Nagoya Workshop 16, May (Mon), 2011

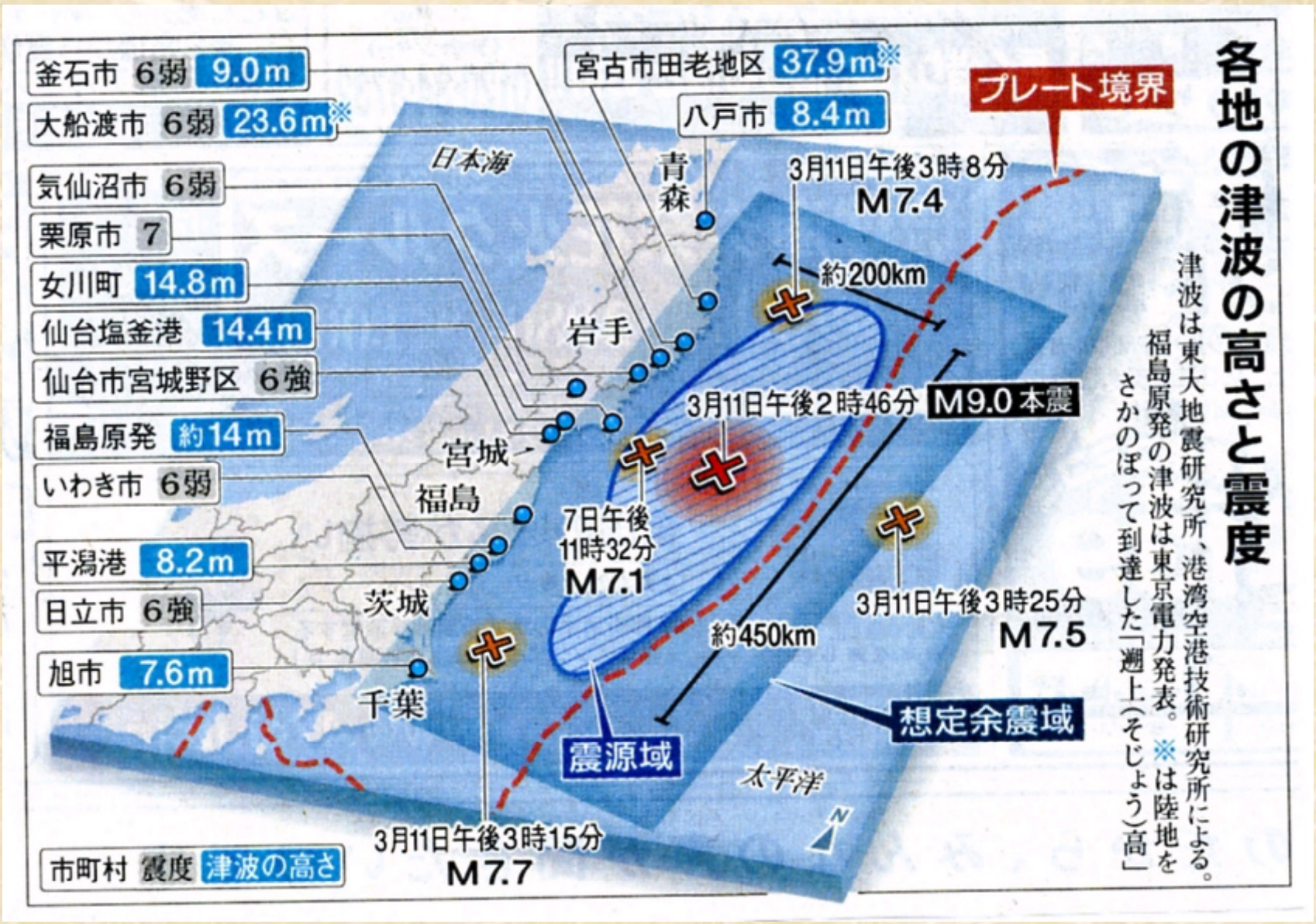
Rebuild Japan : Future Energy and Commissioning

Reviewing essentials of crisis and the role of commissioning at the very moment of big earthquake disaster

- inspecting the concept of design standard and safety

N. Matsuda (CxPE, BSCA director)

岩手県宮古市　閉伊川をさかのぼった津波が堤防を越え海辺の街に襲いかかった＝閉伊川河口付近で、11日午後3時21分、狩野智彦撮影


各地の津波の高さと震度
津波は東大地震研究所、港湾空港技術研究所による。福島原発の津波は東京電力発表。※は陸地をさかのぼって到達した「遡上(そじょう)高」
釜石市 6弱 9.0m
大船渡市 6弱 23.6m※
気仙沼市 6弱
栗原市 7
女川町 14.8m
仙台塩釜港 14.4m
仙台市宮城野区 6強
福島原発 約14m
いわき市 6弱
平潟港 8.2m
日立市 6強
旭市 7.6m
宮古市田老地区 37.9m※
八戸市 8.4m
プレート境界
日本海
青森
岩手
宮城
福島
茨城
千葉
3月11日午後3時8分
M7.4
約200km
3月11日午後2時46分
M9.0 本震
7日午後
11時32分
M7.1
3月11日午後3時25分
M7.5
約450km
想定余震域
震源域
太平洋
3月11日午後3時15分
M7.7
N
市町村 震度 津波の高さ

The overview of the eastern Japan great earthquake

- The date and time of occurrence: 2:46p.m. March 11th (Friday), 2011
- The scale of the earthquake: Magnitude 9.0
- The epicenter: Near 130 km offshore from Oshika peninsula at about 24 km of depth
- The focal region: Iwate Prefecture, Miyagi Prefecture, Fukushima Prefecture, Ibaraki Prefecture offing
- Huge faults covering the area 200 km wide from east to west and 500 km length from north to south moved about 20 to 30 m for about three minutes, resulting the maximum land subsidence of three m deep.
- Seismic intensity of 6 to 7 were experienced as widely as Iwate prefecture to Chiba prefecture, and afterwards the aftershocks with seismic intensity of 6 took place more than three hundred times. The aftershocks still continues now that two months have passed since the main shock.
- The height of the tsunami: From 10 m to 38 m
- The area-of-wetted-surface 561 square km , i.e., 8 times wider than the inside area within JR Yamanote Line in Tokyo)
- The number of building suffering from the quake: About 330,000 buildings
- The number of victims: About 300,000, with 30,000 of the dead and the missing people
- The area of agricultural land damage: 23600 ha (5050 times the area of Tokyo Dome)
- It causes a Fukushima nuclear accident.
- The direct total amount of damage: 20 to 30 trillion yen
- The indirect damage: Immeasurable (as in progress).

What is made to realize looking at hundreds of images of the great earthquake and tsunami. (The essential of crisis)

1. The weakness of human beings facing the huge powers of the nature has been confirmed
   - The human being as the tiny creature on the plate on the mantle
2. The unstableness of the earth that is attacked by the sudden disaster

   -the complex system that consists of a lot of elements mutually acting in the non-equilibrium state.

   -the difficulty of prediction of the releasing process of accumulated energy culminating in the critical state.

   -the earthquake caused by the complex system of accumulated pressure at the numerous faults and cracks

   -the complex system including lots of social elements, such as production, information and distribution interacting each other.
3. Let know of the limit of civilization as well as technology when faced at the culminated power of the nature and of the vulnerability of energy-dependent civilization.

The influence of the great earthquake and future problems

- This disastrous earthquake has given a big influence on the politics, the society, the industry, the technology and the way of thinking in the future.
- Looking at the huge, hazardous and unstable nature, the following subjects of study have surfaced.

1. The ideal way of the future technologies against this level of the huge disasters. (The design basis, or standard)
2. The safety of technologies facing to the public, which has been shown symbolically by the nuclear accidents.
3. The problems concerning to energy that is the basic infra-structure of the society and industries.

In the following, basic frame of discussing these problems and how commissioning concept will come related to these.

The assumption of the crisis level and the basis of design or design standard

- The assumption and estimation of the crisis level are the matter of judgment that purely depend on the scientific knowledge.
- Disaster-prevention measures are taken based on the estimated or assumed level of crises.
- The design basis, or standard, is the basis of the manufacturing, which should be thought the socio-scientific concept as well as the technological concept.
- A technology is realized based on the natural law, however, the purpose of it depends on the value sense of the society at the point of judgment. A technology is prescribed by its purpose and by the natural law as well. (Mitsuo Taketani)
- The assumption of crisis level and the design basis, or standard, are related but belongs to different phase.

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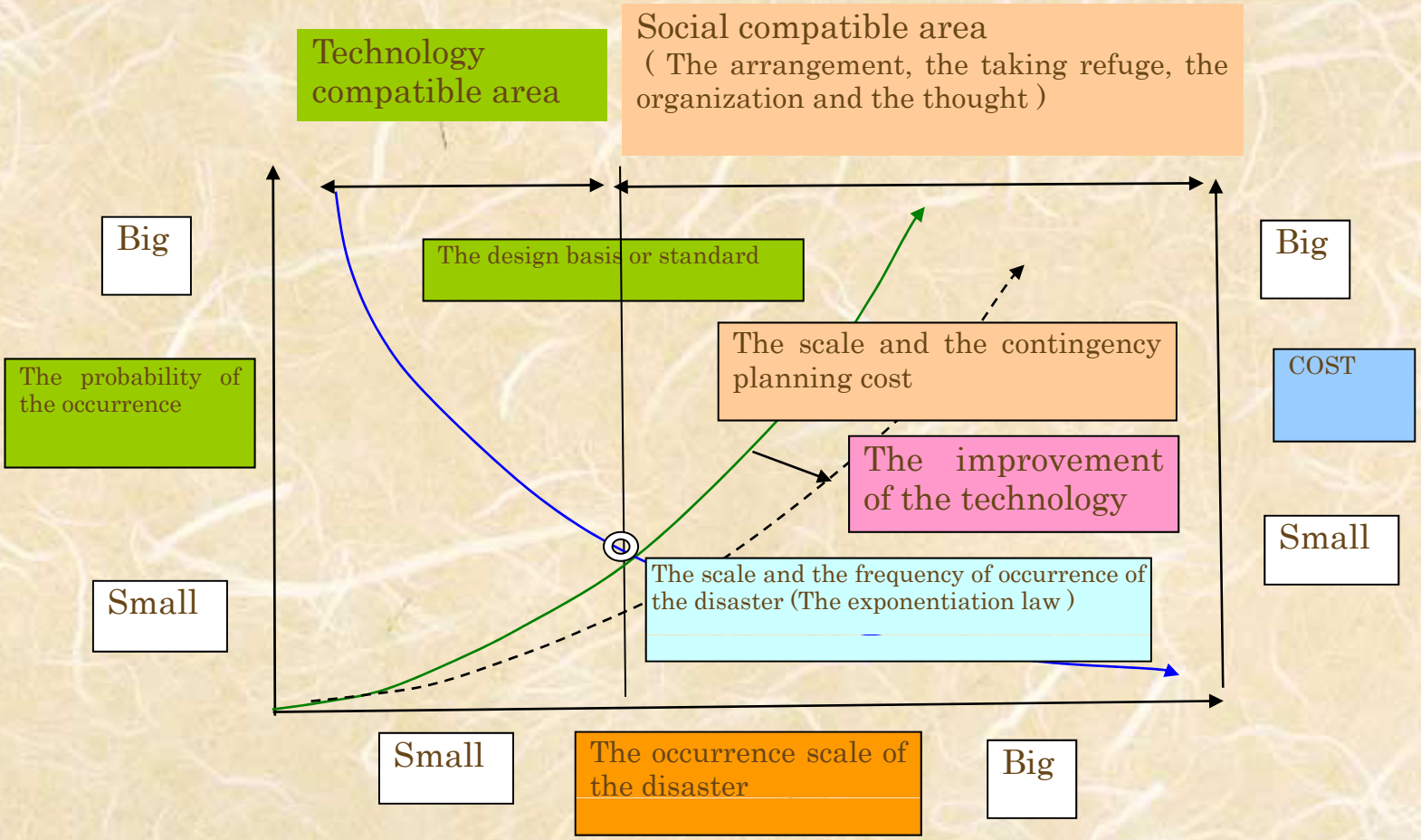
The design and the design basis, or standard

- The design of a system is to define the function and performance of the system that meet the purpose and the value of the system, and to specify how to compose parts and assembles for realization.
- The boundary conditions of the designer's act are the design requirements and set-points, or calculation conditions.
- The design standards define a certain directives or frames of the contents of design.

The character of the design standard, or basis

- The design standard, or basis, is a standard for manufacturing.
- Manufacturing is performed in the economical sphere.
- The standard is determined on the balance among the resource including manpower and cost, benefit, safety and risk level.
- It is the power of technology that creates goods with more benefit, higher safety and less risk.
- The design standard, or basis, can not stand alone against the disturbing, sometimes hazardous, nature but has a certain limit.
- Measures shall be taken considering the occurrence of excessive disturbance above the design standard.
- (Refer lessons learned from the example of Taro-o town called as the disaster preventive town)

Disaster-prevention measures and design standard, or basis



The safety and the risk

- The safety is defined as the peaceful state free from danger, damage and injury. (Kojien, Japanese dictionary)
- The safety is defined as the state from unacceptable risks, or the condition where the risk is acceptable.
  - ISO31000:2009 Risk management-Principles and guideline
  - ISO12000:2003 Safety of machinery –Basic concept, general principles for design
- Formularizing:
  - Risk is formularized as the effect of uncertainly on objectives, the probability of occurrence of an incident x result.
  - When the objective is safety in the above, risk is shown as (the consequence of the result) x (probability of occurrence of an accident).
  - If the safety is defined as the degree of acceptable risk, it will be judged by a factor (danger, or risk)/(benefit) according to the social sense of values and the cultural level.

The character of the concept of safety

- Absolute safety is never realized as long as the life of the human society is led under the unstable nature and social conditions.
- Technology also is never absolutely safe.
- Allowable risk, or safety, is thought a socio-scientific concept that is situated on the balanced benefit and the risk of danger, which is evaluated by (danger of risk)/(benefit).
- The role of the technology lies in decreasing the dangerous risk infinitely or, if the risk is the same, in increasing the benefit caused by the incident.

The frame of the security measures of machines and facilities

division	measures	remarks
1	measure taken inside machines and facilities	plan, design and construction
2	measures taken at the human side as education and training	fullness of acceptance
3	Measures taken at the maintenance system	operation and maintenance

- Commissioning is related to all fields.

Overview of the safety standard (ISO12000) of machines and its characteristic

- The hierarchical structure
  - standard A: basic safety standard
  - Standard B: group safety standard
  - Standard C: product safety standard
- The methodology to the security measures
  - implementation of the risk assessment
  - intrinsic-safety design means
  - safe protection means
  - provide sufficient information for machine use

The safety of machines and systems

- The security measures for individual machine has made progress based on ISO12000, the protection against mechanical hazard standard, the PL law was enforced and the manufacturer's responsibility was legally prescribed.
- As the productive facilities, etc., however, were excluded from applying PL low, Way of thinking on safety measures has delayed to establish.
- The ISO11161:2007, however, was published recently and the way of thinking how to secure system safety as a whole is being provided internationally for the productive facilities, etc.
- There is a matter of system-specific safety concerning to the system safety.
- Owing to the accident at Fukushima nuclear power plant, system safety problem has become a grave subject of research and implementation.

The safety of a system

- The system is defined as "the assemble in which numerous components and subsystems are integrated to work mutually interrelated in order to suffice a certain object and function required".
- For the system to work correctly, not only each equipment and component are sound, but also they shall be properly connected and interrelated.
- Measures shall be taken that defects of a part of the system shall not affect the total system as a fatal damage.

Problems of the safety of systems

- Division of the status
  ① Safety at the normal operation
  ② Safety at emergency
  ③ Safety at restoration

- Division of parts
  ① Safety of equipments either of individual or of assemble
  ② Relation and safety among components and subsystems
  ③ Functional performance of working systems and their safety

- Division inside or outside
  ① Safety for handlers
  ② Safety for outsiders

- Refer ISO11161 as to the safety systems.

The overview of ISO11161 and Commissioning

- This standard was published in 2007 as the international standards to IMS, the integrated manufacturing system. However;
  - it is not a standard about the safety of the simple substance machine, but
  - it is the standard that specifies the safety of complex machine combining more than one machine.
- This standard includes the design, supply, manufacturing of the production system and the construction and it establishes the integrator who takes charge of the safe strategy which contains protection plan, control interfaces and control systems.
- This safety system integrator implements a risk assessment and implements necessary security measures to secure the safety of the system.
- If applying commissioning process, the CA, commissioning authority, will be able to verify the action of the safety system integrator, or sometimes do the business by himself.

The constraints on energy supply and demand given by the BIG DISASTER and subjects to be discussed

- Given the constraints due to nuclear power plant accident;
- The long run strategies:
  - Promotion of the stabilization of the accident
  - Diversification of the energy source together with promotion of natural energy use
- The short run strategies:
  - The increase in energy efficiency of energy use
  - Load leveling using thermal storage and fuel energy
  - Energy saving using various measures

Role of commissioning concerning energy use and constraints

- At the rim of energy crisis due to the power plant damages, it is necessary to urgently promote energy saving and raising energy efficiency as well, where;

① The commissioning process shall be applied to newly built buildings to clarify design requirements concerning energy efficiency and functional performance.

② It is important to apply a retro commissioning process to existing buildings and following continual commissioning with a lifecycle view.

③ On-going commissioning organization in-house of existing building accompanied with re-commissioning by professionals will realize energy saving effect as early as possible.

Subjects expected to Commissioning in Japan

- Upbringing of technical experts to manage commissioning process, develop and handle commissioning tools in order to implement the commissioning procedures effectively and skillfully.
- To reflect the fragility of the safety of the building services systems, the efforts of strengthening safety of the system are to be solved by applying commissioning process.
- The efforts to meet the facing problems shall be initiated for such as reviewing limitation mode of operation at the energy shortage and reviewing emergency circuits as well.

Conclusion

- The author introduced his thought as a professional HVAC engineer at the time of experiencing East-Japan great earthquake disaster.
- From now on, the technical problems concerning the design basis and the safety matters, the power plant accidents caused by this scale of disaster will be discussed in every occasion.
- The author is afraid that, as far as the nuclear power plant accidents are concerned, the political discussion precedes before the technical discussion and safety problems in the technical sense will not be neatly discussed.
- The author is happy if his intention of establishing frame for sincere and reasonable discussions would be understood and used as the reference for future discussion.

The end