*The Foreign Correspondents' Club of Japan: Press Conference*
*April 27, 2015, Monday, 15:00-16:30*

# Japan's first post-Fukushima approval of a Nuclear Power Plant (NPP) issued by the Nuclear Regulation Authority (**NRA**) to the Kyushu Electric Power Co., Inc. on Sept. 10, 2014 is illegal.

The NRA has violated its own legal regulatory requirements regarding the seismic safety assessment of the Sendai NPP in southern Kyushu.

**This matter was not addressed by the Sendai NPP injunction lawsuit, and still remains a serious issue to be addressed.**

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Formulation of Design Basis Earthquake Ground Motion (DBGM) is essential for the seismic safety assessment of NPPs because it is used for the seismic design of NPP facilities.

DBGM is called **Standard Seismic Motion (SSM)** by the NRA.

NRA defines it as *earthquake ground motion that rarely occurs, but may possibly occur in the service period of the facility and have a significant effect on it*.

**Standard of the Annual Exceedance Probability (AEP) of SSM: $10^{-4}$〜$10^{-5}$**

**The Regulation requires:**

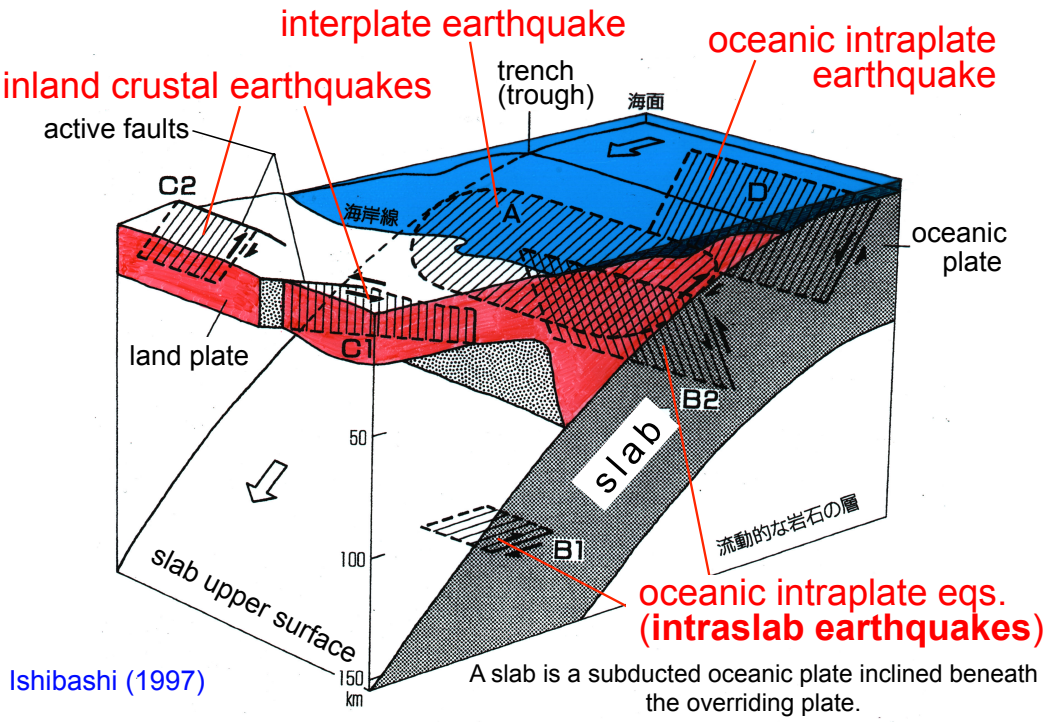
The **SSM** (horizontal and vertical motions on the free rock surface in the site) shall be formulated as the "earthquake ground motion formulated with a hypocenter specified for each site" and the "earthquake ground motion formulated without a hypocenter."

The "earthquake ground motion formulated with a hypocenter specified for each site" shall be formulated by selecting multiple earthquakes *that are predicted to have significant effects on the site* (**Earthquakes for Investigation: EQFIs**) as to inland crustal earthquakes, interplate earthquakes and oceanic intraplate earthquakes, and by implementing the evaluation of ground motions for each selected **EQFI**.

Note: The abbreviations "SSM" and "EQFI" are for the purposes of this presentation and not official abbreviations.

The illegality in the NRA's review took place in the selection of **EQFI**. The consequence appears serious for the **SSM** formulation, and thus the seismic safety assessment of the Sendai NPP.

## 3 types of earthquakes in terms of plate tectonics




Ishibashi (1997)

A slab is a subducted oceanic plate inclined beneath the overriding plate.

The language of the NRA criterion,
*"that are predicted to have significant effects on the site"*
for selecting multiple **EQFIs** is very vague.

Kyushu Electric therefore set up its own criterion that
the seismic intensities (**SI**) of **EQFI** to be examined at the Sendai site
will be **5 Lower (5-) or greater on the JMA* scale**.

(It is appropriate of Kyushu Electric
to have specified the criterion quantitatively.)

*JMA: Japan Meteorological Agency

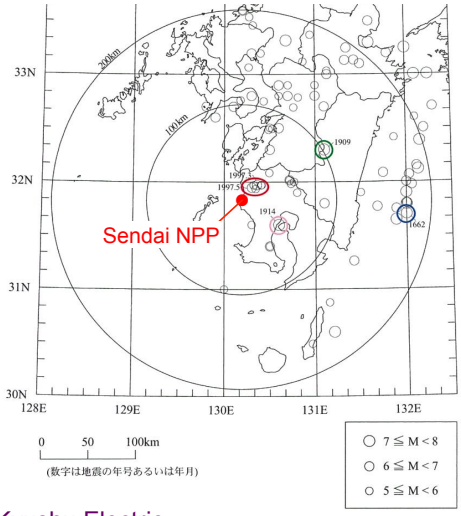
**Seismic intensity scale used in Japan (JMA scale)**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Japan MA | 0 | 1 | | 2 | | 3 | | 4 | 5- | 5+ | 6- | 6+ | 7 |
| Rossi-Forel | 1 | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | 10 | |
| Modified Mercalli | 1 | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| MSK | 1 | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

Note that although the SI of 5 Lower (5-) seems low for NPPs,
this is just the criterion to select **EQFI**, not the **SSM** itself.

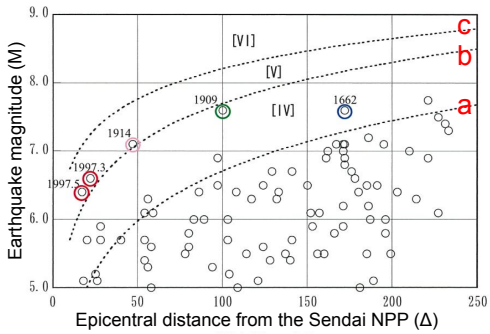
**Kyushu Electric examined the effects of past earthquakes on the Sendai NPP according to its own criterion (whether the SI is greater than 5 Lower or not ).**

Epicentral distribution of past destructive earthquakes in and around Kyushu (679-2010)




Kyushu Electric (2013)

～1884年：最新版 日本被害地震総覧
1885年～1922年：茅野・宇津カタログ（2001）
1923年～　　：気象庁：地震年報（2011）




Plot of earthquakes in the left map in the M—Δ field.
SI of each eq. at the Sendai site is a function of M and Δ.
a, b, and c are empirical curves dividing SI 3, 4, 5 and 6.

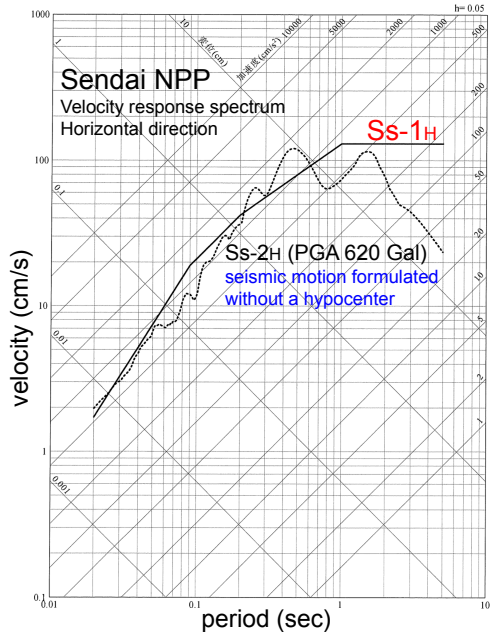
Kyushu Electric claimed:
- sources of the largest interplate and oceanic intraplate eqs. are far from the site; their SIs are inferred to be smaller than 5 Lower, not satisfying the criterion.
- SIs of some inland crustal eqs. are larger than 5 Lower.

Kyushu Electric concluded that interplate and oceanic intraplate earthquakes need not to be selected as EQFIs.

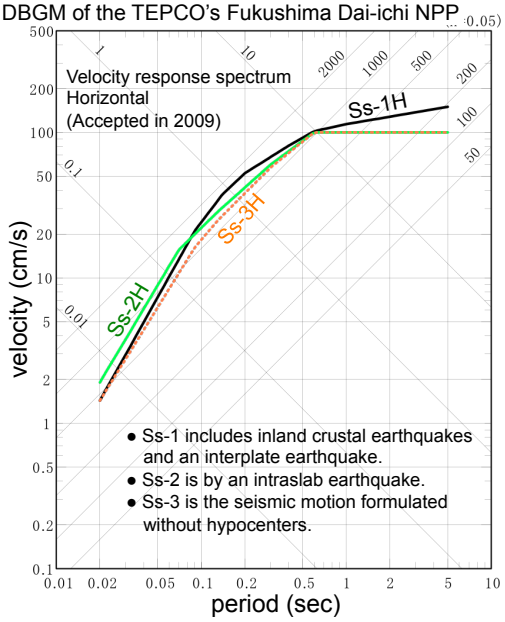
Kyushu Electric's conclusion is wrong.
Examination of only past earthquakes violates the NRA regulations.

Thus, Kyushu Electric formulated the **SSM** of earthquake ground motion formulated with a hypocenter based merely on inland crustal earthquakes: **Ss-1** (PGA 540 Gal).

The SSM is expressed by a **response spectrum**, which is a diagram showing how large the earthquake ground motion oscillates structures at various periods (measured in displacement, velocity, or acceleration).

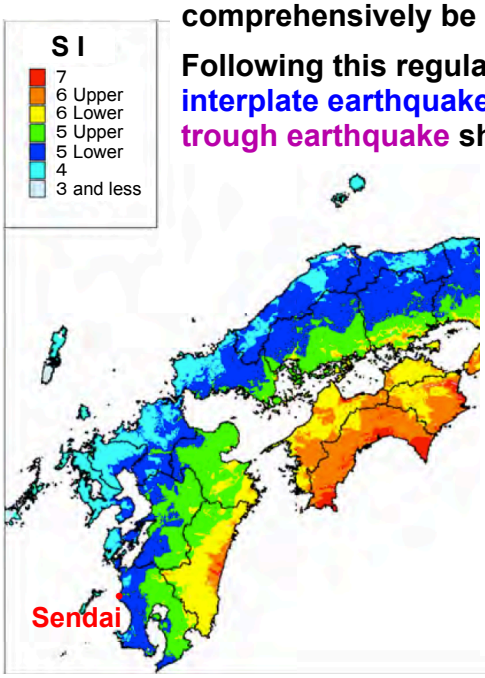



DBGM of the TEPCO's Fukushima Dai-ichi NPP



**The regulatory requirement: Plate tectonics etc. shall comprehensively be considered when selecting the EQFIs.**

**Following this regulatory requirement of examining interplate earthquakes, the anticipated great Nankai trough earthquake should have been selected as the EQFI.**



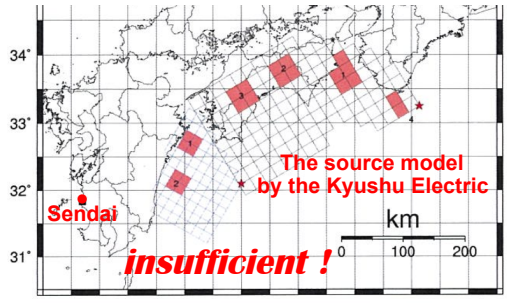

**SI around Sendai reaches 5 Lower, which meets the Kyushu Electric's criterion of EQFI.**

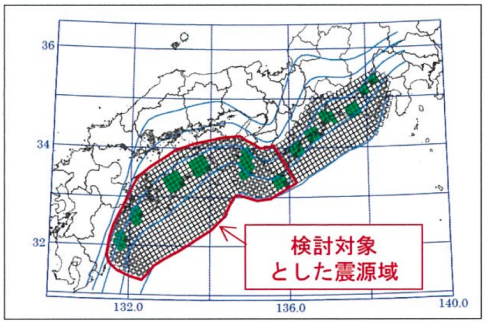
This is probably an underestimation for the NPP's SSM with AEP of $10^{-4}$ – $10^{-5}$, because this mapping was only an estimation for the purpose of obtaining a general picture of seismic shaking that would occur nationwide.

A specific, close examination is required for the estimation for the Sendai NPP.
The EQFI related to the Nankai trough earthquake would have a more stringent source model than that of the Study Team.

**Estimation of maximum SI distribution by the Mw 9.0 Nankai trough eq.**
(Study Team in the Cabinet Office, 2012)

Kyushu Electric tried a preliminary evaluation of ground motion from the Nankai trough earthquake. (Evaluation insufficient. Not included in the application to the NRA.)




A source model of the Mw 9.0 Nankai trough eq.
(Study Team of the Cabinet Office, 2012)

Source parameters by the Study Team

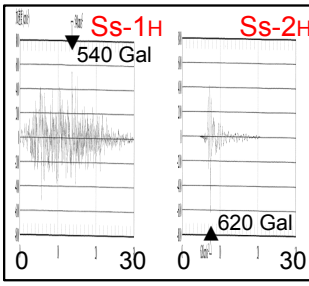
| | Parameters | Values | |
|---|---|---|---|
| | 面積(km2) | 110,150 | |
| | 平均応力降下量(MPa) | 2.3 | |
| | 平均すべり量(m) | 7.6 | |
| | 地震モーメント(Nm) | 3.4E+22 | |
| | マグニチュードMw | 9.0 | |
| 各セグメント | セグメント名 | Off Kyushu | Off Shikoku |
| | 面積(km2) | 19,053 | 53,790 |
| | 平均応力降下量(MPa) | 4 | 4 |
| | 平均すべり量(m) | 5.5 | 9.3 |
| | 地震モーメント(Nm) | 4.3E+21 | 2.0E+22 |
| | Mw | 8.4 | 8.8 |
| 強震動生成域 SMGA | 面積(km2) | 2,112 | 6,130 |
| | 面積比 | 11% | 11% |
| | 平均すべり量(m) | 11.1 | 18.6 |
| | 地震モーメント(Nm) | 9.573E+20 | 4.7E+21 |
| | Mw | 7.9 | 8.4 |
| | 応力パラメータ⊿σ(MPa) | 24.0 | 23.7 |
| SMGA 1 Strong Motion Generation Area | 面積(km2) | 1,028 | 1,960 |
| | 応力パラメータ⊿σ(MPa) | 34.0 | 46.3 |
| | 平均すべり量(m) | 10.9 | 20.5 |
| | 地震モーメント(Nm) | 4.6E+20 | 1.7E+21 |
| | Mw | 7.7 | 8.1 |
| SMGA 2 Strong Motion Generation Area | 面積(km2) | 1,084 | 1,624 |
| | 応力パラメータ⊿σ(MPa) | 34.0 | 46.3 |
| | 平均すべり量(m) | 11.2 | 18.7 |
| | 地震モーメント(Nm) | 5.0E+20 | 1.2E+21 |
| | Mw | 7.7 | 8.0 |
| SMGA 3 | 面積(km2) | | 1,614 |
| | 応力パラメータ⊿σ(MPa) | | 46.3 |
| | 平均すべり量(m) | | 18.6 |
| | 地震モーメント(Nm) | | 1.2E+21 |
| | Mw | | 8.0 |
| SMGA 4 | 面積(km2) | | 932 |
| | 応力パラメータ⊿σ(MPa) | | 46.3 |
| | 平均すべり量(m) | | 14.2 |

Taking the Nankai trough earthquake into account is indispensable in the formulation of the **SSM** for the Sendai NPP.

Generally, for **SSM**, not only the peak ground acceleration (PGA) but also frequency characteristics and duration times are very important.

If the ground motion due to the Mw 9-class great Nankai trough eq. is formulated by setting up the possible maximum fault parameters, the ground motion may exceed Ss-1.

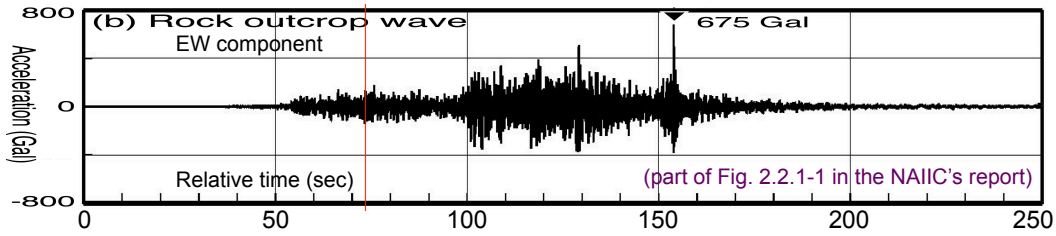
The duration of the ground motion of the anticipated great Nankai trough eq. is surely very long.



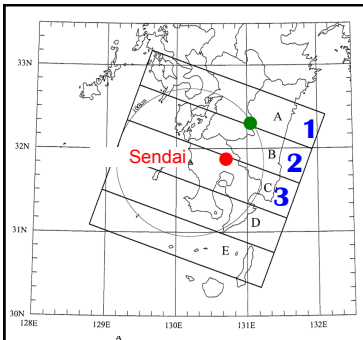

Waveforms of the Sendai NPP's Ss-1H and Ss-2H. (calculated by Kyushu Electric)

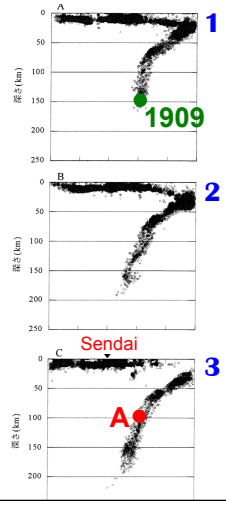
Duration times are extremely short !

Cf. Strong ground motion which attacked the TEPCO's Fukushima Dai-ich NPP.




(part of Fig. 2.2.1-1 in the NAIIC's report)



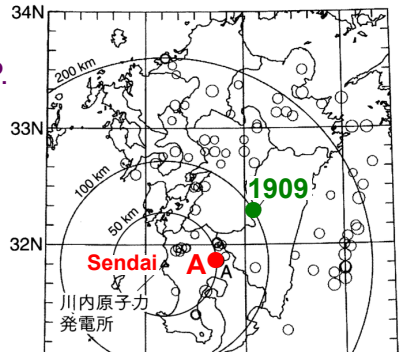

Concerning **intraslab earthquakes**, since the slab exists beneath the whole of Kyushu from north to south, an event like the 1909 eq. (M 7.6) can occur near Sendai NPP.

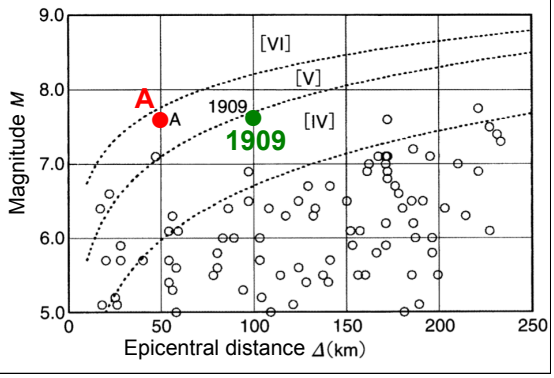
If it occurs around **A**, the SI at Sendai is estimated 5 Upper by the diagram used by Kyushu Electric.

This meets the criterion for inclusion in the **EQFI**.

Thus, an Intraslab eq. should have been selected as an **EQFI**.

The magnitude could be larger than 7.6.



## Conclusion and Additional Remarks

❖The NRA Review for the restart of the Sendai Nuclear Power Plant Unit 1 and 2 which overlooked Kyushu Electric's error at the very basic level **violated the post-Fukushima New Regulatory Requirements**, and thus **accepted inadequate Standard Seismic Motion** essential for the safety of the plant.

❖Although Kyushu Electric's error was immediately evident from its own explanation in the open Review meeting, the NRA made no question nor comment regarding this. The NRA granted final approval, **merely reiterating Kyushu Electric's claim** as it had been submitted to the NRA.

❖I addressed the problems I have described to the **NRA Pubic Comment Process**. However, there too, the NRA's response was **merely to reiterate Kyushu Electric's claim** as it had been submitted to the NRA.

❖**There are many serious defects with the New Regulatory Requirements** themselves, not limited to the earthquake issue. **They must be radically revised if nuclear power plants are to be utilized.**

❖It is outrageous that even these inadequate standards are being violated.

❖If such lax review processes continue, sometime, at some nuclear power plant, it will be inevitable that there will be an earthquake that far surpasses the Standard Seismic Motion of that plant, and this could very well lead to **a second Genpatsu Shinsai (Earthquake-Nuclear Combined Disaster)**.