Earthquake Early Warning System(EEWS) for CGDs

Sushil Kumar,
Dy. General Manager
GAIL(India) Limited

Earthquake Early Warning System(EEWS) for CGDs

INTRODUCTION

- Earthquakes can be deadly and with modern developments and civic infrastructure.
- Recent earthquakes have demonstrated the vulnerability and risks associated with gas transportation and distribution systems.
- Adequate methodologies for seismic risk estimation are required to establish insurance and risk management strategies, as well as emergency and contingency plans.

Earthquake Early Warning System(EEWS) for CGDs

- Gas leaks after an earthquake are more likely if:
  - There are structural weaknesses
  - Gas appliances are not anchored
  - Flexible pipe connections are not used.
- The primary concern is loss to life, as well as property loss from fire damage.

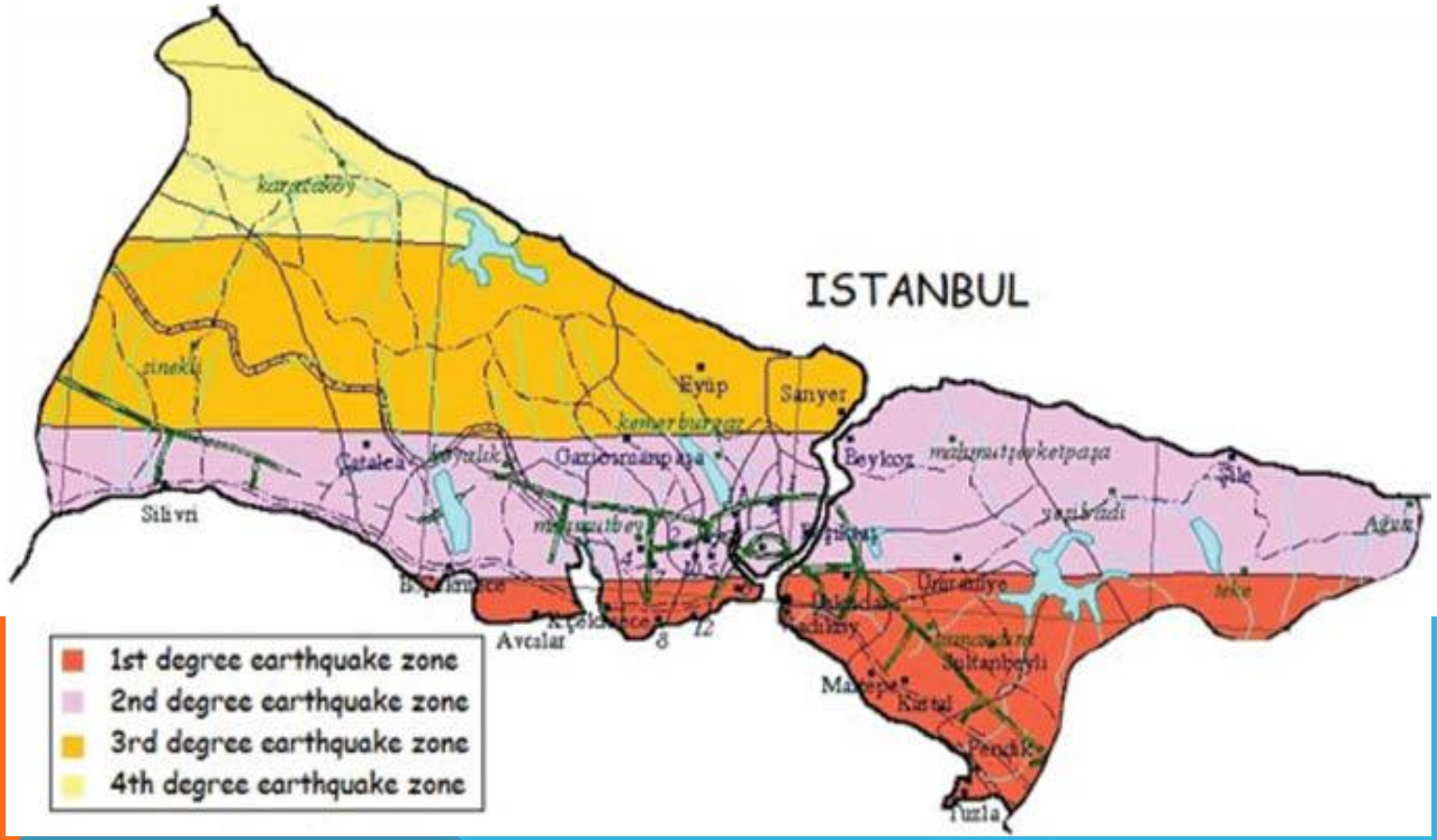
Earthquake Early Warning System(EEWS) for CGDs

RECENT NG PIPELINE EXPLOSIONS DUE TO EARTHQUAKE

- On Dec. 26, 2012 a gas pipeline blast followed by a mild earthquake struck Russia's Black Sea resort of Sochi at 5.2 magnitude.
- A blast from a gas explosion in a Mexico City on September 19, 2017. There were 16 gas pipes in total. The 7.1-magnitude earthquake killed more than 200 people.
- The pipeline explosion occurred at 6:11 pm on September 9, 2010, in San Bruno, California, when a 30-inch diameter steel natural gas pipeline exploded. As of September 29, 2010, the death toll was eight people. Explosion and resulting shock wave as a magnitude 1.1 earthquake.

Earthquake Early Warning System(EEWS) for CGDs

Earthquake Zones of Istanbul, Turkey



Earthquake Early Warning System(EEWS) for CGDs

EEW SYSTEM INSTALLED IN IGDAS, ISTANBUL,TURKEY .

- On 17, August 1999 earthquake in Turkey featured a 45-second earthquake of Richter magnitude 7.4. The earthquake was felt over a large area. Unofficial estimates place the death toll at 30,000-40,000.

- Deployed of earthquake-actuated systems that will prevent explosions from happening during and/or following an earthquake.

- This sort of protection is available using new, advanced earthquake detection techniques and low cost technologies. Such an automatic earthquake-actuated shut-off valve system will seal off valves on pipelines and distribution systems carrying explosive or hazardous material.

Earthquake Early Warning System(EEWS) for CGDs

- IGDAS, the primary natural gas provider in Istanbul, operates an extensive system 9,867 km of gas lines serving 5 million customers.
- The Istanbul Earthquake Early Warning (EEW) network consisting of inland and sea bottom strong motion stations operated by KOERI.
- Data transmission between the remote stations and the base station KOERI is provided both with satellite and fibre optic cable systems.
- The continuous on-line data is used to provide warning for disastrous earthquakes. The data transmission time from the remote stations to the KOERI data centre is less than a second via satellites.

Earthquake Early Warning System(EEWS) for CGDs

- The early warning signal (consisting three alarm levels) is communicated to the shut-down systems of the recipient facilities, that automatically decide proper action based on the alarm level.
- Istanbul Gas Distribution Corporation (IGDAS) is one of the end users of the EEW signal.
- State of-the-art protection systems automatically cut natural gas flow when breaks in the pipelines are detected.
- Since 2005, buildings in Istanbul using natural gas are required to install seismometers that automatically cut natural gas flow when certain thresholds are exceeded.
- IGDAS uses a sophisticated SCADA (supervisory control and data acquisition) system to monitor the state-of-health of its pipeline network.

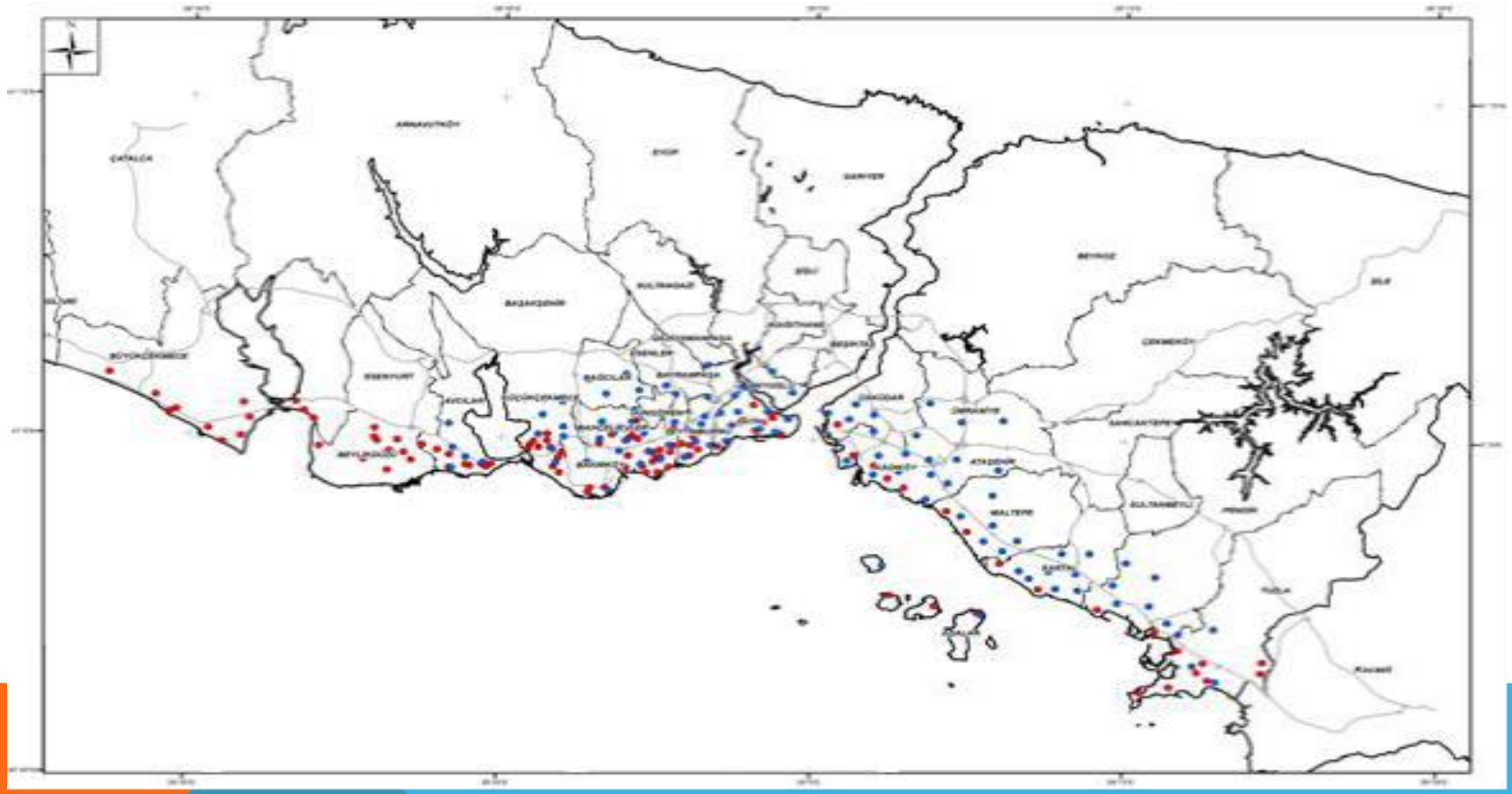
Earthquake Early Warning System(EEWS) for CGDs

- The Istanbul Earthquake Rapid Response System (IERRS) has been deployed by KOERI in 2002 with the 110 strong motion stations distributed in the densely populated parts of the Istanbul city.

- In 2013, Istanbul Natural Gas Distribution Company (IGDAS) has also deployed 110 strong motion stations at the Natural Gas network district regulators with the purpose of automated shut-off the gas flow

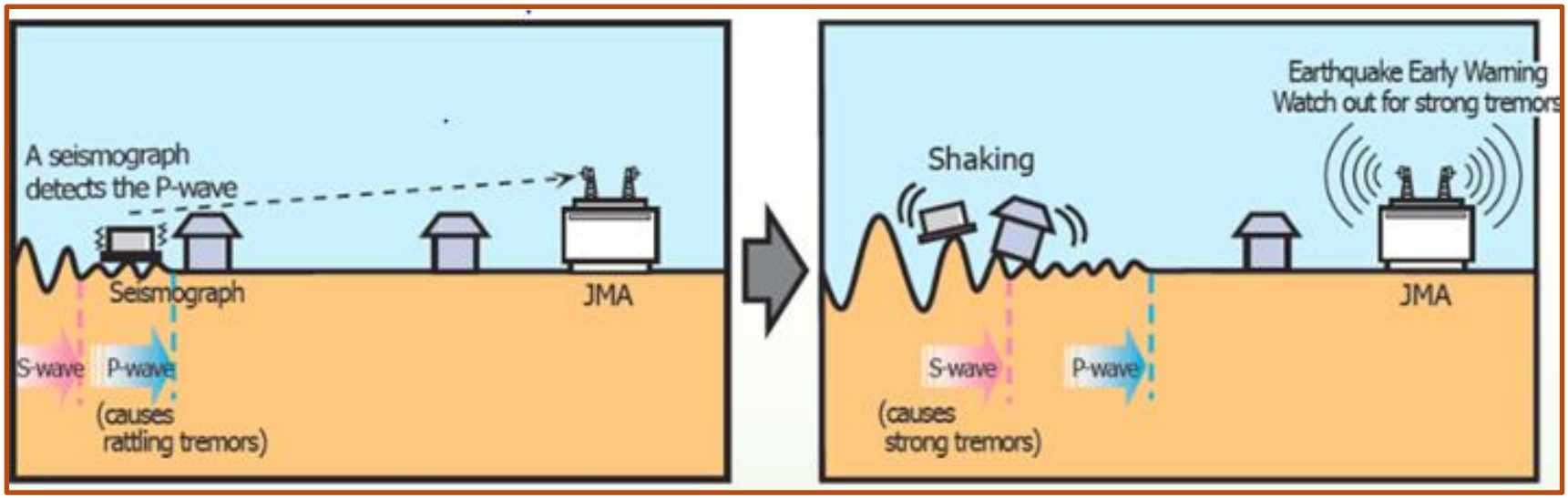
- In 2013, Istanbul Natural Gas Distribution Company (IGDAS) has also deployed 110 strong motion stations at the Natural Gas network district regulators with the purpose of automated shut-off the gas flow

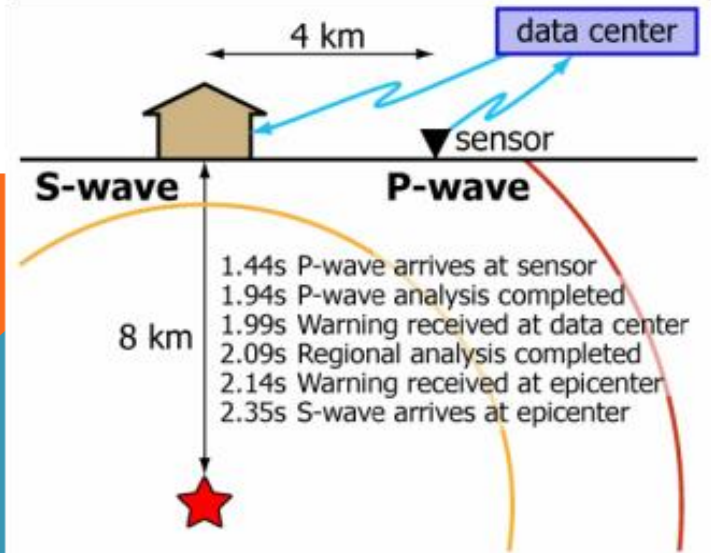
Earthquake Early Warning System(EEWS) for CGDs



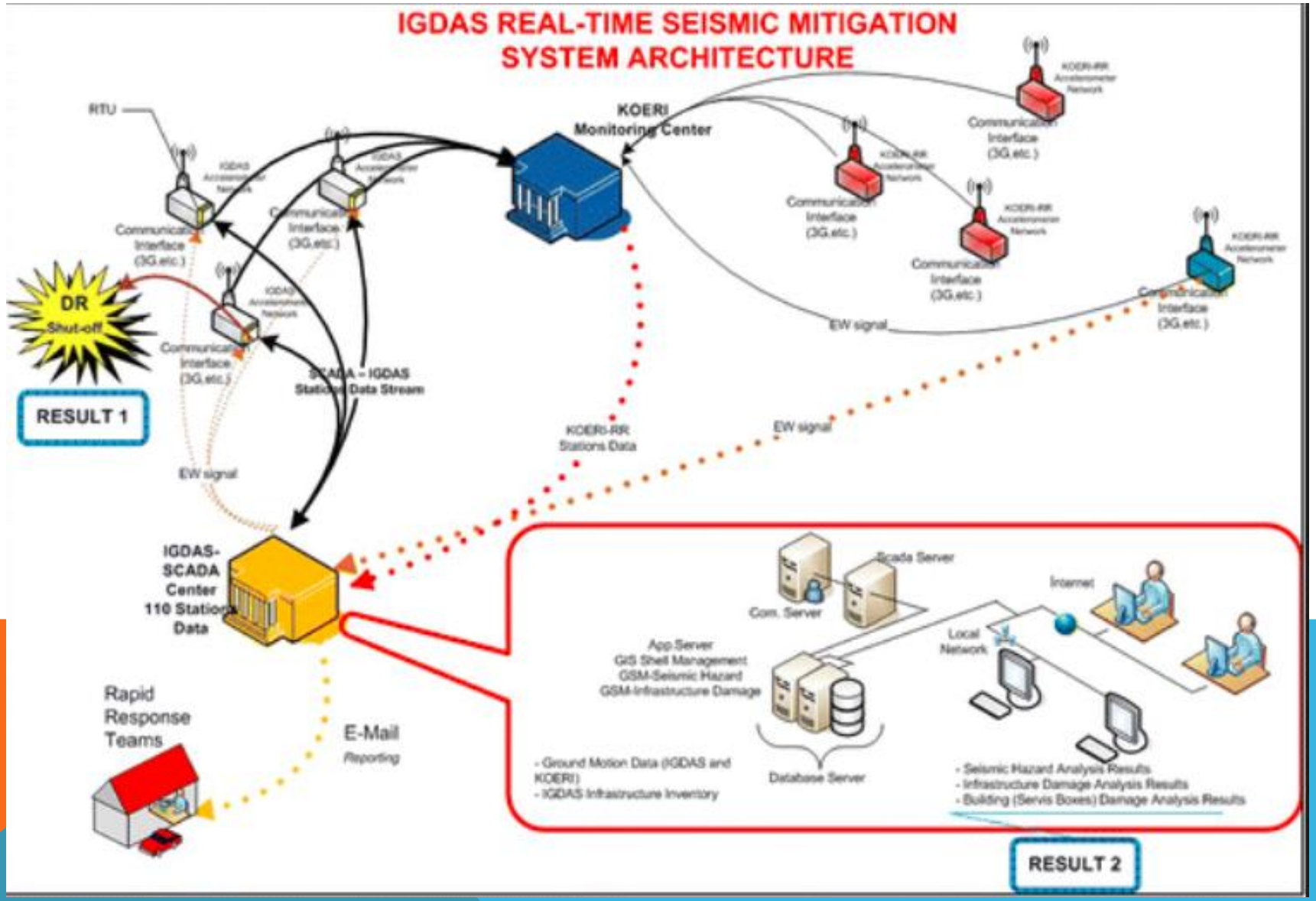
Integration of KOERI (blue circles) and IGDAS (red circles) strong motion networks for real-time shake mapping purpose

Earthquake Early Warning System(EEWS) for CGDs





Earthquake Early Warning System(EEWS) for CGDs



Earthquake Early Warning System(EEWS) for CGDs

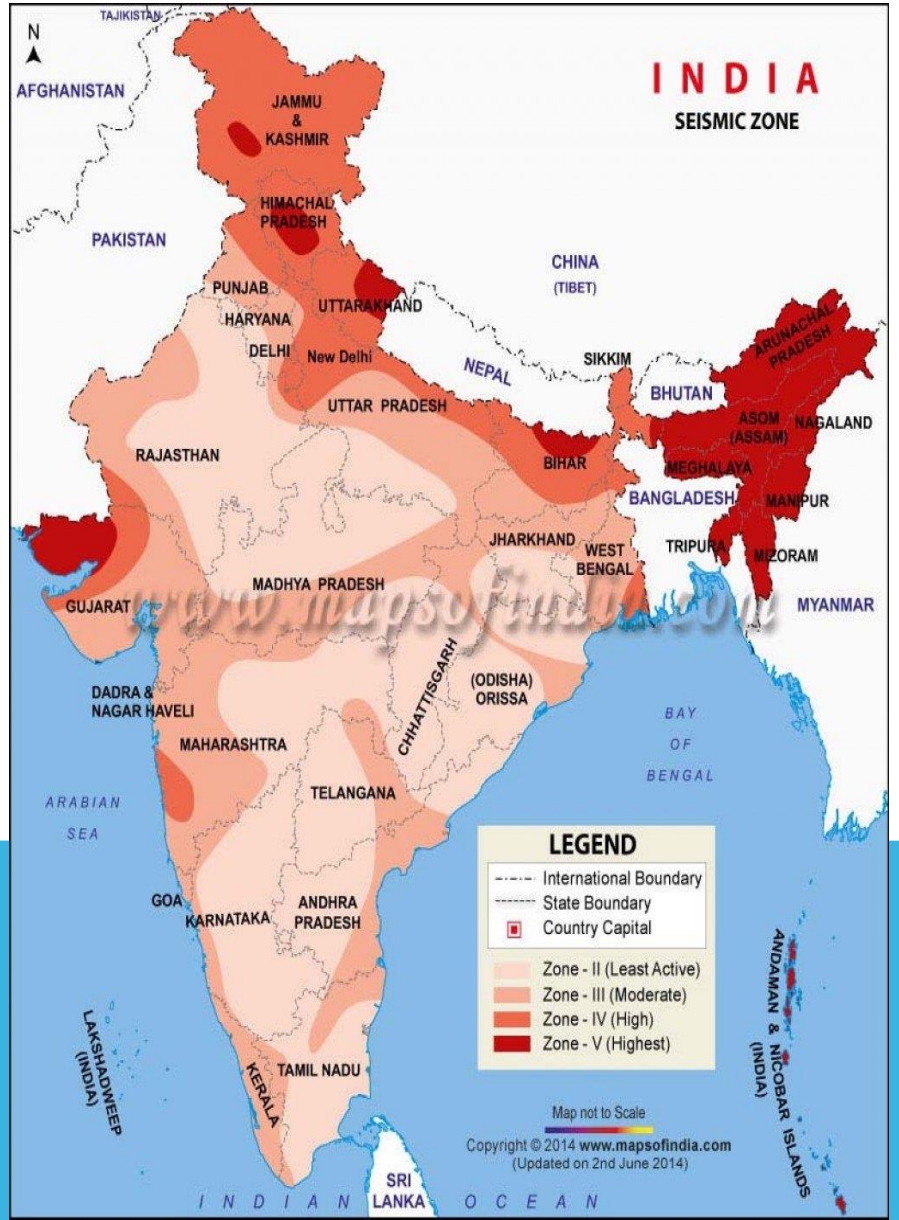
INDIAN SCENARIO

Zones of Earthquake

Zone 5

covers the areas with the highest risks zone. The IS code assigns zone factor of 0.36 for Zone 5. The zone factor of 0.36 is referred to as the Very High Damage Risk Zone.

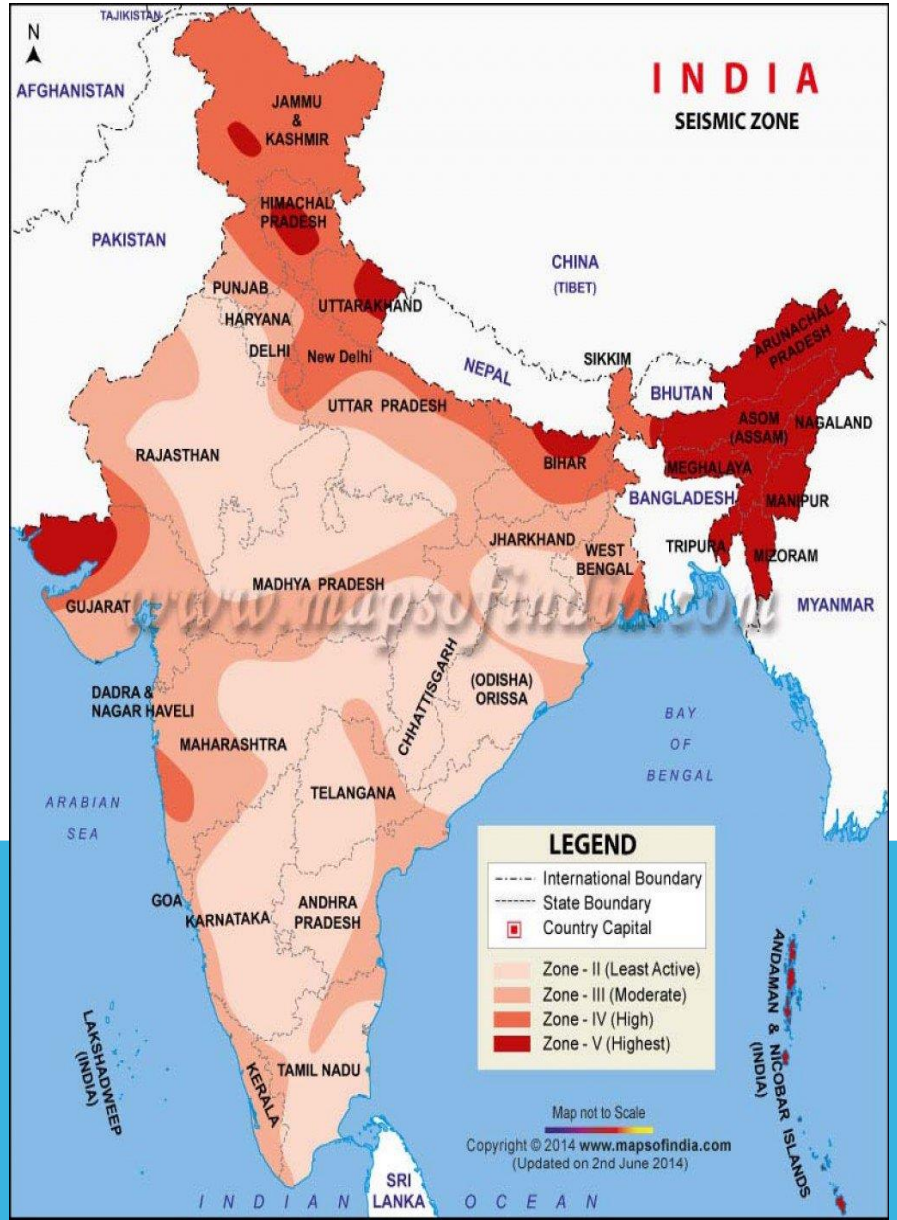
The region of Kashmir, the Western and Central Himalayas, North and Middle Bihar, the North-East Indian region, the Rann of Kutch and the Andaman and Nicobar group of islands fall in this zone.



Earthquake Early Warning System(EEWS) for CGDs

Zone 4: This zone is called the High Damage Risk Zone. The IS code assigns zone factor of 0.24 for Zone 4.

Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, North Punjab, Chandigarh, Western Uttar Pradesh, Terai, North Bengal, and the capital of the country Delhi fall in Zone 4. In Maharashtra, the Patna area is also in zone no-4. In Bihar the northern part of the state like Raxaul, Near the border of India and Nepal, is also in zone no-4.

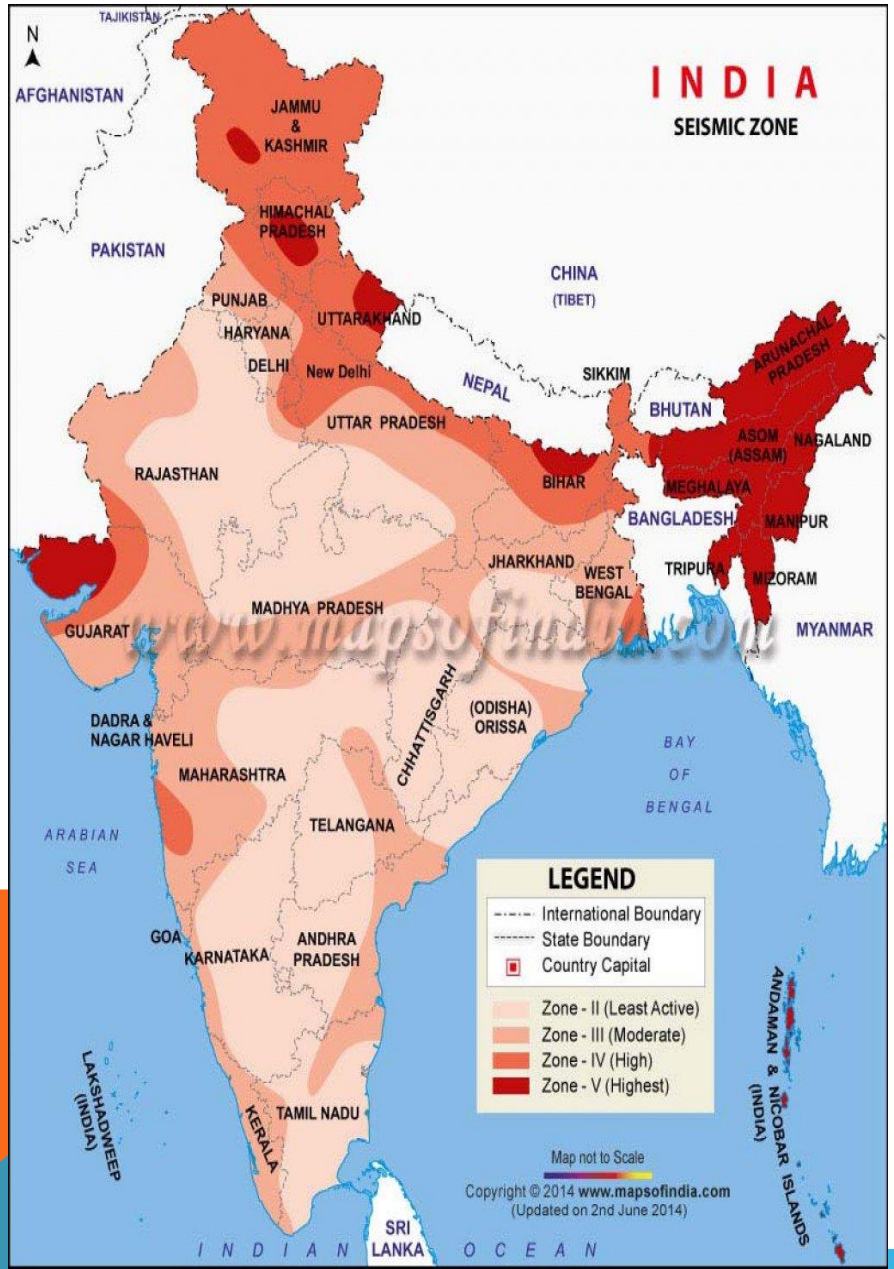


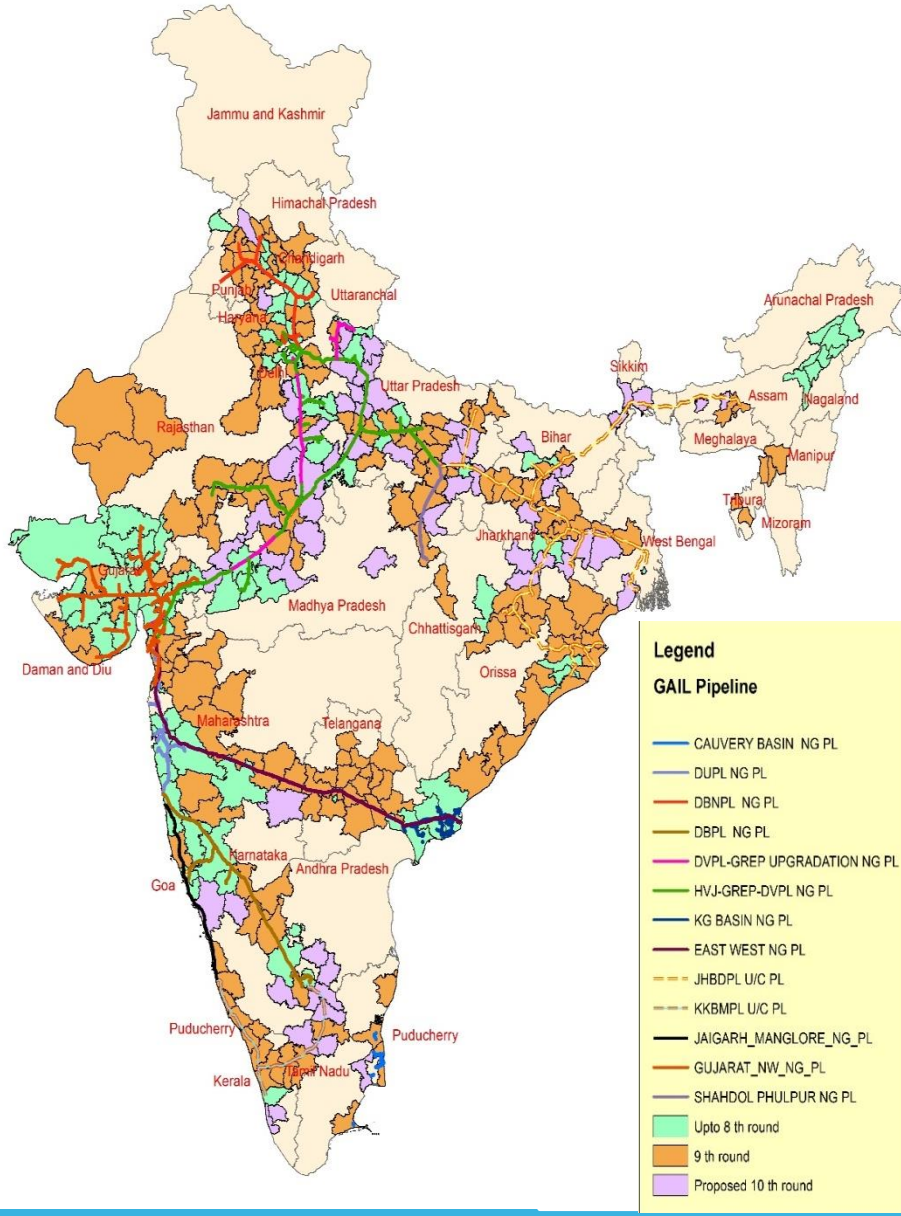
Earthquake Early Warning System(EEWS) for CGDs

MAJOR EARTHQUAKES IN INDIA AND NEAR BY REGION

Sr. No.	Place	Deaths	Date, Time, and Year	Magnitude	Epicenter
1	Indian Ocean	> 283,106	08:50, December 26, 2004	9.1–9.3	West coast of Sumatra, Indonesia
2	Kashmir	130,000	08:50:38, October 8, 2005	7.6	Muzaffarabad, Pakistan-administered Kashmir
3	Bihar and Nepal	> 30,000	14 :13, January 15, 1934	8.7	South of Mount Everest
4	Gujarat	20,000	08:50:00, January 26, 2001	7.7	Kutch, Gujarat
5	Kangra	> 20,000	06:10, April 4, 1905	7.8	Himalayas
6	Latur	> 9,748	22:25, September 30, 1993	6.4	Killari, Latur
7	Assam	1,526	19:39, August 15, 1950	8.6	Rima, Tibet
8	Assam	1,500	17 :11, June 12, 1897	8.1	Exact location not known
9	Uttarkashi	>1,000	Unknown time, October 20, 1991	6.8	Garhwal, Uttarakhand
10	Koynanagar	180	04:21, December 11, 1967	6.5	Koyna

Earthquake Early Warning System(EEWS) for CGDs





Earthquake Early Warning System(EEWS) for CGDs

CGD entities operating in Very High Damage Risk Zones and High Damage Risk Zones may consider installation of EEW Systems for Preventing loss of lives, Damage of Assets and Infrastructure due to gas explosions from happening during and/or following an earthquake.

Earthquake Early Warning System(EEWS) for CGDs

THANKS