Countermeasures of Gas and Water Supply Systems against Natural Disasters in Japan

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Contents

- Countermeasures of gas pipeline system in Tokyo Metropolitan area against earthquakes
  - ➢ Real-time earthquake disaster mitigation system SUPREME

SUPREME
Super-dense Realtime Monitoring of Earthquakes

- Countermeasures of water supply system against multi-hazards
  - ➢ Ductile cast iron pipe with earthquake-resistant joint HRDIP

HRDIP
HAZARD RESILIENT

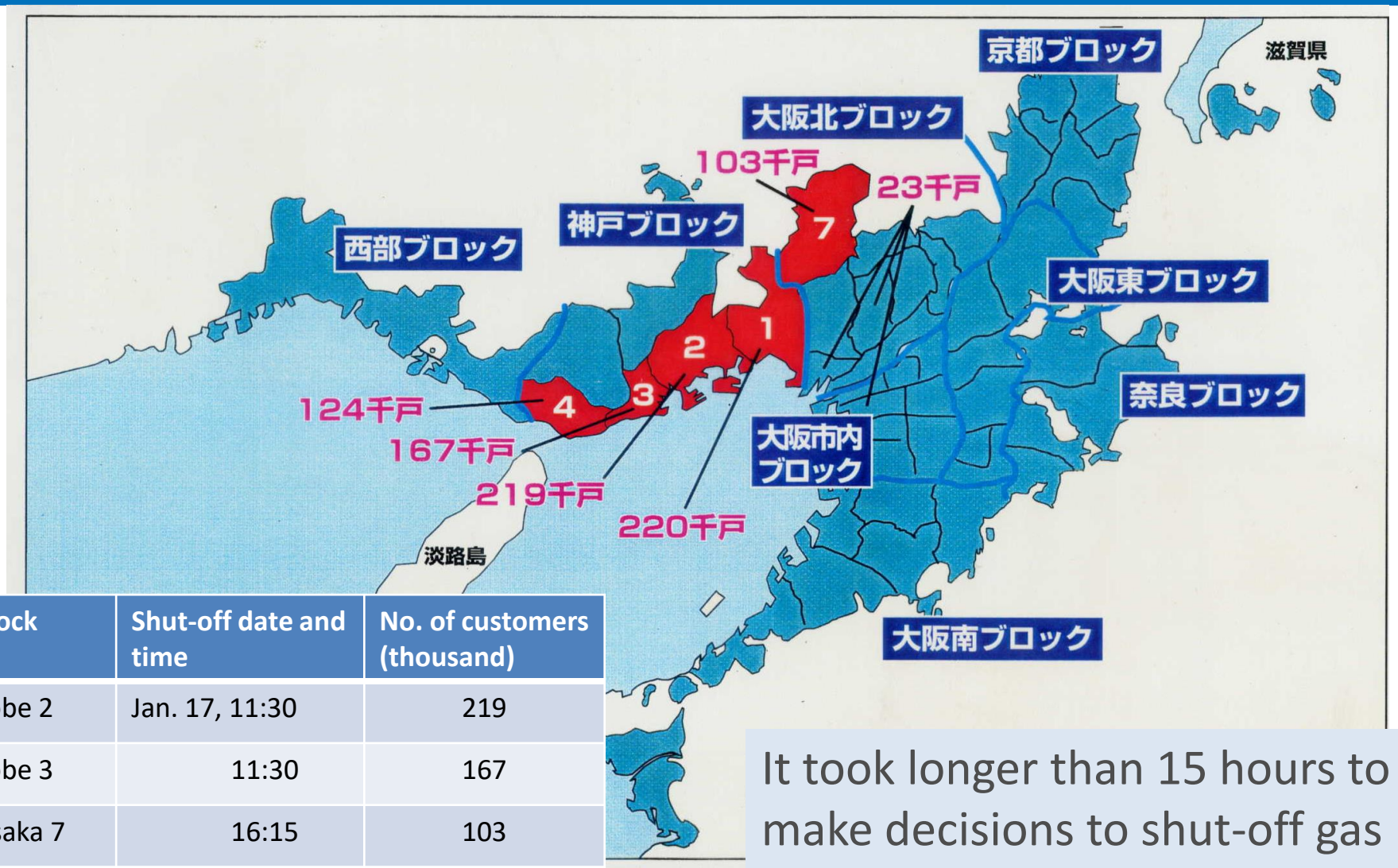
Hazard 自然災害に対して
Resilient 復元力の高い、または
しなやかな強靭性を持った
Ductile
Iron ダクタイル鉄管
Pipe

Damage to Gas Pipes after the 1994 Northridge EQ

Gas from a ruptured supply line burns, and water from a broken water main floods.

Gas supply should be suspended soon when damage to pipes is anticipated.

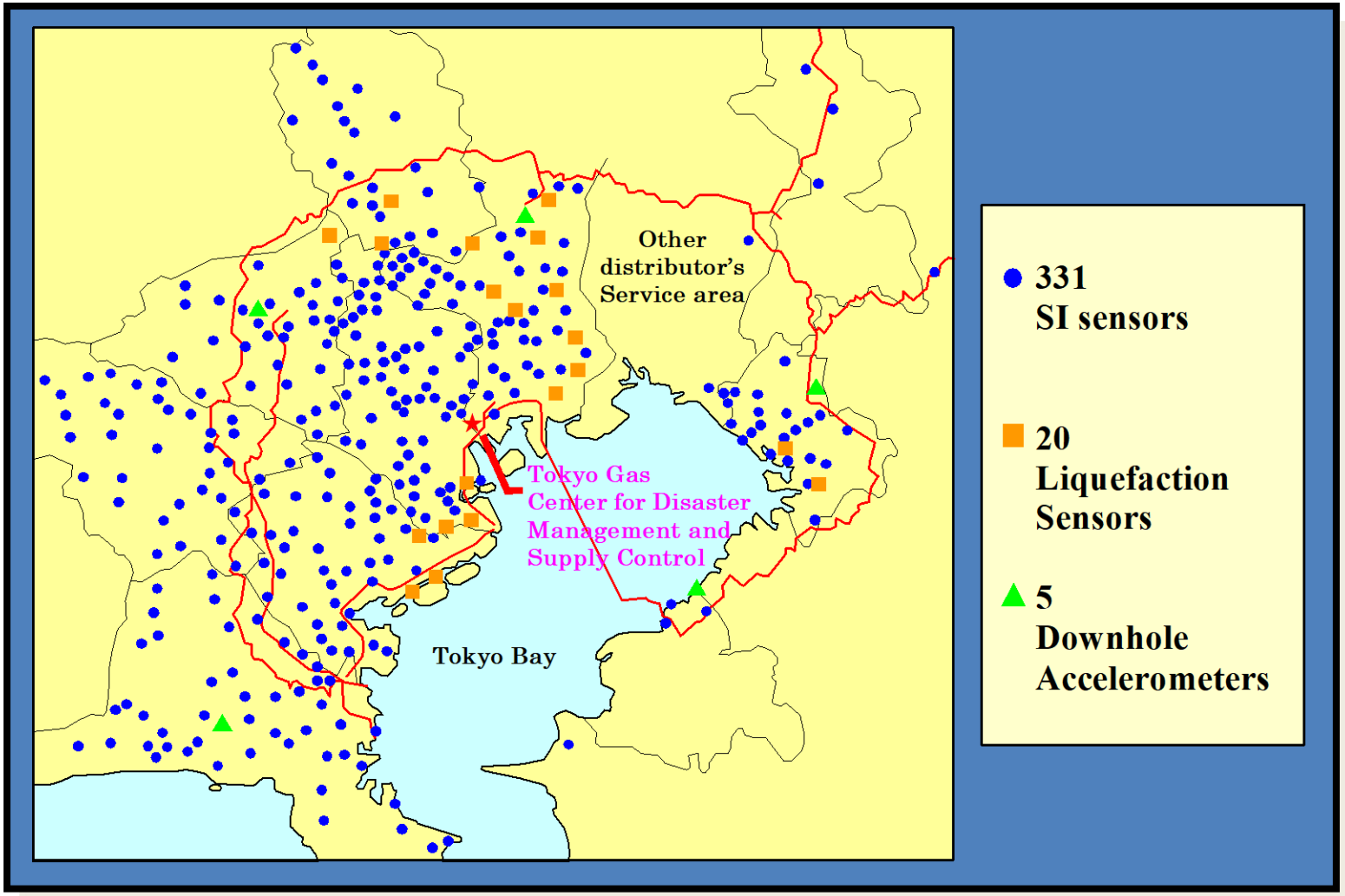
Supply Shut-off after the 1995 Kobe EQ



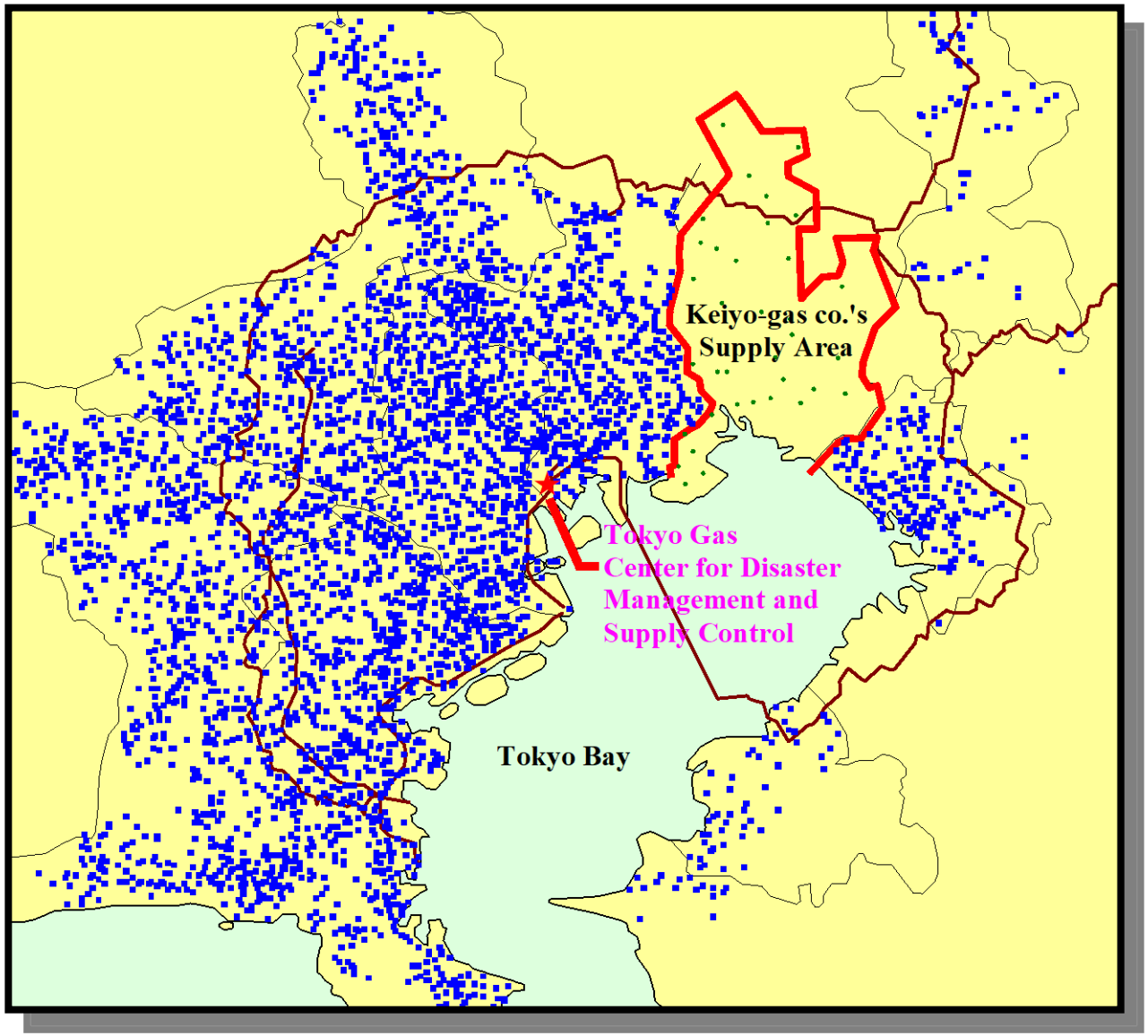
Block	Shut-off date and time	No. of customers (thousand)
Kobe 2	Jan. 17, 11:30	219
Kobe 3	11:30	167
Osaka 7	16:15	103
Kobe 1	19:10	220
Kobe 4	21:00	124

It took longer than 15 hours to make decisions to shut-off gas supply because of the lack of damage information.

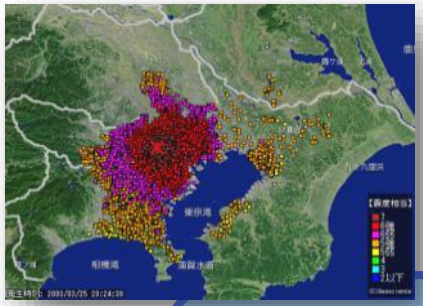
Service Area of Tokyo Gas and Seismic Sensors used in SIGNAL (since 1994)



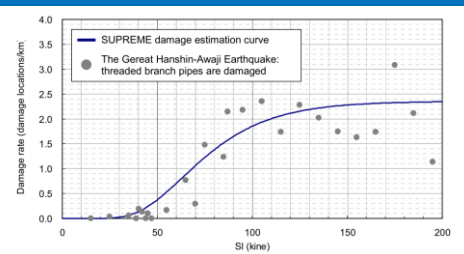
SUPREME (SUPer-dense REaltime Monitoring of Earthquakes) with 4,000 Seismic Sensors

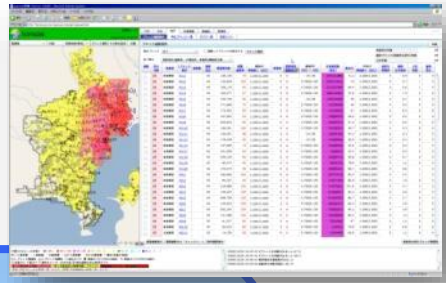


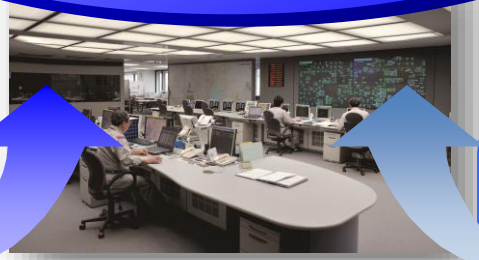
SUPer-dense REaltime Monitoring of Earthquakes (SUPREME)



- Emergency shut down decision
- Restoration strategies



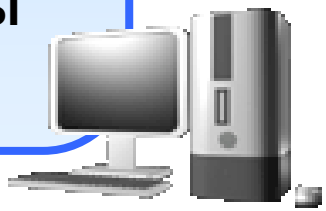




SUPREME
Super-dense Realtime Monitoring of Earthquakes

Approximately 4,000 district supply governors, from which low pressure gas is transmitted, are all equipped with SI sensors

SUPREME estimates the number of damaged locations of low-pressure pipeline based on the distribution of SI values.



The 2011 off the Pacific Coast of Tohoku Earthquake

0 min → 5 min

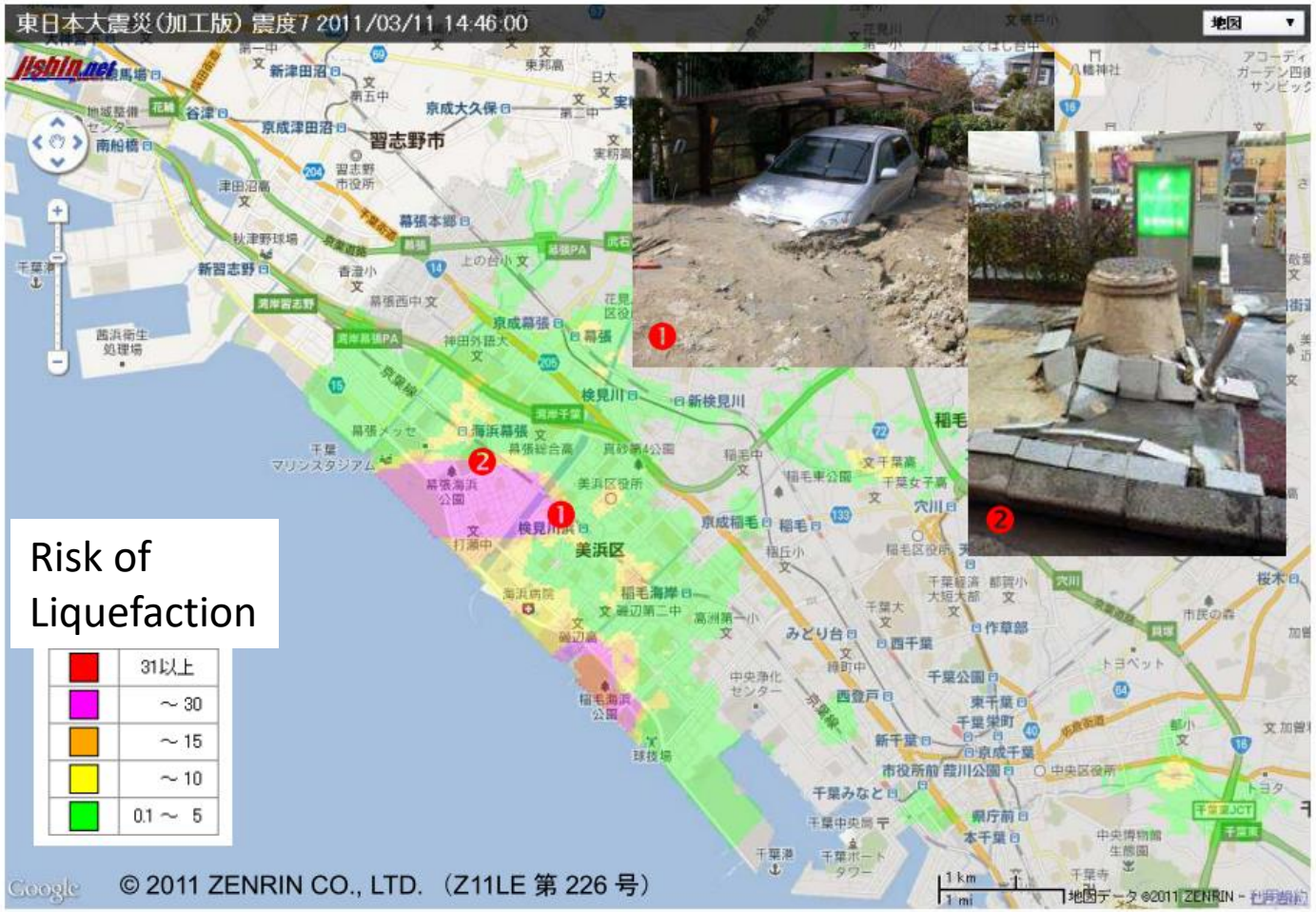
Collecting earthquake information was almost over

SUPREME

SUPREME quickly gathered enough information to perform its initial response

It estimated damage to gas pipelines and evaluated the risk of liquefaction.

Estimated risk of liquefaction



The estimated results are similar to the actual state, and the effectiveness of liquefaction estimation is confirmed.

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Damage to Water Pipes during Recent Earthquakes in Japan

2011 Tohoku Japan EQ.
Steel pipe (ϕ 2400 mm) deployed in 1981

2016 Kumamoto EQ.
Steel pipe (ϕ 1350 mm) deployed in 1982

2011 Tohoku Japan EQ.
Ductile cast iron pipe (K-type, ϕ 500 mm)
deployed in 1974

- ✓ Old types of water pipes were sometimes damaged during recent earthquakes in Japan.
- ✓ Newly deployed water pipes with earthquake-resistant joints were completely safe against large earthquakes.

Deformation Test of DIPs with Earthquake-Resistant Joints

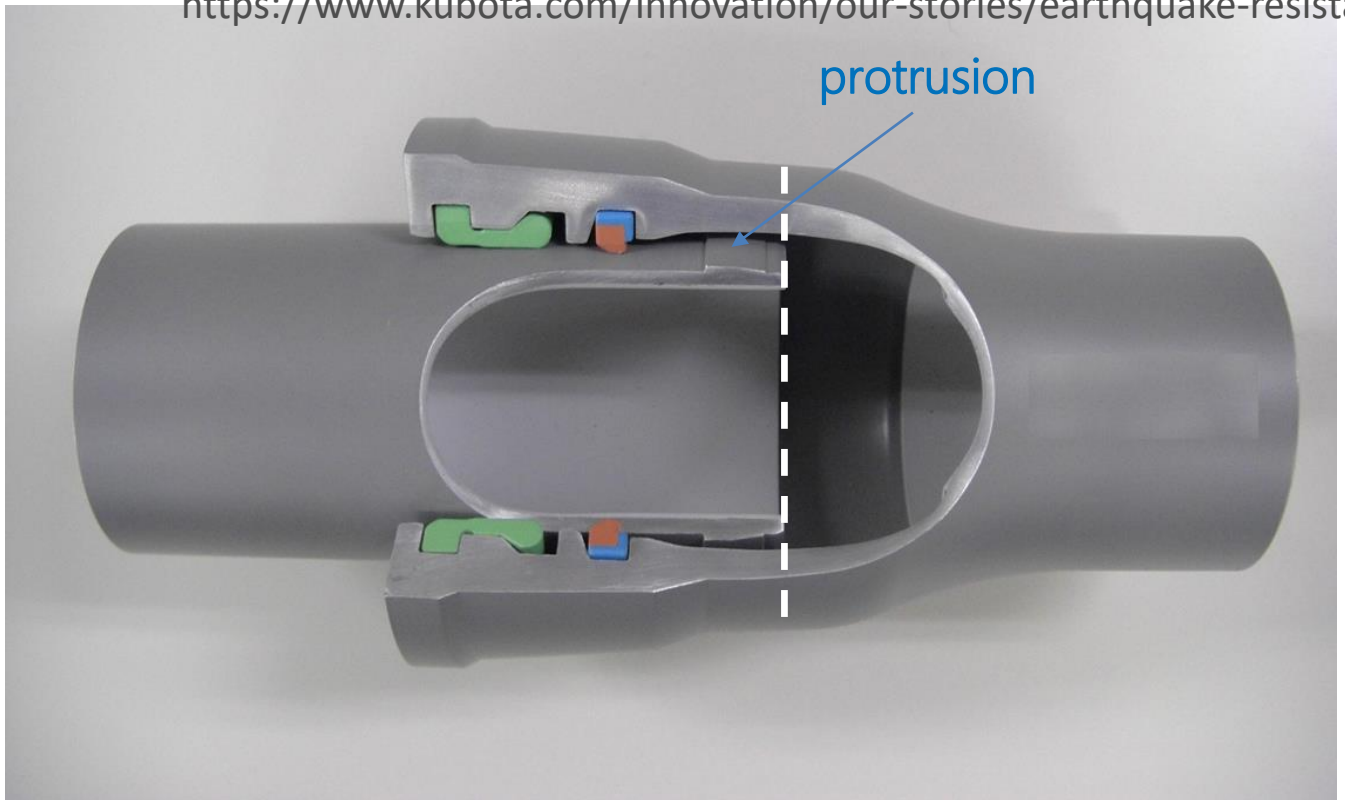
https://www.kubota.com/innovation/our-stories/earthquake-resistant-pipes.html

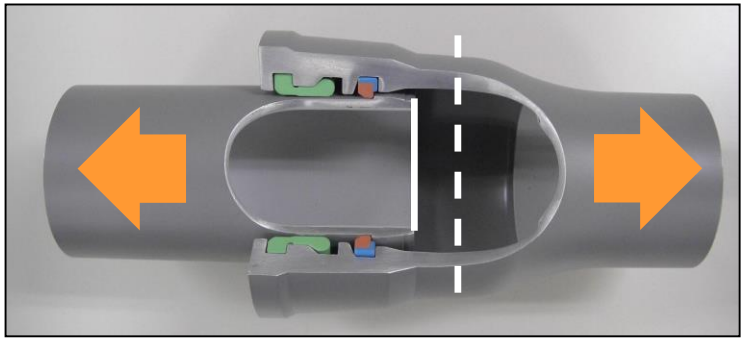
Ductile cast iron pipe (GENEX, ϕ 300 mm)

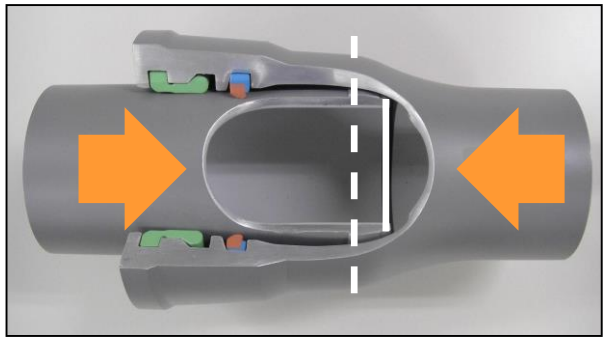
The joints are fine under the extreme large deformation.

Mechanism of DIPs with Earthquake-Resistant Joints

https://www.kubota.com/innovation/our-stories/earthquake-resistant-pipes.html



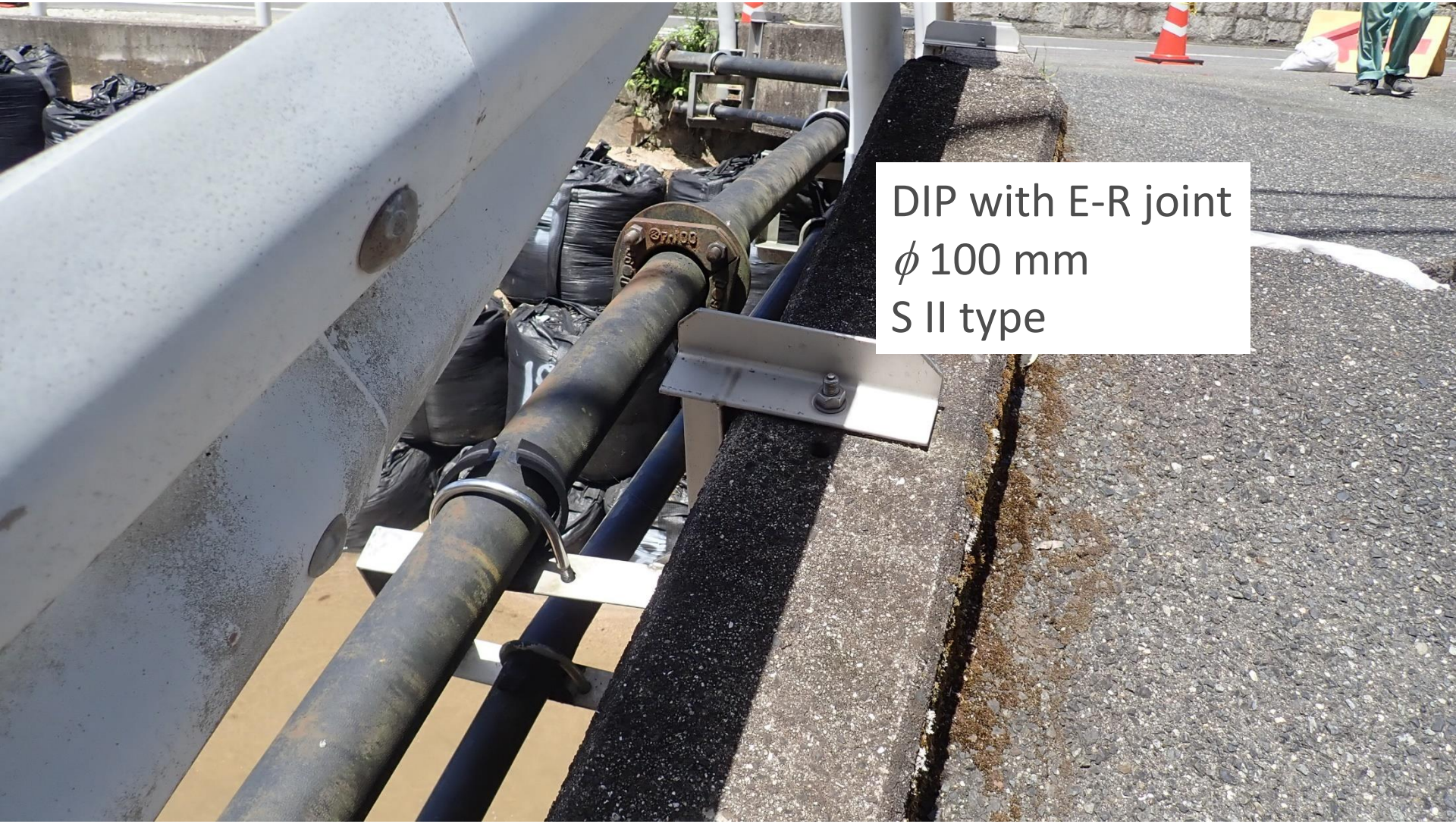




The pipes are not slipped out.

2018 Western Japan Floods and Rain

Aki Ward, Hiroshima City



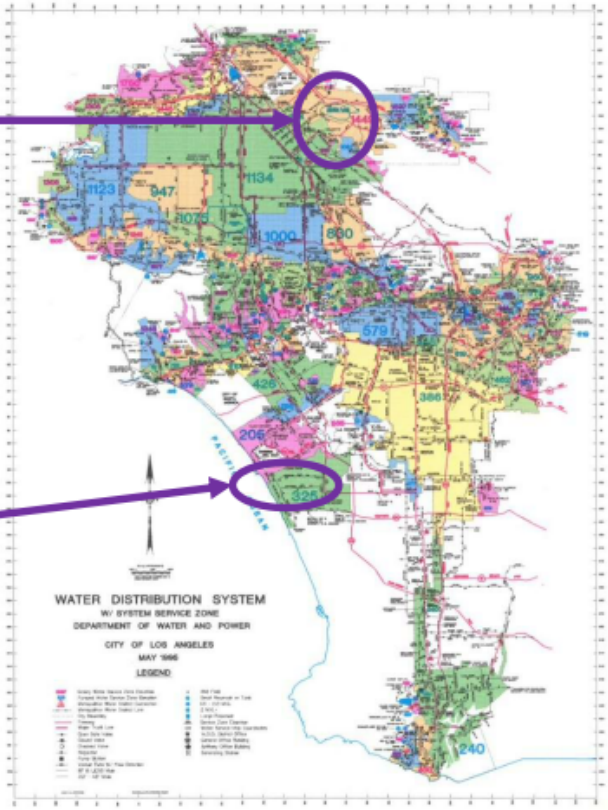
Earthquake-Resistant DIPs Deployed in USA

Current ERDIP projects in LA

Trunk Line

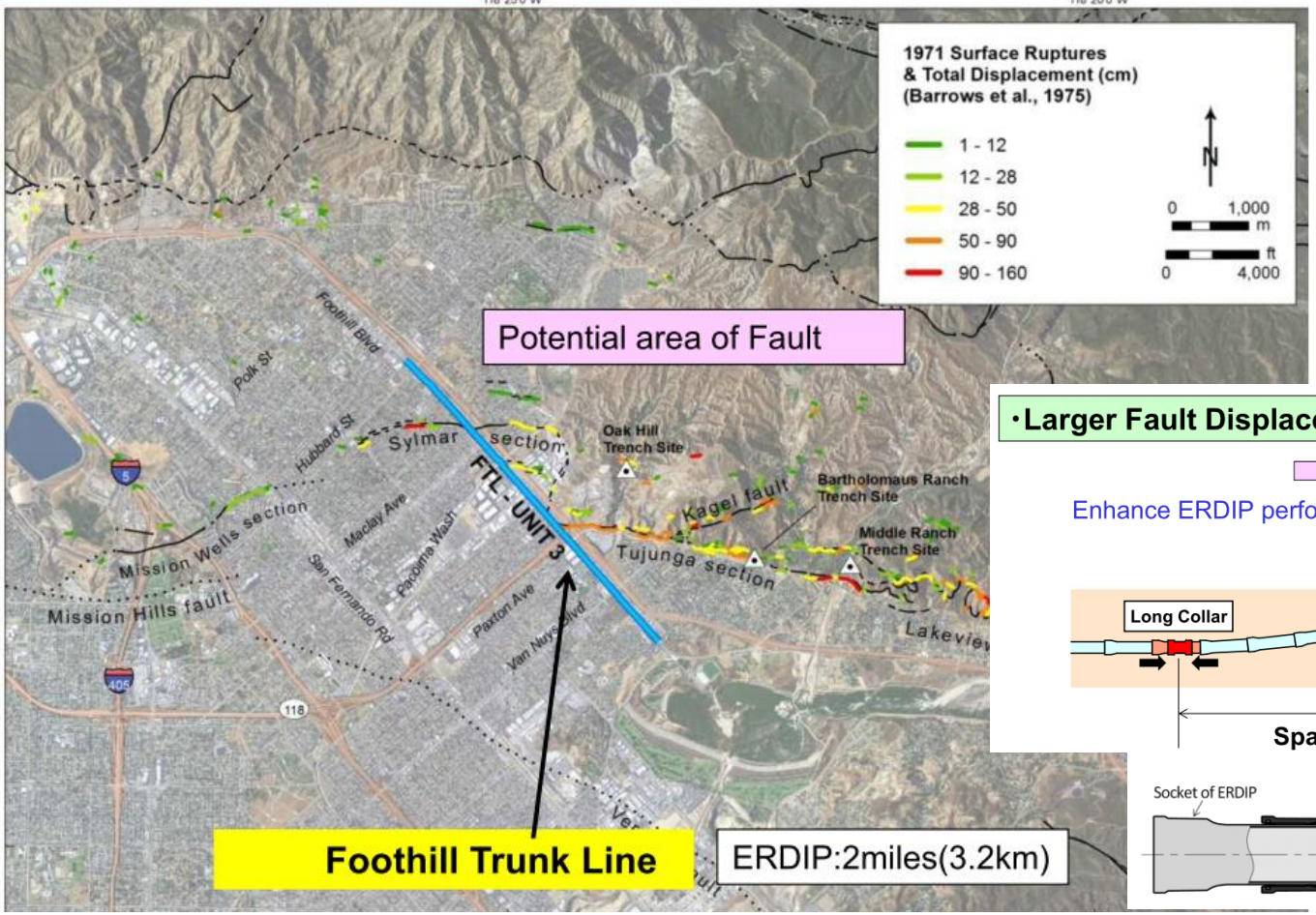
- Foothill trunk line project
  [Crossing 1971 fault rupture]
  - Pipe size: 54” ϕ1350 mm
  - Pipe length: 2miles 3.2 km

- Century project (Planning)
  [Crossing fault and liquefaction zone]
  - Pipe size: 48”
  - Pipe length: 2 miles



Earthquake-Resistant DIPs Deployed in USA

54” Foothill trunk line project (Installing)

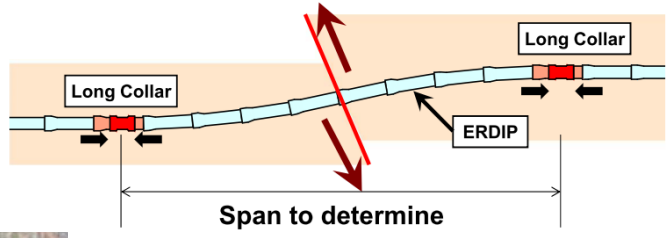


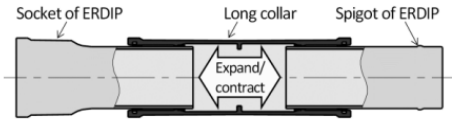
1971 San Fernando earthquake

・Larger Fault Displacement

Install Long Collars.

Enhance ERDIP performance to absorb large displacement.





Earthquake-Resistant DIPs Deployed in USA

June 26, 2018

Summary

Countermeasures of gas and water pipeline system against natural hazards in Japan are introduced.

- Real-time earthquake disaster mitigation system SUPREME was activated during the 2011 Tohoku Japan earthquake, and the initial responses of Tokyo Gas were properly performed.

- The DIPs with earthquake-resistant joints are fine under the extremely large ground deformations. Hence, they are safe against not only earthquakes but also floods.

Thank you very much!