

URBAN SEARCH AND RESCUE BY JAPANESE FIRE SERVICE ORGANIZATION

Fukuoka City Fire Prevention Bureau

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福岡市消防局 梅崎 徹



7. Dec, 2017

発表内容 (Contents)

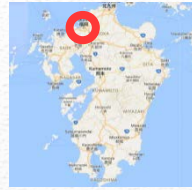
1 都市型搜索救助
(Urban Search and Rescue)

2 地下鉄火災
(Subway Fire)

Introduction



Fukuoka City



Business Complexes



International Airport



Subway



Port Facilities

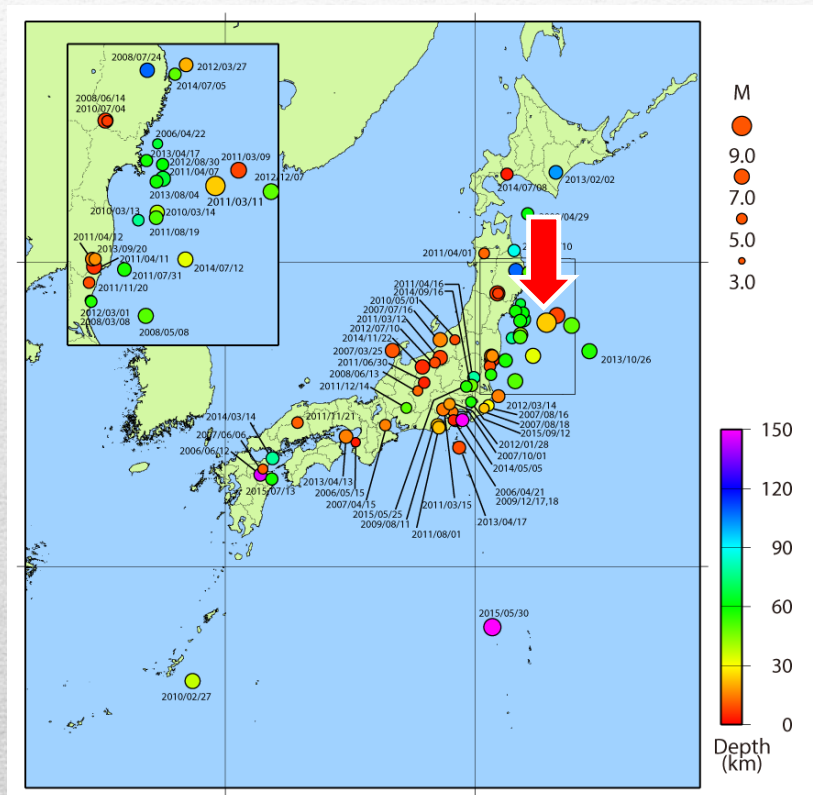
Fukuoka City Fire Prevention Bureau

| Population | 156 million |
|----------------------------------|--|
| Staff of Bureau | 1,080 |
| Fire Station | Headquarter 1 Fire Station 7 Branch Station 24 |
| Fire (2016) | 283 |
| Ambulance Attendance (2016) | 76,141 |
| Rescue Service Attendance (2016) | 2,065 |

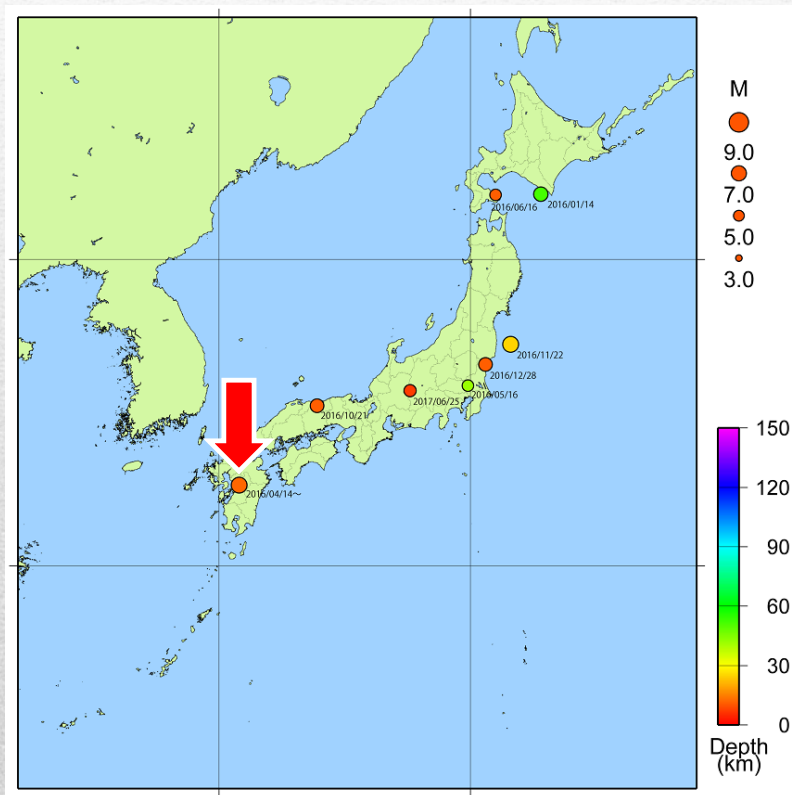
都市型搜索救助

- Urban Search and Rescue -

Epicenter and Magnitude



2006 ~ 2015



2016 ~ 2017

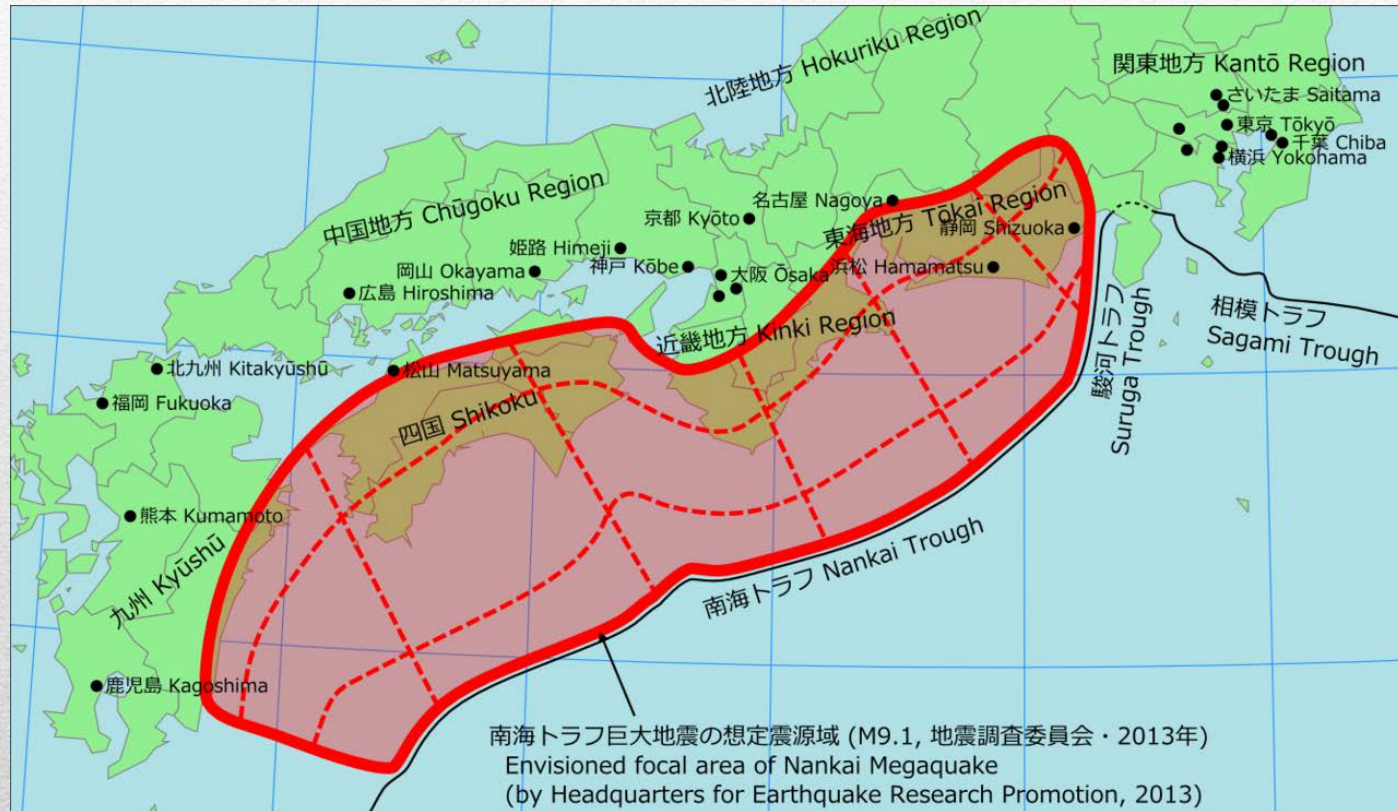
Large Scale Earthquakes

– Recently happened in Japan

| Year | Earthquake | Magnitude | Death & Missing |
|------|-----------------------------------|-----------|-----------------|
| 2016 | Kumamoto Earthquake | 6.5 | 160 |
| 2011 | Great East Japan Earthquake | 9.0 | 15,690 |
| 2007 | Niigataken Chuetsu-Oki Earthquake | 6.8 | 68 |
| 2004 | Niigataken Chuetsu Earthquake | 6.8 | 40 |
| 2003 | Tokachi Oki Earthquake | 8.0 | 48 |
| 1995 | Great Hanshin-Awaji Earthquake | 7.2 | 6,418 |
| 1993 | Hokkaidō Nansei Oki Earthquake | 7.8 | 230 |

*Earthquakes with more than 10 casualties are picked up on the table above.

Nankai Trough Earthquake



Likelihood of Earthquake at M7-8 within 30 Years : 70%

Tokyo Inland Earthquake



Likelihood of Earthquake at M7 within 30 Years : 70%

Enhancement of Rescue Technic

| Expertise Group on Enhancing Rescue Technic | |
|---|--|
| 2008 | Shoring at collapsed building |
| 2009 | Shoring to Wooden Frame Construction |
| 2010 | Rescue at Buckled / Collapsed Reinforced Building – Technic |
| 2011 | Rescue at Collapsed Construction – Operation |



米国の都市型搜索救助隊 US&R
【Urban Search & Rescue Task Force】

Urban Search & Rescue Task Force

- Structural Rescue : 構造物からの救助
- Structural Collapse : 構造物の倒壊
- Confined Space Rescue : 閉鎖空間・瓦礫の中の救助
- Swift Water Rescue Technician : 急流救助技術者
- K-9 : 災害救助犬

2010

Guideline; Rescue at Buckled / Collapsed Reinforced Building -Technic

米国の都市型捜索救助隊 US&R
【Urban Search & Rescue Task Force】



- 1 安全管理 Safety Management
- 2 情報収集 Information Gathering
- 3 人命検索 Search
- 4 進入・退出路確保 Entry Space
- 5 危険要因の排除 Removal of Risk Factors
- 6 救出・救助 Rescue
- 7 観察・応急手当 Medical Observation & Care

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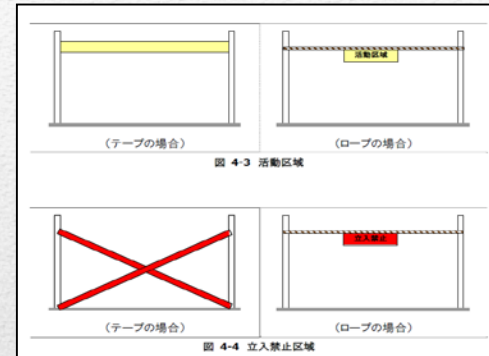
7 観察・応急手当 Medical Observation & Care

1. Safety Management

Must-to-Do things before Starting Rescue Activity



1. Base of Operation



2. Identifying of Dangerous Zone



3. Sharing of Operation Principle



4. PPE

1. Safety Management

Risk Factors

| Physical Factors | <ul style="list-style-type: none">• Another collapse by aftershocks• Unstable structures• Glass chips• Reinforcing steel exposed• Object falling |
|-----------------------|--|
| Environmental Factors | <ul style="list-style-type: none">• Dust and asbestos• Oxygen lacking• Leaks (gas, hazmat etc.)• Electricity leak |



1. Safety Management

Safety Monitoring with Device



Earthquake Alarm



Gas Detector

2010

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2. Information Gathering

Prior to Operation

Weather Information



Situation on Site



2. Information Gathering

On-Site Information Gathering

1. Possible Victims

Possibility of victims inside building, hearing from residents, neighbors and witnesses

2. Structure

Draw layout map of inside of collapsed building based on hearing from people living in

3. Other Rescue Teams

Activities by other rescue teams and first responders and sharing info with each other

4. Risk Factors

Further buckling, crack on and tilt of building under operation

5. Hazmat Evaluation

Leakage of electricity, gas, gasoline and radiation

6. Aftershock

Reconsideration of operation principle through information gathering after aftershock happens

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3. Search

Hailing to Possible Victims



1. Silent Time

2. Search Formation

3. Hailing with Loud Speaker

4. Keep Silent

5. Listen Attentively

3. Search

Search with Instruments



Video Scope

Filming the inside situation with a small camera equipped at the top of the scope

- Temperature Sensor
- Sound Concentrating Microphone
- Gas Detector
- Air Supply
- Lighting

3. Search

Search with Instruments



Underground Sound Detector

Signalize victim's voice or vibration for detection

- Sonic Sensor
Communication with survivor in need of help
- Vibration Sensor
Vibration gets visible on screen even if small

3. Search

Search with Instruments



Carbon Dioxide Surveying
Instruments

Detection of carbon dioxide
generated from breathing

Detection of the ammonia
emitted from body wastes

3. Search

Search with Instruments



Electromagnetic Wave
Surveying Instruments

Detect cancer work or heart
pulse of survivors by radiating
electromagnetic waves

Possible to detect multiple
victims in wide space

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4. Entry Space

鉄筋コンクリートの破壊技術 Breaching Reinforced Concrete

| 区分 | 内容 |
|-----------------|---|
| Dirty Breaching | Quickly penetrate vertically below to a void space, allowing debris to fall into the void space, when victim is not entrapped close floor or wall |
| Clean Breaching | Penetrate vertically below to a void space, preventing debris to fall into the void space, when victim is entrapped near floor or wall |

4. Entry Space

鉄筋コンクリートの破壊技術要領 Breaching Reinforced Concrete - Procedure



Drilling hole on surface
– “Searching Hole”

Place hole on surface with hammer drill to
insert camera of video scope



Measure dimension of concrete



Confirm existence of victim entrapped or
not behind concrete barrier with camera

No Existence



Dirty Breaching

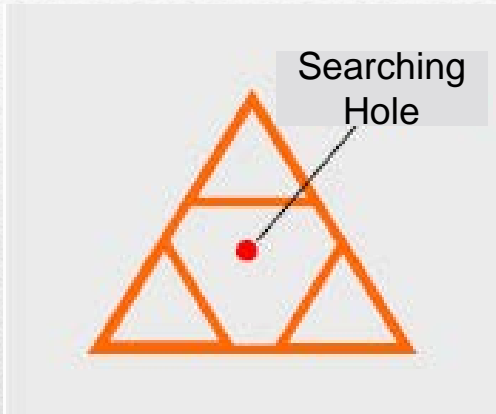


Existence

Clean Breaching

4. Entry Space

Dirty Breaching Vertically Below



1. Marking & Cutting in section



2. Penetration



3. Chipping & Hammering



4. Cutting of reinforcing steel

4. Entry Space

Clean Breaching Vertically Below



1. Penetration & Marking



2. Prevent concrete from falling into



3. Cutting & Chipping



4. Remove concrete

2010

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5. Removal of Risk Factors

Timber Shoring



Raking Shoring



Spot Shoring



Window Shoring, Door Shoring



Sloped Floor Shoring

5. Removal of Risk Factors

Shoring with Rescue Shoring Tools



| | Merits | Demerits |
|----------------------|---|---|
| Rescue Shoring Tools | <ul style="list-style-type: none">• Easy to set up – quick composition• Easy to master way to build up | <ul style="list-style-type: none">• Necessary to disassemble• Collapse could happen when disassembling |

5. Removal of Risk Factors

Timber Cribbing - Stabilization



2010

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6. Rescue

Confined Space Rescue



Leader's action – grasping situation, creating rescue plan, sharing the sign for rescue activities and deploying rescuers



Shoring & Setting Guide Rope



Get **rescuers paired** when entering collapsed building



Carry on calling to possible victims during the search and keep **the leader updated on the inside situation.**



6. Rescue

Confined Space Rescue



Shoring the collapsed building to secure the **evacuation space** for safe rescue activity



Medical observation and care after discovering victims – **Crash Syndrome** should be most cared.



6. Rescue

Confined Space Rescue



Get the victim to wear the **protector**



Wrap the victim with **insulating blanket**



Bind on the stretcher



Carry with two rescuers holding the head side and the foot side individually

2010

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7. Medical Observation & Care

Characteristic symptom of victims in collapsed building – Crush Syndrome

Muscle damage due to part of body **pressed by heavy stuff for a long time**



Removing heavy stuff



Calcium, Myoglobin and lactic acid start leaking from necrotic muscle to blood



Hyperkalemia ⇒ **Ventricular Fibrillation** ⇒ Heart Arrest

Kidney **Tubular Necrosis** ⇒ **Acute Kidney Failure** ⇒ Death

7. Medical Observation & Care

Characteristic symptom of victims in collapsed building – Crush Syndrome

Medical Observation



Pressed by heavy stuff **for more than two hours?**

Any **anesthesia** around four limbs?

30% or more of skeletal muscle crashed with heavy staff?

Black/Red-Brown colored urine?

7. Medical Observation & Care

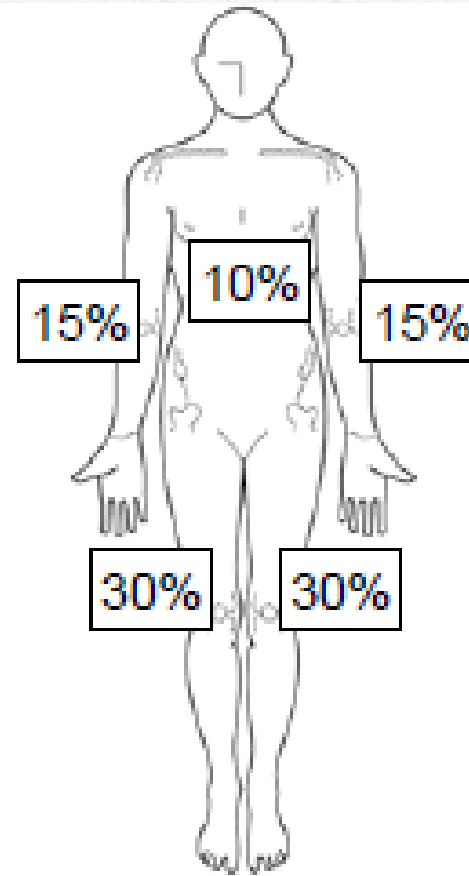
Characteristic symptom of victims in collapsed building – Crush Syndrome

Proportion of Skeletal Muscle
– in Case of Adult

One Upper Limb: 15%

One Lower Limb: 30%

Head and Trunk: 10%



7. Medical Observation & Care

Characteristic symptom of victims in collapsed building – Crush Syndrome

Emergency Medical Care



2,000ml or over **infusion solution** before removing heavy stuff

Electrocardiogram ⇒ **Defibrillation** when ventricular fibrillation happens

Securing hospital which can do **blood dialysis**

Sodium bicarbonate ⇒ Correction of Acidosis
Calcium Gluconate ⇒ Prevention of Arrhythmia Death

***only when a doctor attends the scene**

都市型搜索救助 (Urban Search And Rescue)

Expert Group for Enhancing Rescue Technic, 2010
Guideline; Rescue at Buckled / Collapsed Reinforced Building - Technic



Encouraging local fire service organizations to make training in
line with the guideline



Implementation and review at each local fire service organization



Enhancement of rescue skill for possible future large scale
earthquake

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(Subway Fire)

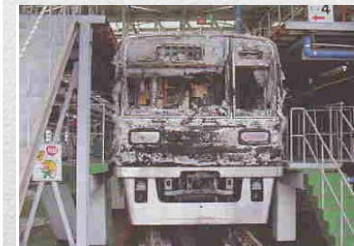
地下鉄火災

- Subway Fire -

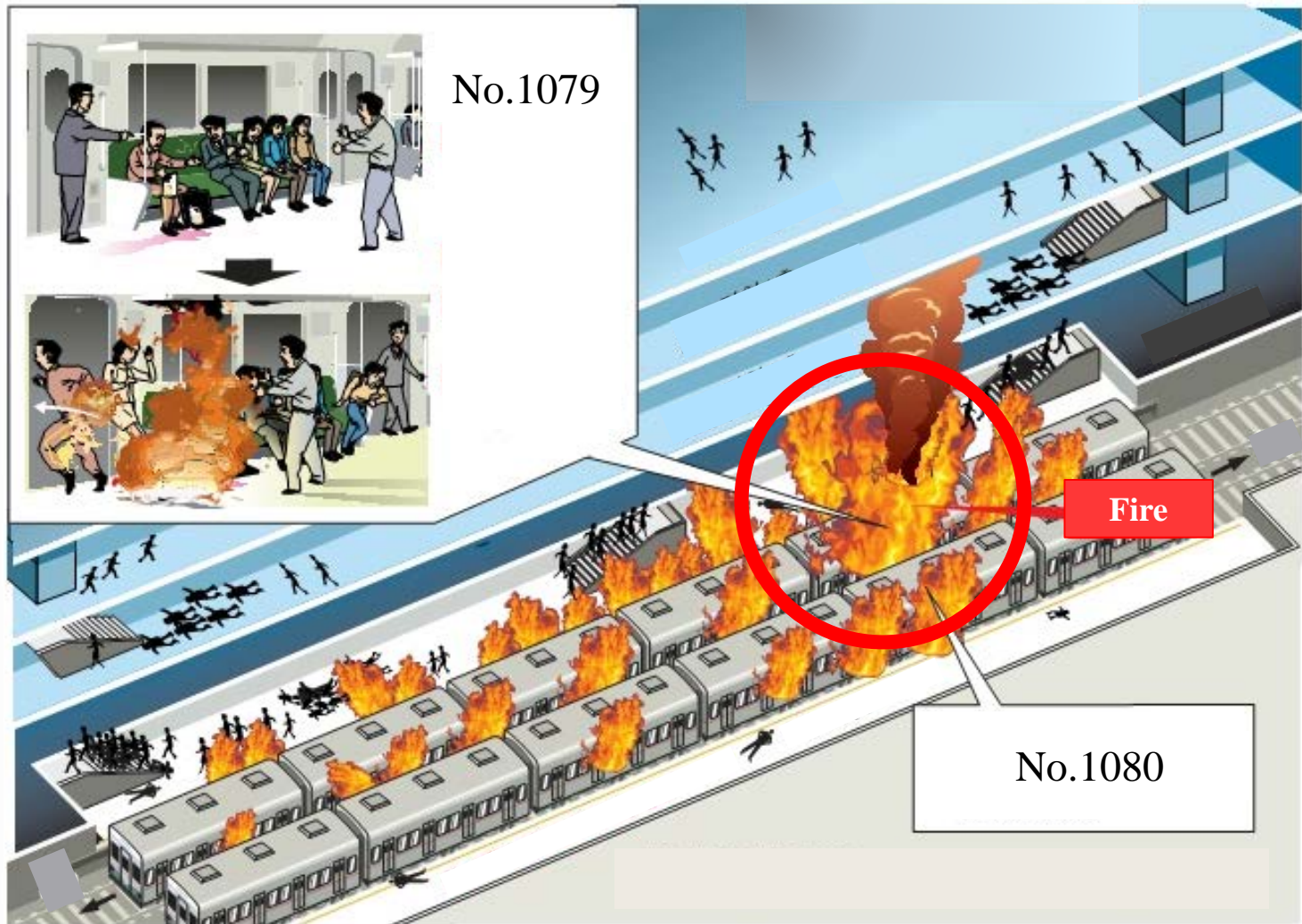


Korea Daegu Subway Fire

| Date & Time | 09:53 Feb 18, 2003 |
|---------------------------|--|
| Place | Jungangno Station of the Daegu Metropolitan Subway in Daegu, South Korea |
| Cause | Arson Attack - a 56 aged man set fire with flammable liquid. |
| Deaths | 192 |
| Injuries | 148 |
| Firefighters on Operation | 1,150 (Fire Engine 222 and Helicopter 1) |



Korea Daegu Subway Fire



Korea Daegu Subway Fire

Firefighting
by Taegu Fire and Safety
Department

Fire breakout

1min

Fire breakout learnt of

10min

Command to mobilize

3min

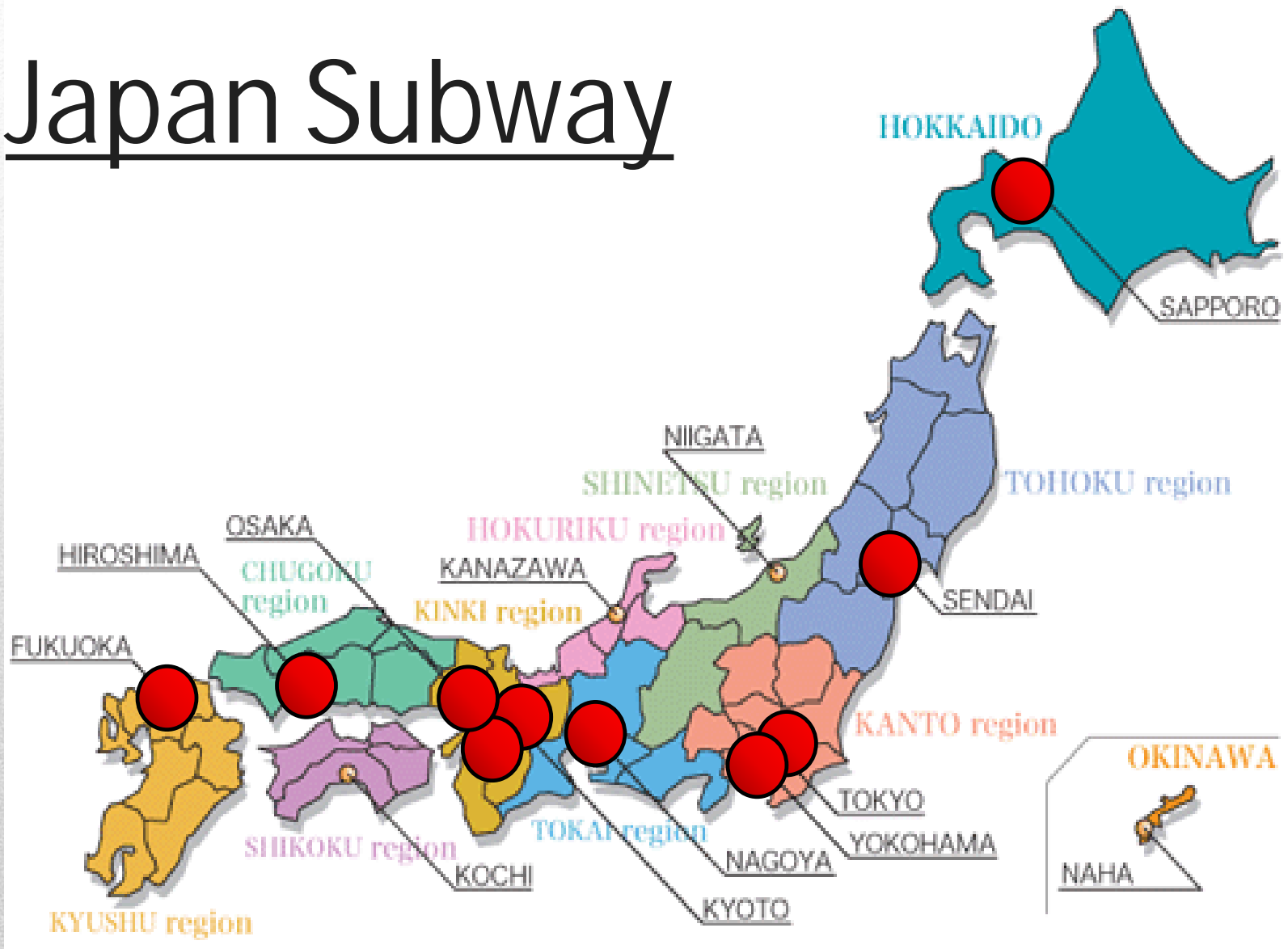
Fire service team arrival

Approaching the insident site along
rails from nearby stops

Fire got under control 3h45min
after breakout



Japan Subway



Fukuoka City Subway

| Started Operation | 1981 |
|---------------------------------|--|
| Operator | Fukuoka City Transportation Bureau |
| Number of Stations | Total 35 |
| | Airport Line 13 Hakozaki Line 7 Nanakuma Line 16 |
| Passengers Carried (per day) | 426,000 |



Fukuoka City Subway



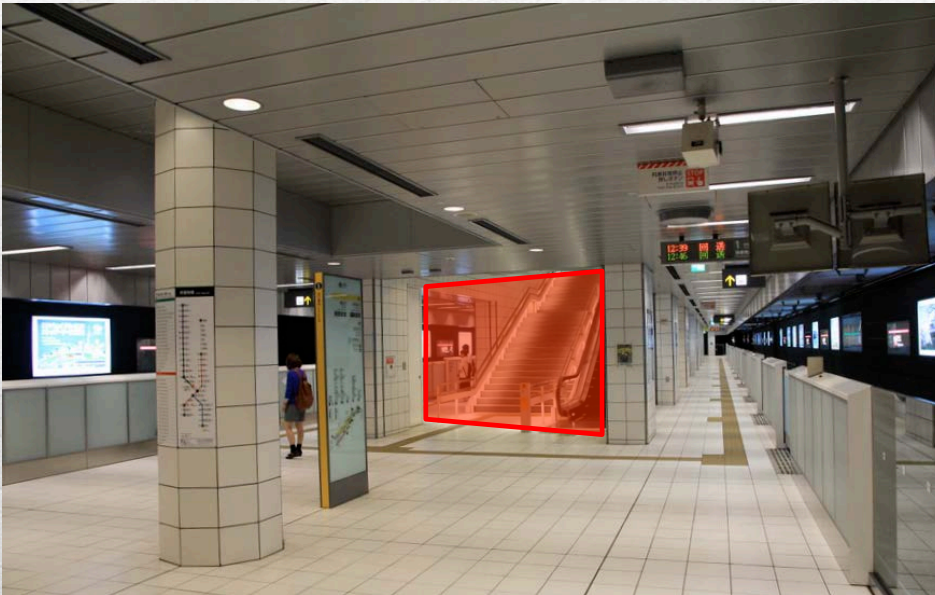
Bore Diameter: W8.1m, H5.6m

Power Current :
Direct Current 1500V

Air Vent

- ① set at every midpoint
between stations
- ② Normal $2,500\text{m}^3/\text{min}$
- ③ in Fire $5,000\text{m}^3/\text{min}$

Fukuoka City Subway



Flame Proof Zone

Fire and flame proof shatter – to work automatically with smoke detector, is located at the stairs of the platform to prevent smoke from spreading across the station.

Fukuoka City Subway



Emergency Door Cock
inside Vehicle



Emergency Door Cock
outside Vehicle

Fire Fighting Device and Tool



Fire Extinguisher



Drencher (Water Curtain)



Sprinkler



Fire Hydrant
Water Pipe

Fire Fighting Device and Tool



Emergency Phone



Emergency Power Point



Smoke Control System

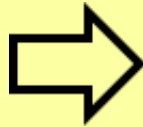


Radio Communication
Support System

Operation Procedure in Fire



Command Team①



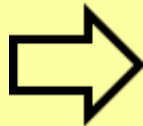
Operation
Command Center

Power Transmission
halted

Smoke Discharger
activated



Command Team②



Connected to Radio Communication Support System

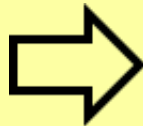
Field Command Cell set up

Operation Procedure in Fire



Fire Service Team①

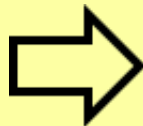
Dashing to
Fire Hydrant



Discharging water into pipe
connected to subway station



Fire Service Team②



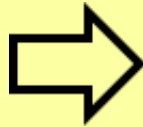
Evacuation Instruction and Firefighting



Operation Procedure in Fire



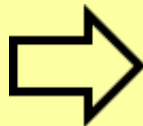
Rescue Team



Search and Rescue



Ambulance Team



First Aid Site



Triage

Operation Procedure in Fire

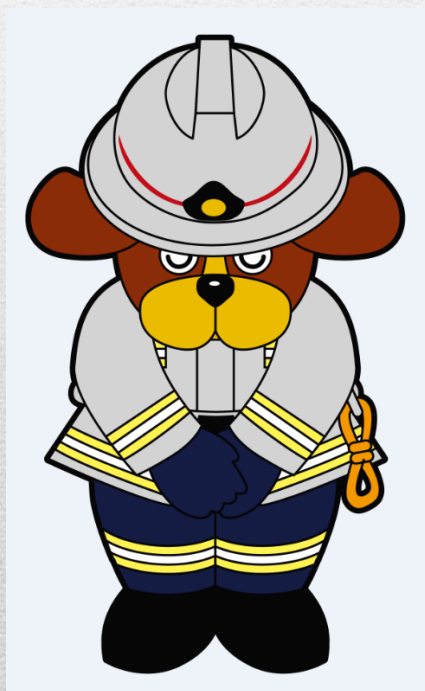


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ご清聴ありがとうございました
Thank you for listening



Q&A