3.64 ° S	128.5 ° E	Seram, Indonesia
	Isb	-	0:39:59		5.6			
	Pwr	ep es	0:50:41 0:59:29		5.4			
	Lhr	ep es	0:48:48 -		5.6			
	Usgs	-	0:39:59		5.4			
26	Qta	ep es	- -	11 Km	-	40.88 ° N	28.18 ° E	Turkey
	Isb	-	10:59:27		5.8			
	Pwr	ep es	11:06:20 1.25902778		5.7			
	Lhr	ep es	11:06:45 -		5.7			
	Usgs	-	10:59:26		5.7			
29	Qta	ep es	- -	68 Km	-	5.71 ° N	126.5 ° E	Mindanao, Philippines
	Isb	-	2:02:54		6.3			
	Pwr	ep es	2:12:36 2:20:25		6.2			
	Lhr	ep es	2:12:16 -		6.3			
	Usgs	-	2:02:50		6.2			

September 2019			Minor Shocks	
Date	Station	Phase	H:M:S	Magnitude
4	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	5:54:08 5:54:33	3.8
6	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	12:50:17 12:50:49	3.9
7	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	1:36:47 1:37:14	4.2
8	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	10:20:41 10:21:16	4.2
9	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	4:56:30 4:57:12	4
11	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	7:15:26 7:16:01	4.5
13	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	11:36:36 11:37:00	4.3
13	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	18:33:14 18:33:54	4.4
13	Qta	ep	0:00:00	-
		es	0:00:00	
	Lhr	ep es	18:34:29 0:00:00	4.5

September 2019				Minor Shocks
Date	Station	Phase	H:M:S	Magnitude
17	Qta	ep	0:00:00	-
		es	0:00:00	
	Pwr	ep es	11:05:04 11:05:37	4.2
18	Lhr	ep es	11:05:22 0:00:00	4.2
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	20:24:48 20:25:18	4.1	
21	Lhr	ep es	20:25:25 0:00:00	4.1
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	1:49:28 1:50:01	4	
22	Lhr	ep es	1:49:45 0:00:00	3.8
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	5:03:40 5:04:24	4.9	
22	Lhr	ep es	5:20:57 0:00:00	4.8
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	13:42:58 13:43:34	4.5	
26	Lhr	ep es	13:43:05 0:00:00	4.5
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	7:02:05 7:02:30	4.7	
26	Lhr	ep es	7:00:23 0:00:00	4.4
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	17:20:35 17:23:20	4.8	
27	Lhr	ep es	17:20:22 0:00:00	4.4
	Qta	ep	0:00:00	-
		es	0:00:00	
Pwr	ep es	17:20:35 17:23:20	4.8	
27	Lhr	ep es	12:32:50 0:00:00	3.5