Seismic Safety of Nuclear Power Plant

Keep stopped,
Keep cooling,
Keep Sealed off
after severe accident

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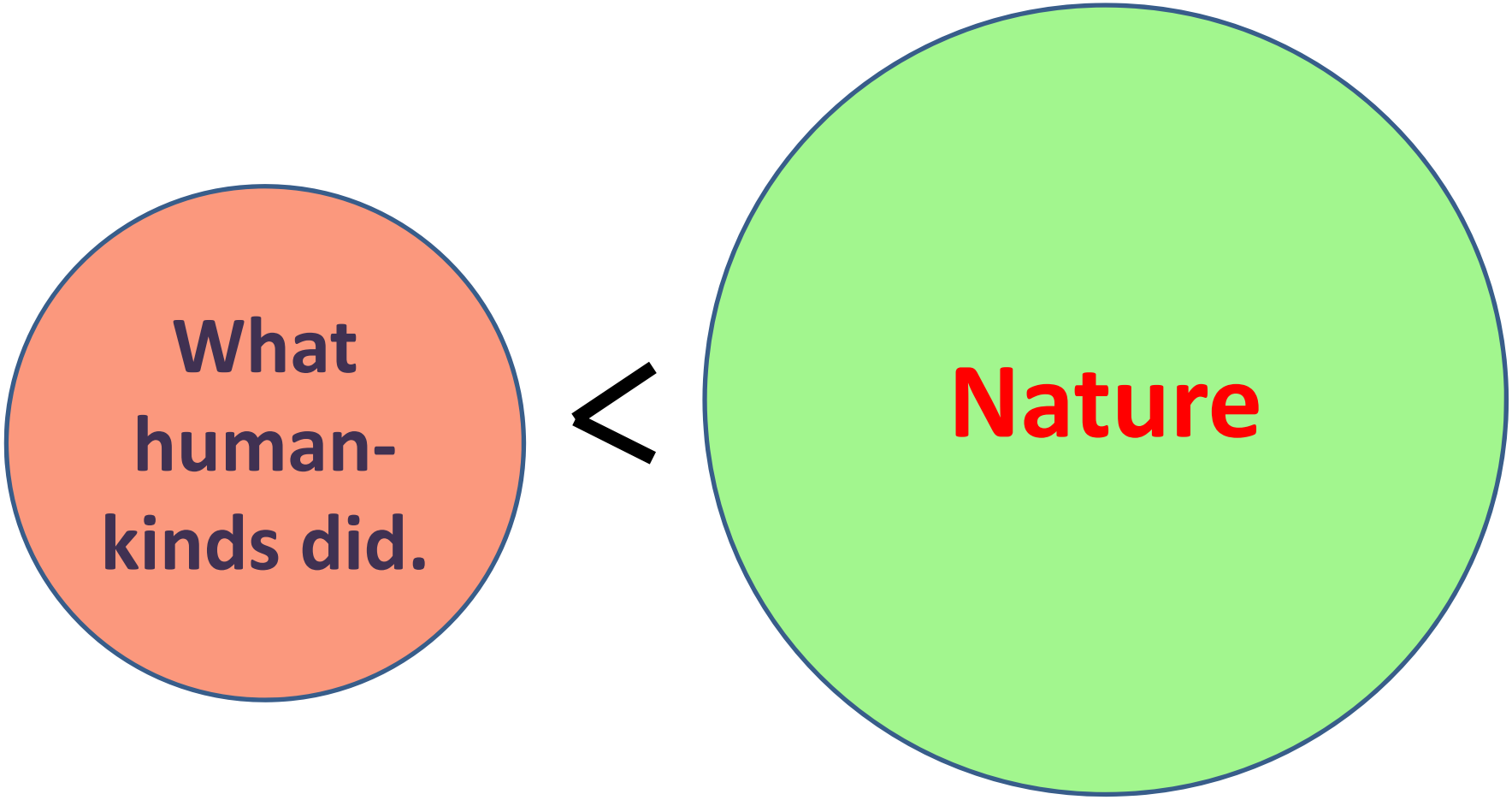
Huge Tsunami on March 11, 2011

We, all Japanese people, appreciate your sympathy and supports to the disasters on 3.11, 2011 very much.

SVOCの構文にしました。

Why natural disaster cannot be prevented



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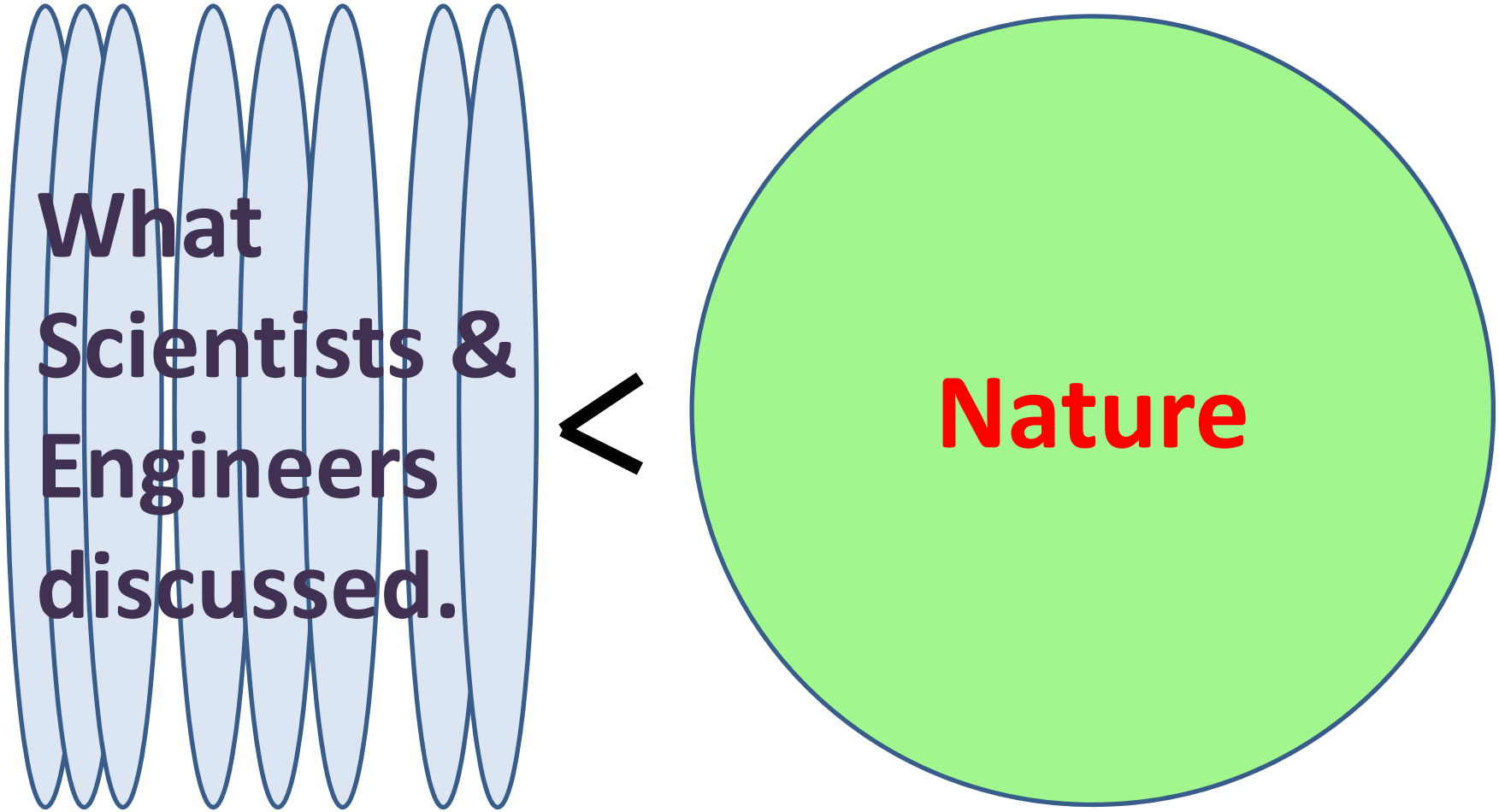

Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities

- **Basic idea was developed more than 40 years ago.**
- **Original version of the regulatory guide was published at 1981.**
- **Current version was revised at September 19, 2006.**
- **Unfortunately, we cannot use this guide after the earthquake on March 11, 2011.**
- **We are making the New Seismic Design guide, now.**

Contents: September 19, 2006

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4. Classification of Importance in Seismic Design

Importance in seismic design of Facilities shall be classified into the followings from the standpoints of the possible impact of radiation to the environment corresponding to the categories of Facilities.

S Class Most important

B Class Important

C Class ordinary

5. Determination of Design Basis Earthquake Ground Motion

The ground motion to be established as the basis of the seismic design of the Facilities shall be determined adequately as the ground motion to be postulated to occur but very scarcely in the operational period of Facilities from the seismological and earthquake engineering point of view relating to geology, geological structure, seismicity, etc. in the vicinity of the proposed site.

6. Principle of Seismic Design (1/3)

(1) Primal Policy

Facilities shall be designed to fulfill the following primal policies of the seismic design for respective categories of Class.

1) Respective Facilities of S Class shall maintain their safe function under the seismic force caused by DBGM Ss. And also they shall bear the larger seismic force loading of “Elastically Dynamic Design Earthquake Ground Motion Sd” or the static seismic force shown below.

6. Principle of Seismic Design (2/3)

2) Respective Facilities of B Class shall bear the static seismic force.

3) Respective Facilities of C Class shall bear the static seismic force.

4) In respective items shown above, the integrity of upper Class Facilities shall not be impaired by the damage of the lower Class Facilities.

6. Principle of Seismic Design (3/3)

(2) Computation Method for Seismic Force

1) Seismic forces caused by DBGM Ss

Time history analysis for severe earthquakes.

2) Seismic forces caused by EDGM Sd

Time history analysis for big earthquakes.

3) Static seismic force factors over story shear coefficient

S Class 3.0

B Class 1.5

C Class 1.0

7. Load Combination and Allowable Limit

The combination of loads and allowable limits shall be considered in assessing adequacy of design principle regarding seismic safety.

8. Consideration of the accompanying events of earthquake

(1) Safe functions of Facilities shall not be significantly affected by the collapses of surrounding ground of Facilities.

(2) Safe functions of Facilities shall not be significantly affected by the **tsunami** which could be postulated appropriately but occur very scarcely in the operational period of Facilities.

What we have to reconsider

- We, experts and professionals from the field of seismology, structural engineering, nuclear engineering and all other related fields, have to take the responsibility and do our best to deal with the nuclear accident, rather than to consider it as the work of someone else.
- It is also important to ensure the successful implementation of 'keep stopped, keep cooling and keep sealed off' procedure in case of accidents or emergencies to guarantee the safety of nuclear facilities.

What we have to reconsider

- History of the Earth is as long as 4.6 billions years
- Our civilization started only 5000 years ago,
- The study of modern science started 400 years ago by Galileo Galilei.
- The knowledge of Earthquake Engineering has been accumulated only in latest 100 years.
- We cannot say that we know earthquake.

What we have to reconsider

- Design, manufacturing and construction cannot be carried out by analyses only.
- Engineers divided one big total system of engineering a nuclear power plant into too many small separated parts, such as S, B and C.
- Each researcher and engineer treats only several small parts of engineering taken out from the big total system.
- We need to engineer the total system and do more synthetic actions.

What we have to reconsider

- The big complicated system has to be consisted as the system of parallel components.
- Many components will support each other.

- But the existing system has many components in series.
- When one component fails, the series of components would fail.
- Eventually, total system of power plant would fail.

What we have to reconsider

- Before March 11, 2011, we had no experience that the tsunami hit nuclear power plant at all.
- Japanese seismic design guideline use only one word of ‘tsunami’ at the final short sentence.
- Humankind is always optimistic.
- We cannot take into consideration before an accident that we have not experienced.

What we have to reconsider

- We can say easily about what happened.
- We, scientists and engineers, have to imagine what will happen from now on.
- But, not only general people, but also governments and private companies do not believe or accept what researchers explained before the disaster.
- People tend to forget bitter experiences after long period of time since it happened.
- We have to take action while the experiences are still in people's mind.

What we have to reconsider

- No seismically isolated nuclear power plant exist in Japan yet.
- Seismic design guide did not say anything about the use of seismic isolation or passive control structures.
- We need to use these technologies to Nuclear Power Plants also.


TER sits on
Seismic Isolators in
France


I believe that new technologies will bring a happy future for us. Furthermore, we have to do so.
Thank you very much