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Research Report
– My Recent Events and Activity on IEC 61508

2011/07/04

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1. New Book Published
2. Earthquake on 11 Mar., 2011
   Absence from IFIP TC. 10. Meeting
3. IEC 61508 Ed. 2.0 Issued

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New Book Published

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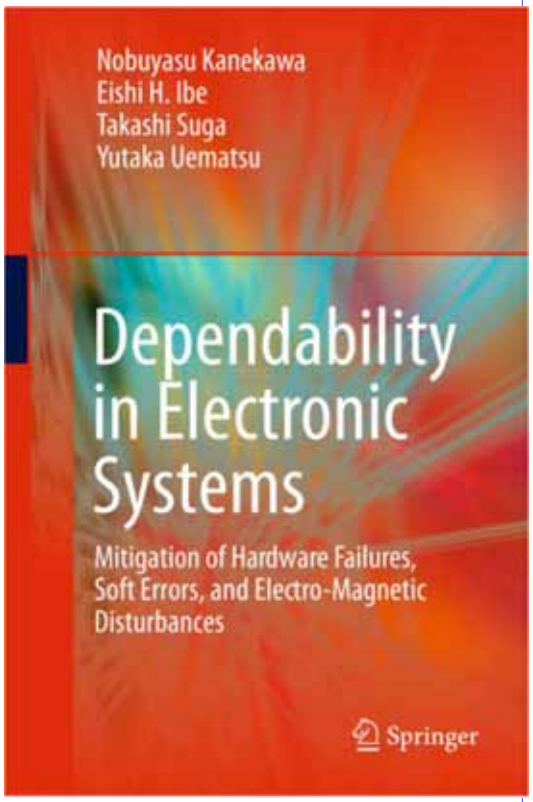
1. Introduction
2. Terrestrial Neutron-Induced Failures
   Semiconductor Devices and Relevant Systems and Their Mitigation Techniques
3. Electromagnetic Compatibility
4. Power Integrity Design
5. Fault-Tolerant System Technology

Presented yesterday.



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Earthquake on Mar. 11, 2011

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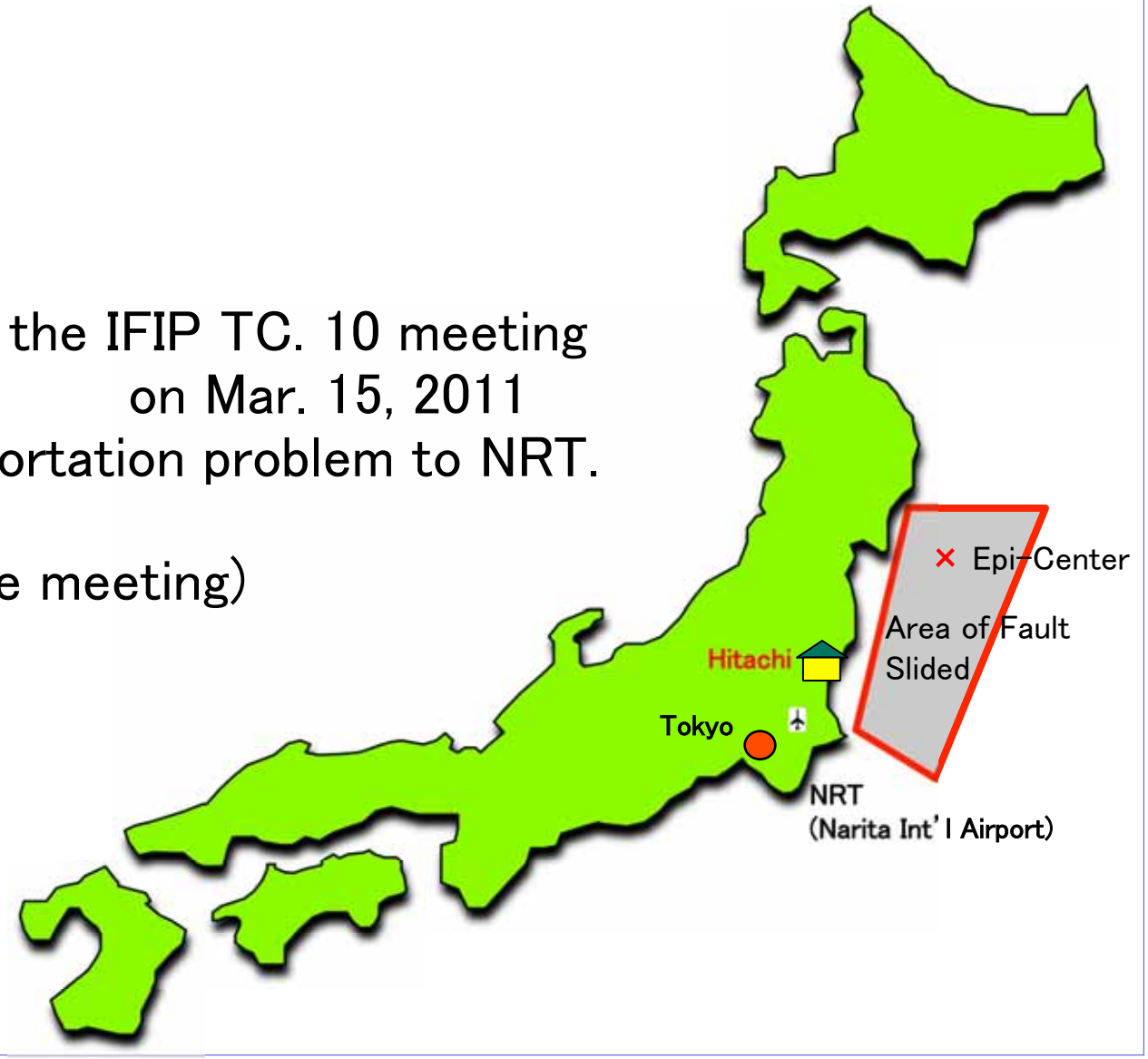
- I have survived.

- But ...
  I could not attend the IFIP TC. 10 meeting
  on Mar. 15, 2011
  because of transportation problem to NRT.

- (Rick attended the meeting)



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Functional Safety Standards

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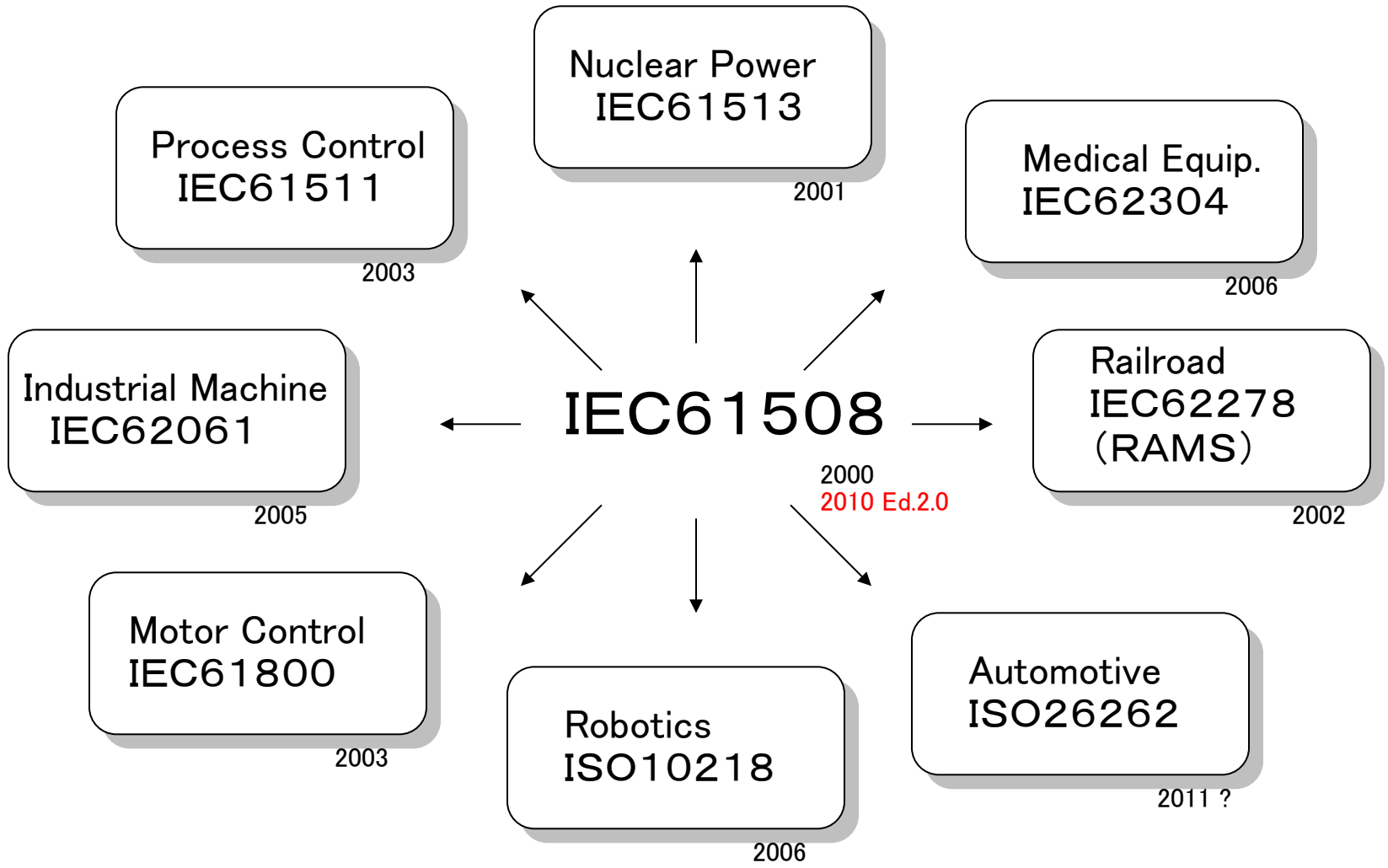

SIL (Safety Integrity Level)

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(a) low demand mode of operation

Safety Integrity Level (SIL)	Average probability of a dangerous failure on demand of the safety function
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$

(b) high demand mode of operation or continuous mode of operation

Safety Integrity Level (SIL)	Average frequency of a dangerous failure of the safety function [h^{-1}]
4	$\geq 10^{-9}$ to $< 10^{-8}$
3	$\geq 10^{-8}$ to $< 10^{-7}$
2	$\geq 10^{-7}$ to $< 10^{-6}$
1	$\geq 10^{-6}$ to $< 10^{-5}$

IEC 61508 Ed. 2.0 Interpretation

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(0) Interpretation on β_{IC} in IEC61508 Ed. 2.0 Part 2 Annex E
(Special Requirements for ICs with On-Chip Redundancy)

Initial Value: β_{B-IC}=33%
→ add according to Table E.1
→ subtract according to Table E.2
→ if β_{IC} < 25% then SIL 3

Annex D:
β_{IC}: Ratio of undetectable failures by CCF (Common Cause Failure)

$$\lambda_{D-CCF} = \beta_{IC} \cdot \lambda \qquad (1)$$

where,
λ_{D-CCF} : Failure rate of undetectable failures by CCF,
λ : Failure rate of the item.

Interpretation

Failure rate of the Chip λ = 400 [fit]

Dangerous failure rate for SIL 3 λ_{D-CCF} < 10^{-7}[hr.$^{-1}$]

→ β_{IC} < 0.25 according to eq. (1)

Proposals for IEC 61508 Ed. 3.0

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(1) Upper bound of β_{IC}

Failure rate of the Chip λ is not always be 400 [fit]

Failure rate of the Chip λ = 200 [fit]
Dangerous failure rate for SIL 3 $\lambda_{D-CCF} < 10^{-7}[hr.^{-1}]$ ⟶ $\beta_{IC} < 0.5$

Failure rate of the Chip λ < 100 [fit]
Dangerous failure rate for SIL 3 $\lambda_{D-CCF} < 10^{-7}[hr.^{-1}]$ ⟶ $\beta_{IC} = 1.0$

⋮

proposal

Upper bound of β_{IC} shall be determined according to failure rate of the Chip λ ?

Proposals for IEC 61508 Ed. 3.0

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(2) Others

Ed. 2.0 Part 2 Annex E mainly lists
Physical Protection Countermeasures (Signal Net Separation, Power Supply/GND Separation, etc.)
to guarantee Independence of Redundant Channels in a Chip.

Logical, Code-Theoretical Countermeasures (Redundant Codes, Alternative Codes, Specially Modulated Signals, etc.) should be added.

Many things to be improved.


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