

CAST Applied to Fukushima Daiichi Nuclear Disaster



(Source) <http://www.gimu.fks.ed.jp/shidou/jiten/>

Horseback archery
in Furudono Town,
Fukushima

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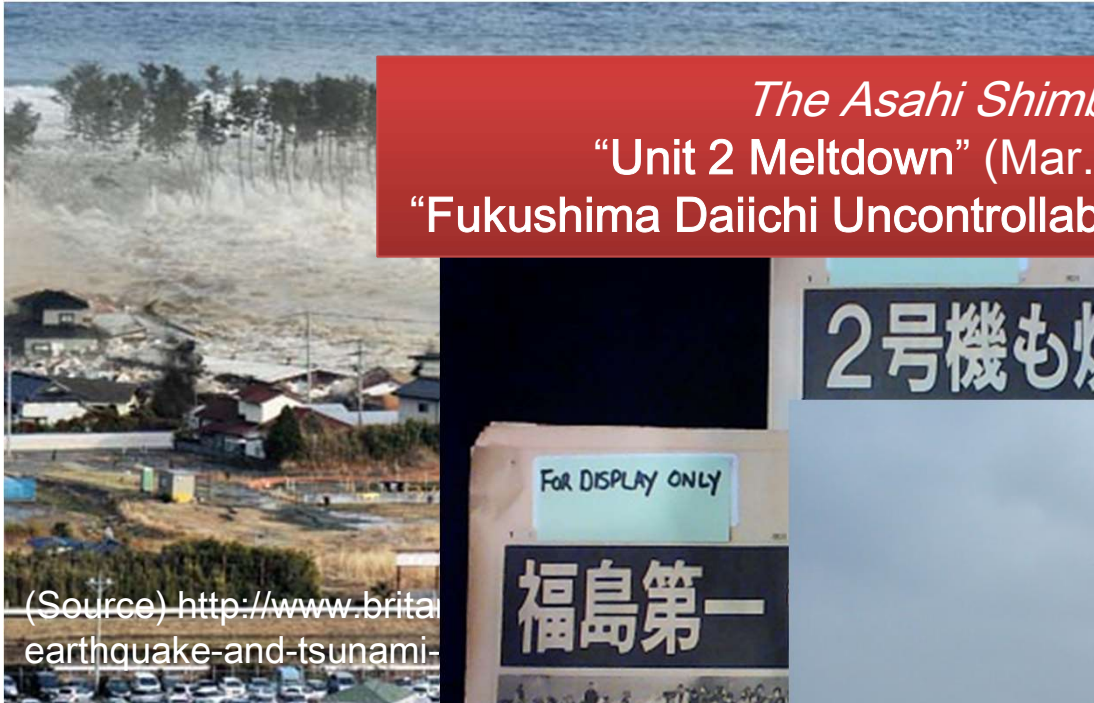
Leadership, Innovation, Systems Thinking

MITsdm

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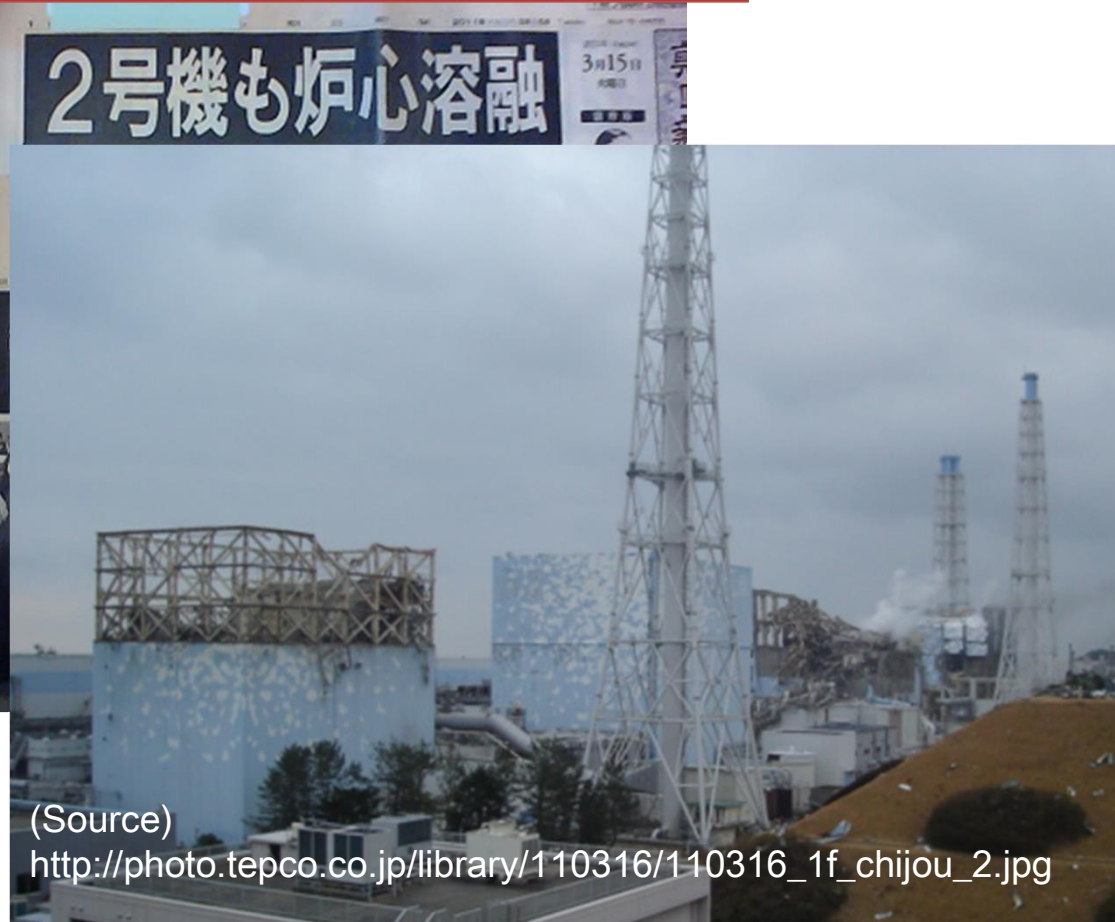
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3. Stakeholders, Safety Constraints and Unsafe Control Actions
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5. Administrative Issues
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1. Fukushima Daiichi Nuclear Disaster



(Source) <http://www.britain.com/earthquake-and-tsunami>

The Asahi Shimbun
“Unit 2 Meltdown” (Mar. 15, 2011)
“Fukushima Daiichi Uncontrollable” (Mar. 16, 2011)



(Source)
http://photo.tepco.co.jp/library/110316/110316_1f_chijou_2.jpg

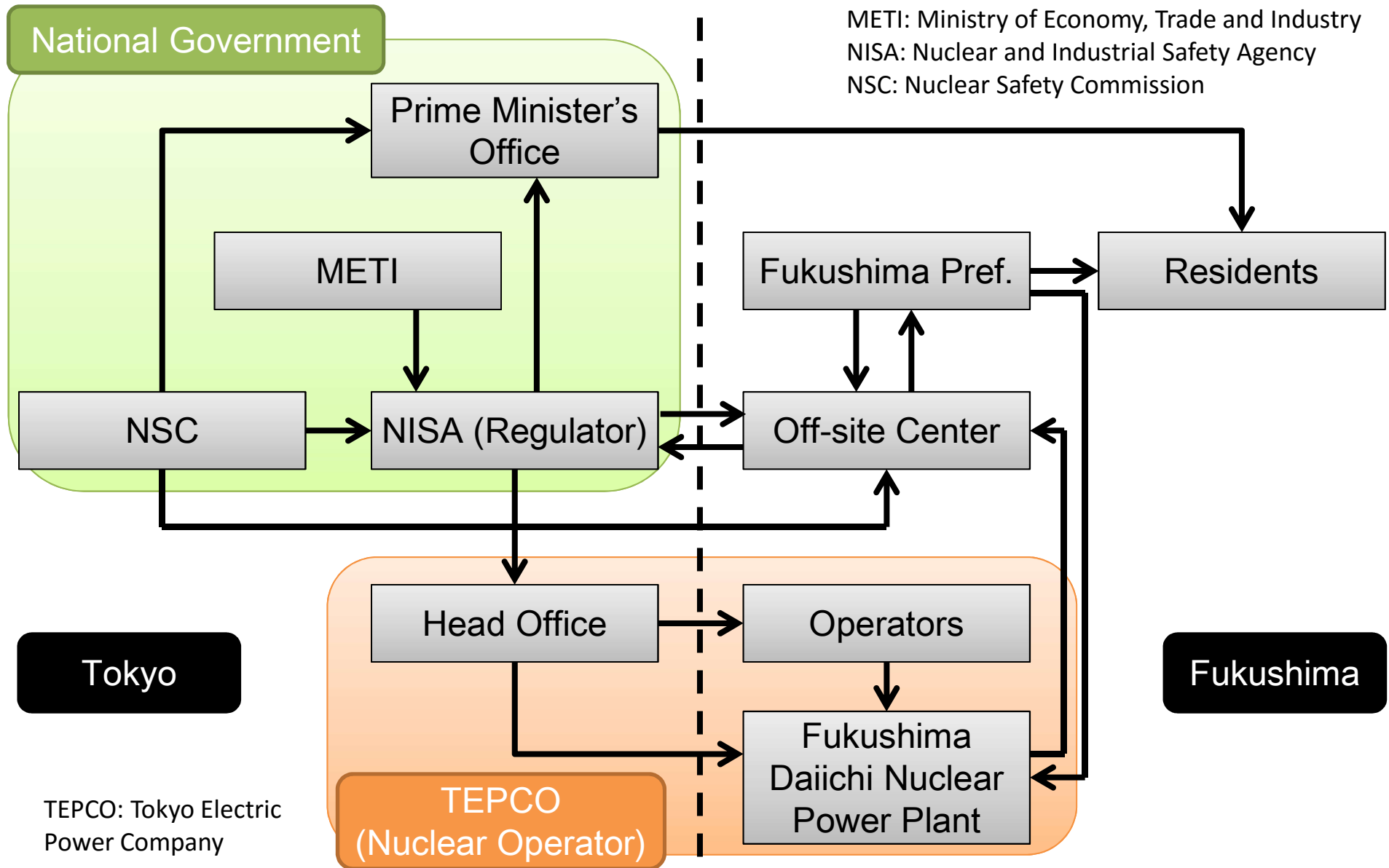
2. Research Questions and Purposes

HOW and WHY did the safety control structure go wrong in managerial contexts?

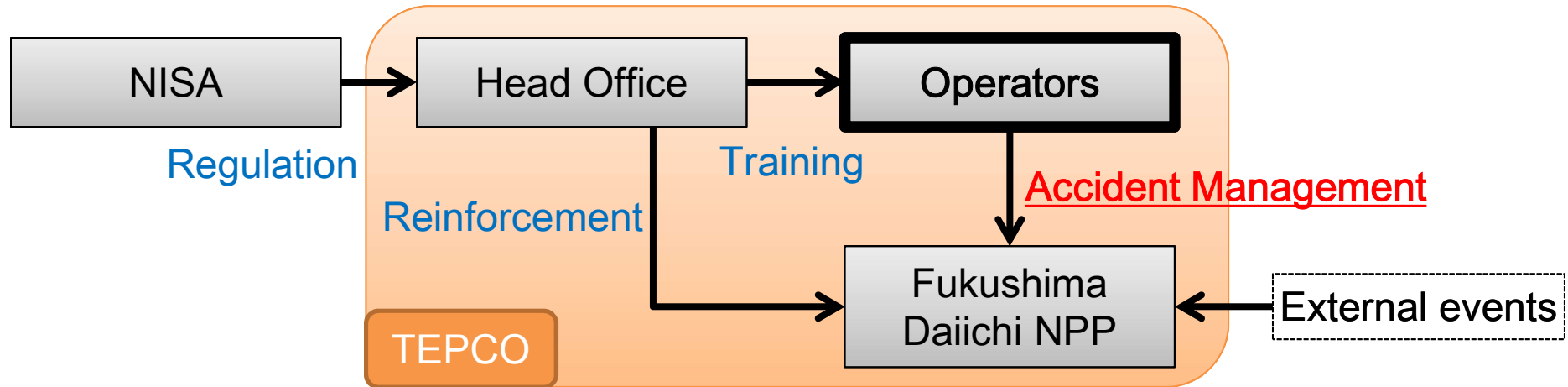
[Purposes]

1. Identifying organizational constraints and unsafe control actions (UCAs)
(Peacetime UCAs / Emergency UCAs)
2. Identifying the beliefs and contexts underlying these actions

3. Stakeholders, Safety Constraints and UCAs



3-1. Tokyo Electric Power Company (TEPCO)



[Safety Constraints]

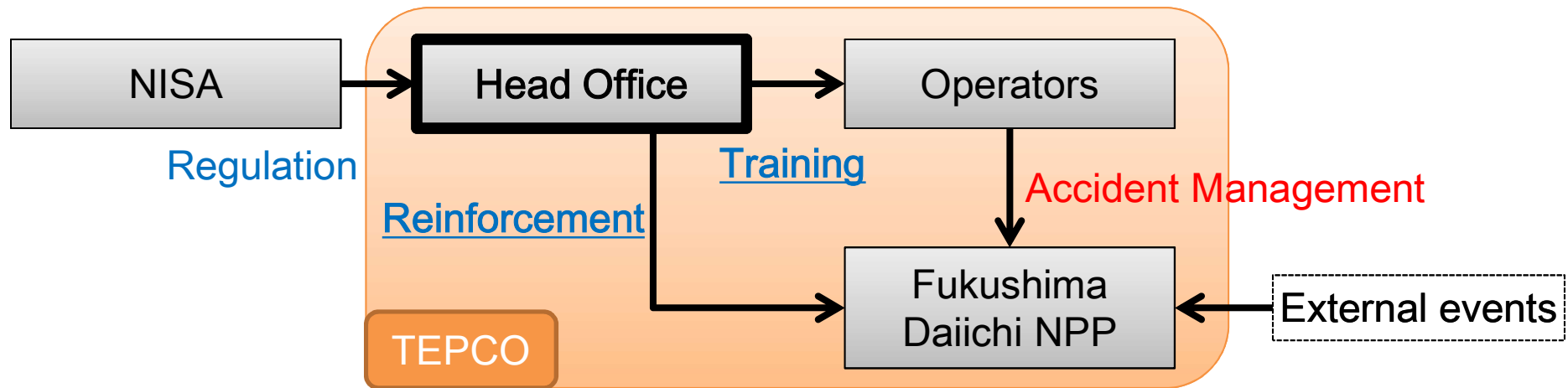
- Primarily responsible for nuclear safety

[Unsafe Control Actions] (Operators)

- **Inadequate control of severe accidents**

(Context) Loss of the main control room function,
lighting and communication systems

3-1. Tokyo Electric Power Company (TEPCO)



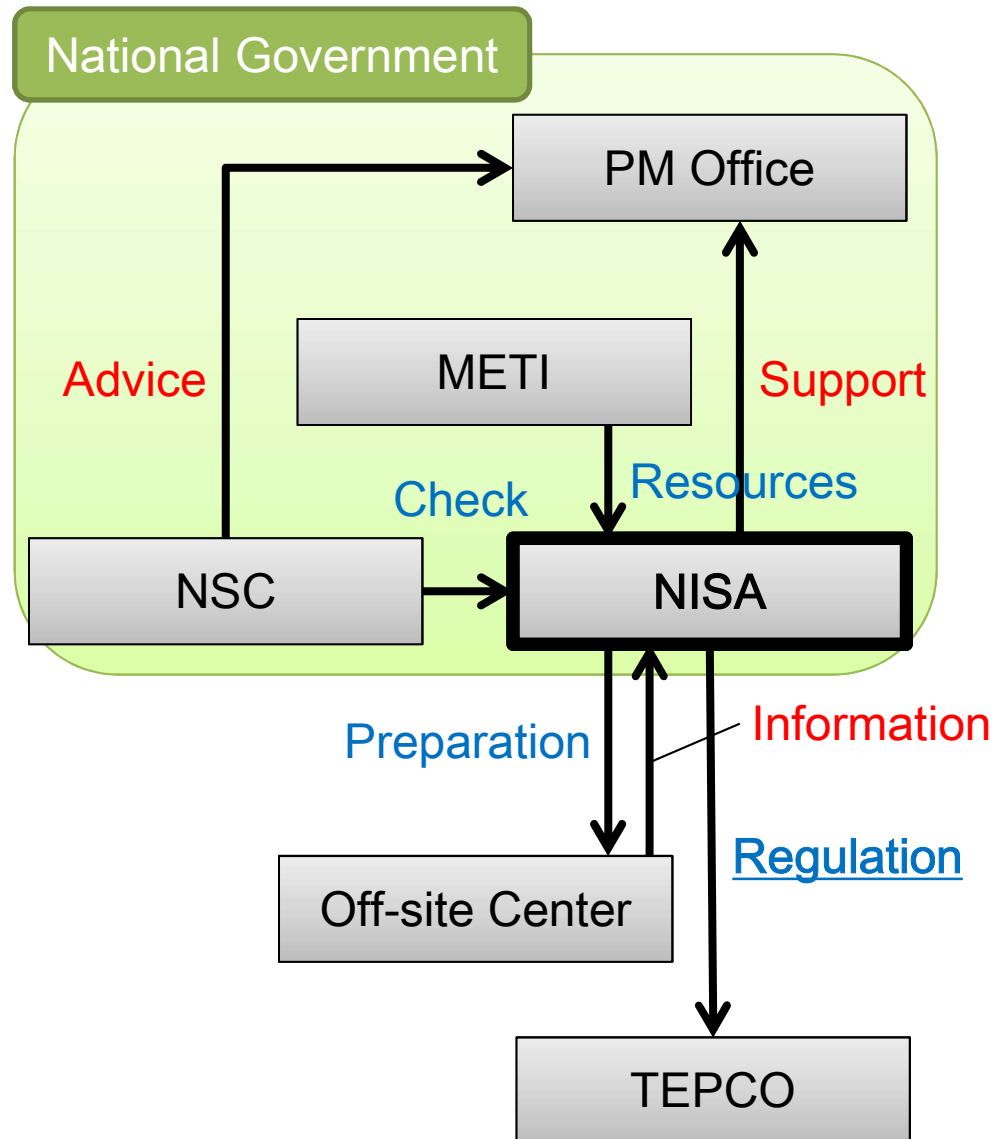
[Unsafe Control Actions] (Head Office)

- Lack of NPP reinforcement against tsunamis
- Inadequate education, training and instruction

(Mental Model Flaws)

- “Huge tsunamis will not occur in the near future.”
- “Nuclear accident will not happen.” (Safety Myth)

3-2. Nuclear and Industrial Safety Agency (NISA)



[Safety Constraints]

- Nuclear regulation
- Disaster prevention and damage mitigation

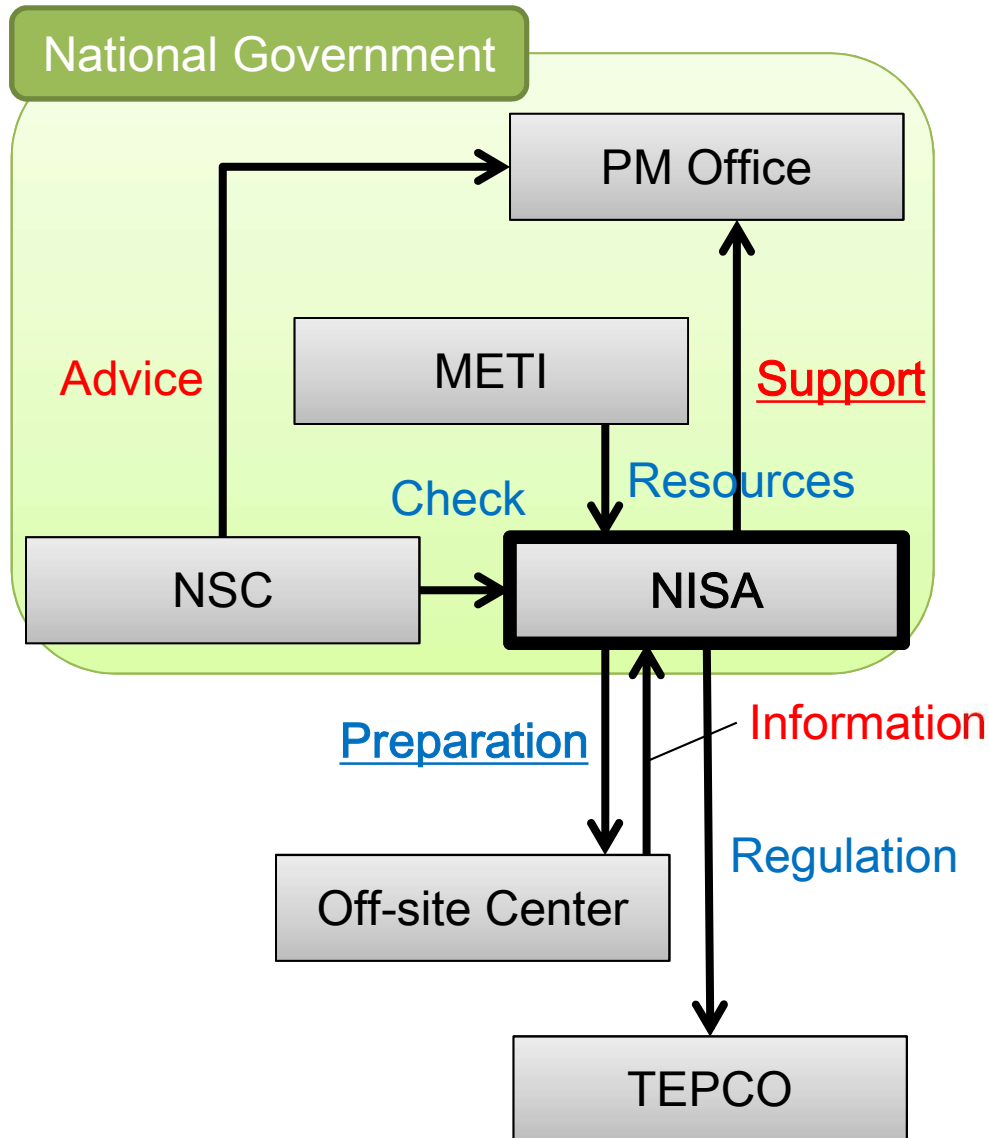
[Unsafe Control Actions]

- Did not give TEPCO appropriate supervision

(Mental Model Flaws)

- “Severe accidents will never happen.” (Safety Myth)

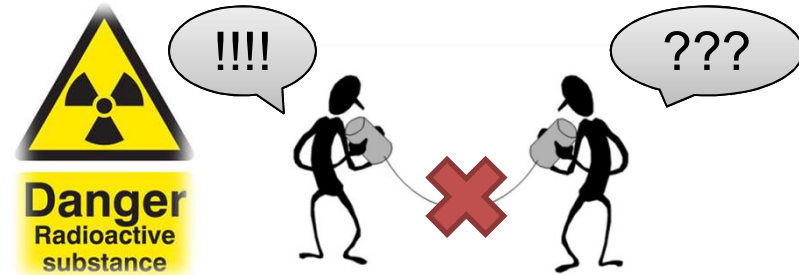
3-2. Nuclear and Industrial Safety Agency (NISA)



[Unsafe Control Actions]

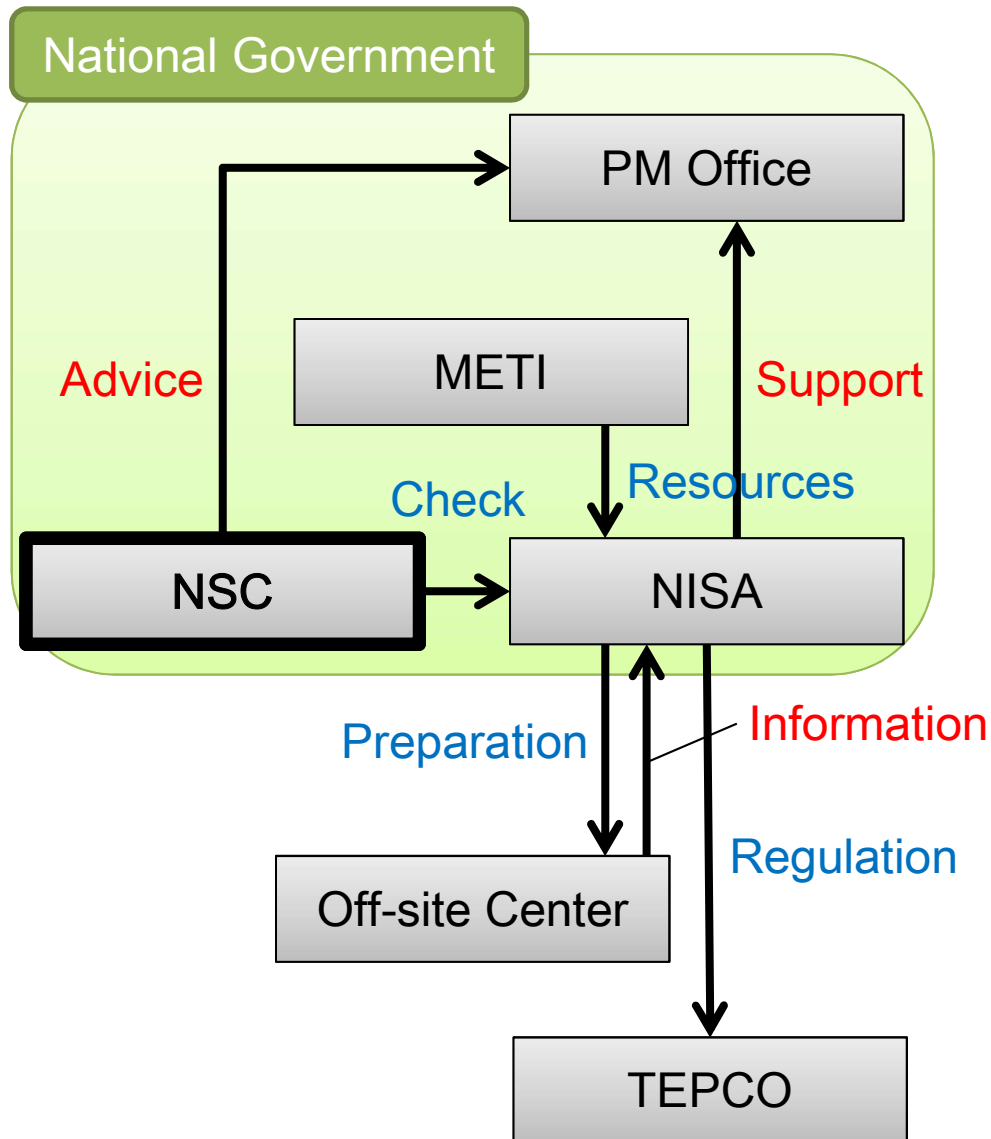
- Did not prepare for severe accidents beforehand

→ Off-site Center did not function (disconnected communication)



→ NISA's **ineffective** emergency response

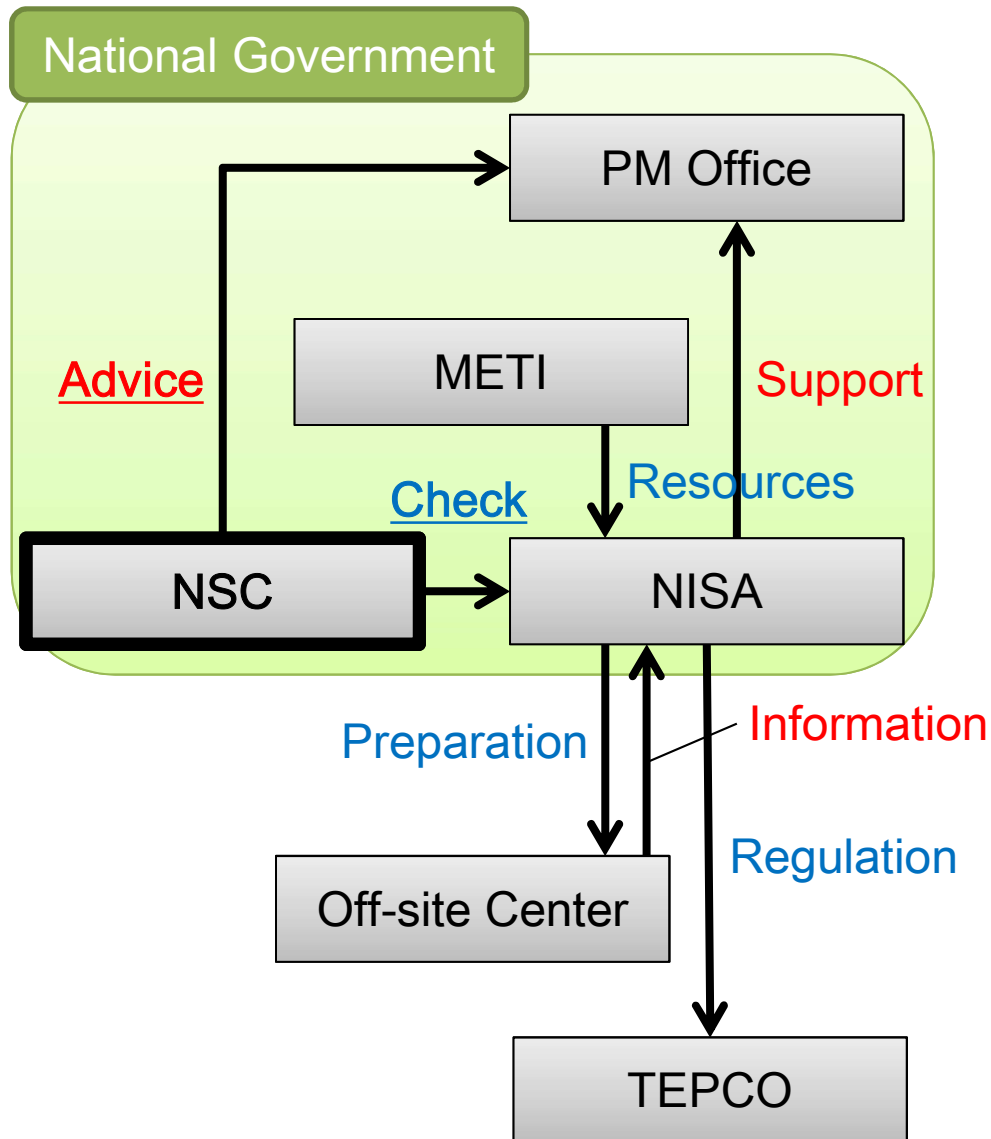
3-3. Nuclear Safety Commission (NSC)



[Safety Constraints]

- Double check safety regulations and decide regulation policies
- Provide technical advice to the Prime Minister in case of an emergency

3-3. Nuclear Safety Commission (NSC)



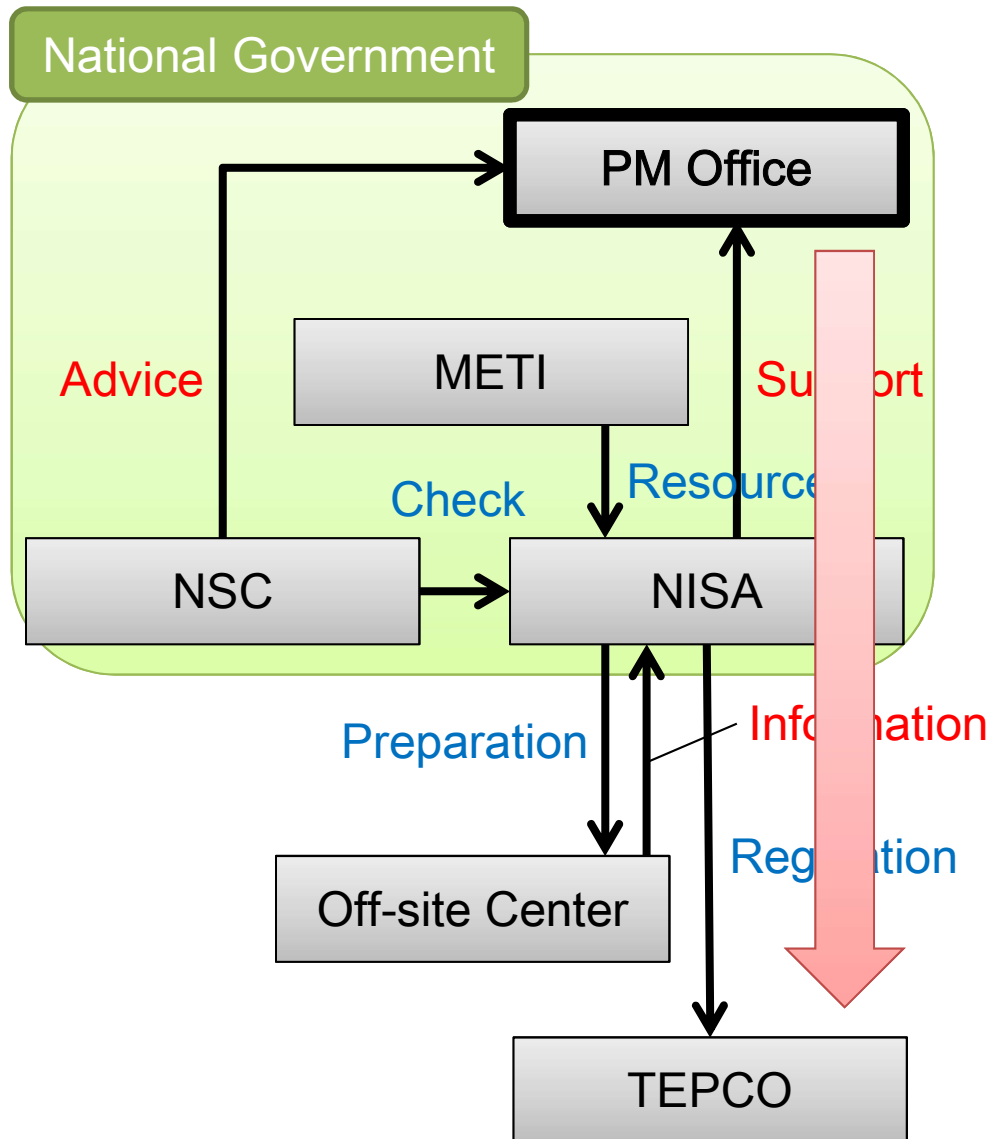
[Unsafe Control Actions]

- Did not sufficiently check regulations and decide effective regulation policies

(Context) Influence of METI etc. / No right to investigate NISA and TEPCO

- Did not provide appropriate advice to the Prime Minister at the time of disaster

3-4. Prime Minister's Office



[Safety Constraints]

- Play a pivotal role in the emergency response (*e.g.* protection of residents)

[Unsafe Control Actions]

- **Caused confusion by unplanned decision making processes** (*e.g.* direct intervention to TEPCO)

3-5. Fukushima Prefectural Government and Municipal Governments

[Safety Constraints]

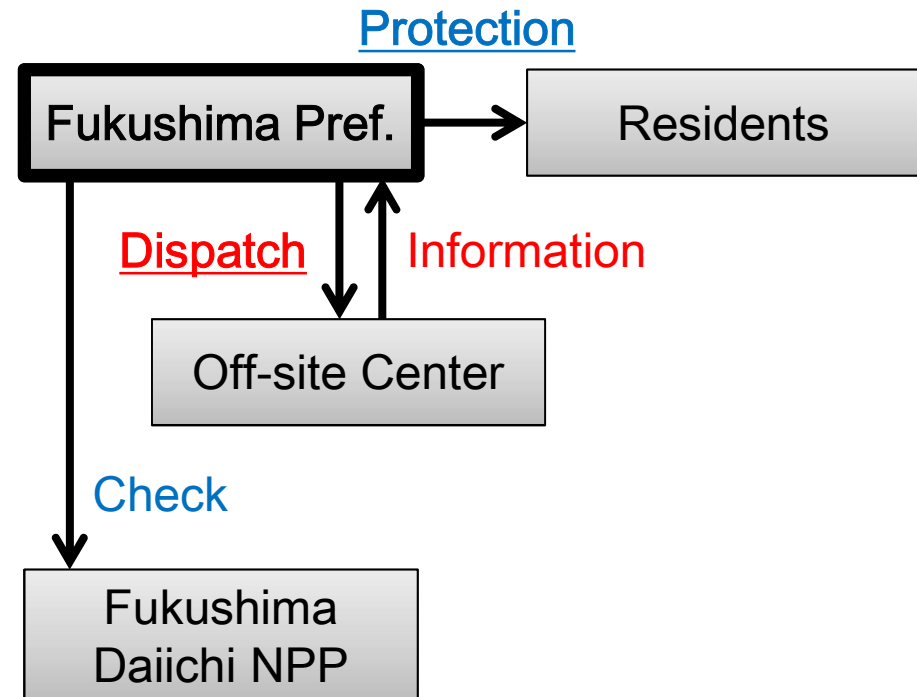
- Protection of residents

[Unsafe Control Actions]

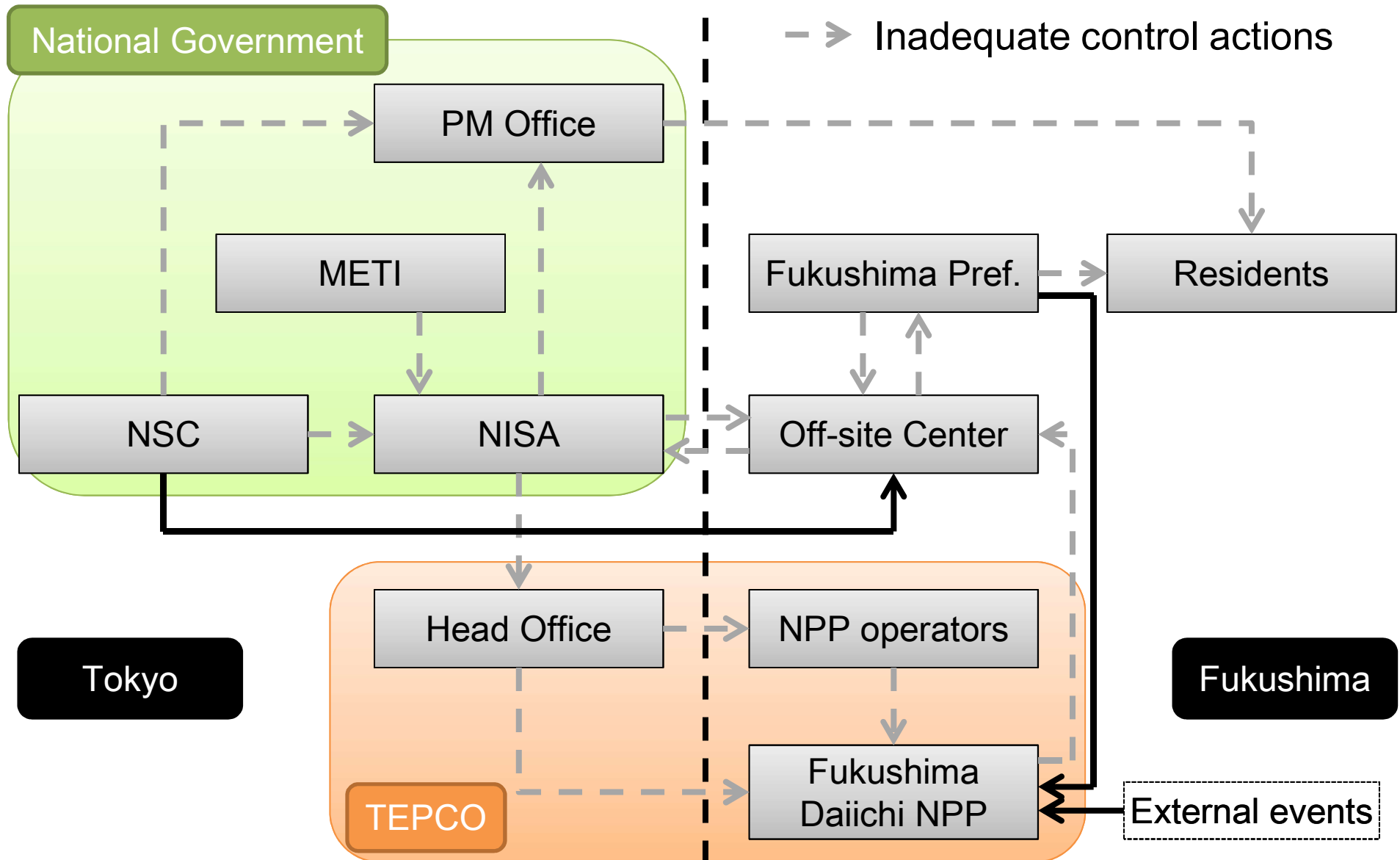
- Ineffective evacuation drills
- Did not dispatch personnel to the Off-site Center

(Contexts)

- Tied up with their response to the earthquake and tsunami disasters



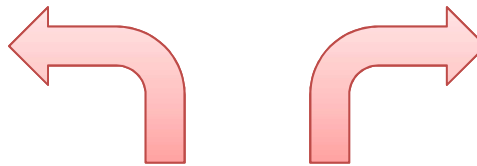
Regulations didn't work. Poor emergency response.



4. Underlying Beliefs and Contexts

Unpreparedness for
severe accidents

Unpreparedness for
compound disasters



Difficulty to take
actions for
system safety

(e.g.)
earthquake AND
nuclear accident

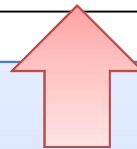
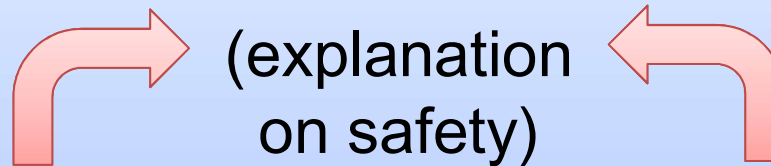
(Symptoms)

(Beliefs, Contexts)

“Safety Myth”
(explanation
on safety)

Micromanagement of
every aspect of hardware

Past performance on
plant robustness



5. Administrative Issues

(TEPCO)

- Top management lacked attitude toward nuclear safety.

In contrast, Tohoku Electric Power Company:

- Was well aware of the risks of tsunamis
- Had top management firmly advocating safety
- Had a culture to prioritize safety above all



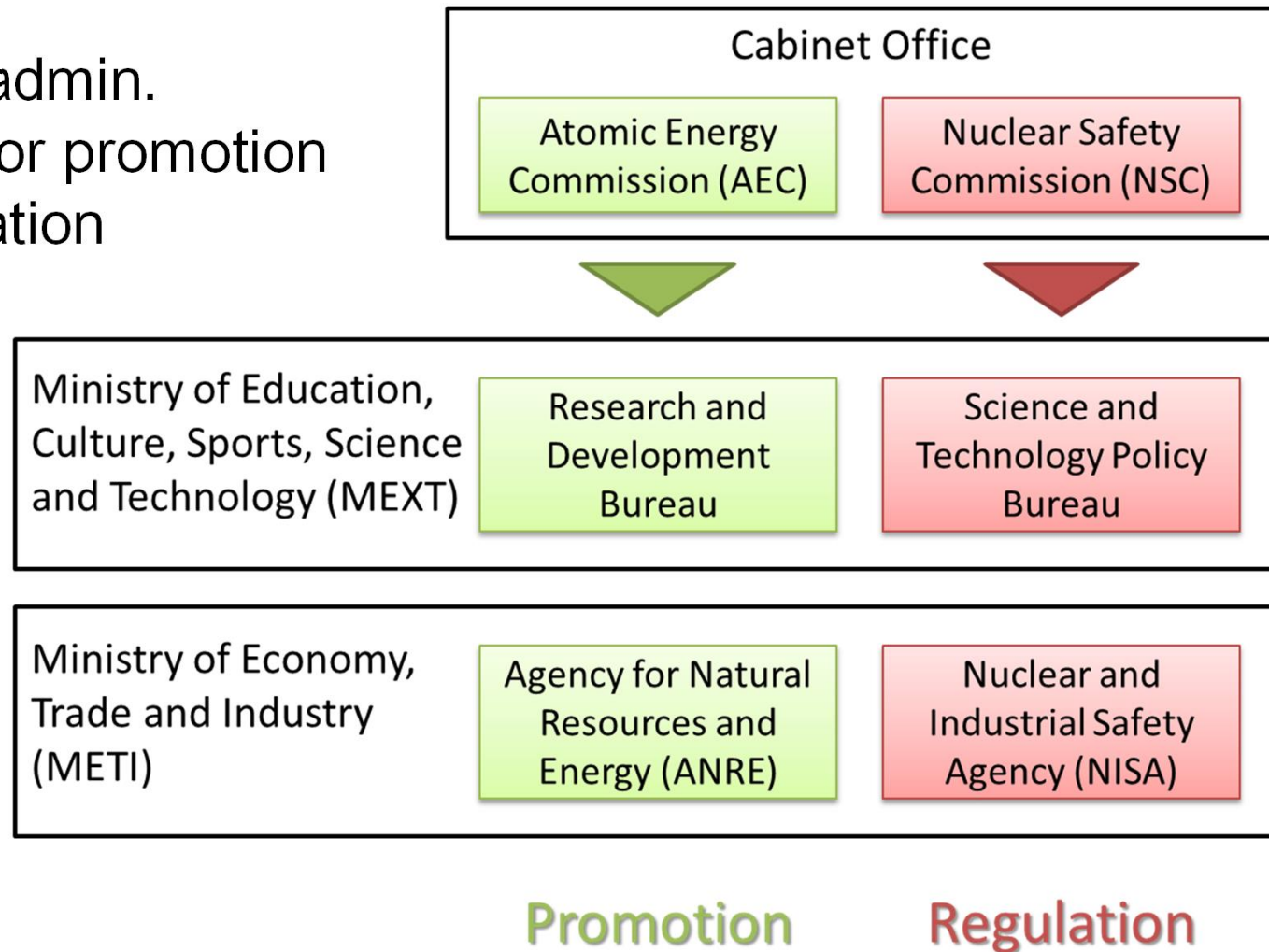
(Source) <http://www.tohoku-epco.co.jp/>

Onagawa NPP
(Tohoku Electric Power Co.)

5. Administrative Issues

(Government)

- Complex admin. structure for promotion and regulation



5. Administrative Issues

(Government)

- Bureaucracy
 - Reliance on precedent
 - Regulations rarely reviewed and updated
 - Document-based inspections (“Checklists”)
 - Micromanagement of hardware
 - Periodic personnel rotation
 - Lack of expertise as a regulator



6. Conclusion

By using the CAST process,

- The control structure proved to have been ineffective for a severe accident or a compound disaster (NOT just TEPCO and NISA)

Administrative issues helped “Safety Myth” grow, which made it difficult to take further actions for system safety

Possible recommendations include:

- Administrative reformation ✓
- Periodic check by third-party scientists / IAEA
- Learning from this accident (*e.g.* preservation)

References

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- Ryu, A., Meshkati, D. (2014). *“Why You Haven’t Heard About Onagawa Nuclear Power Station after the Earthquake and Tsunami of March 11, 2011 – Nuclear Safety Culture in TEPCO and Tohoku Electric Power Company: The root-cause of the different fates of Fukushima Daiichi Nuclear Power Plant and Onagawa Nuclear Power Station”*. Fall 2013. Daniel J. Epstein Department of Industrial & Systems Engineering, USC.