Managing an Emergency Situation on Site, Theory and Real Life
- A Plant Managers View-

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Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant

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Nuclear Accidents

- Three Mile Island PWR USA 1979 America IHF
- Tchernobyl RBMK USSR 1986 Europe IHF
- Fukushima Daiichi BWR Japan 2011 Asia IEE

(Fukushima Daini)

Lessons Learned: "It can happen"

Conclusion:

We must be prepared

Nuclear Emergencies – The Difference

Nuclear Emergencies are somewhat different from "normal" Emergencies (catastrophes)

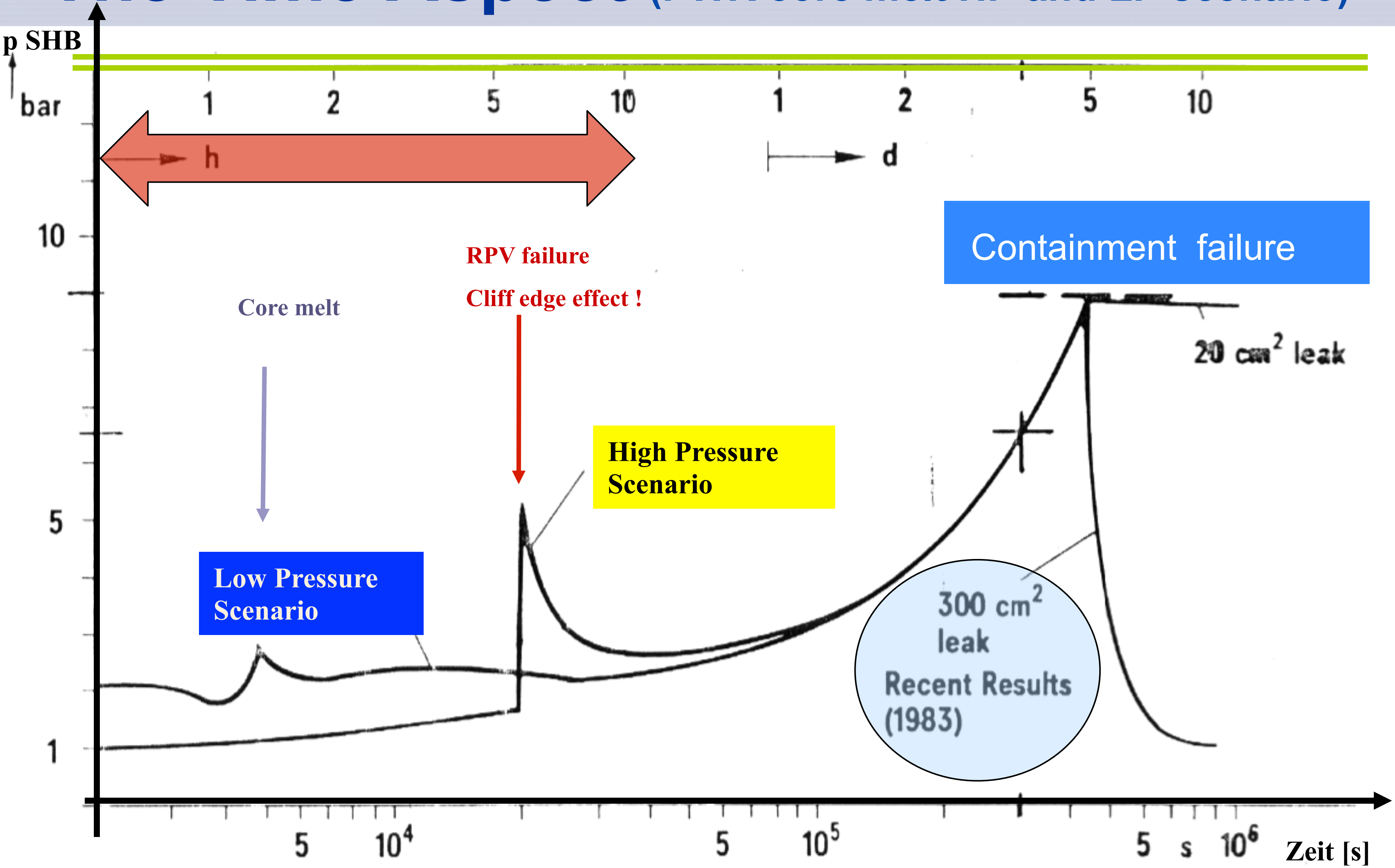
The crisis management has not only rescue lives and to restore infrastructure

+

A Nuclear crisis management requires:

<u>to get control over the "cause of the disaster"</u>

The Time Aspect (PWR core melt HP and LP scenario)



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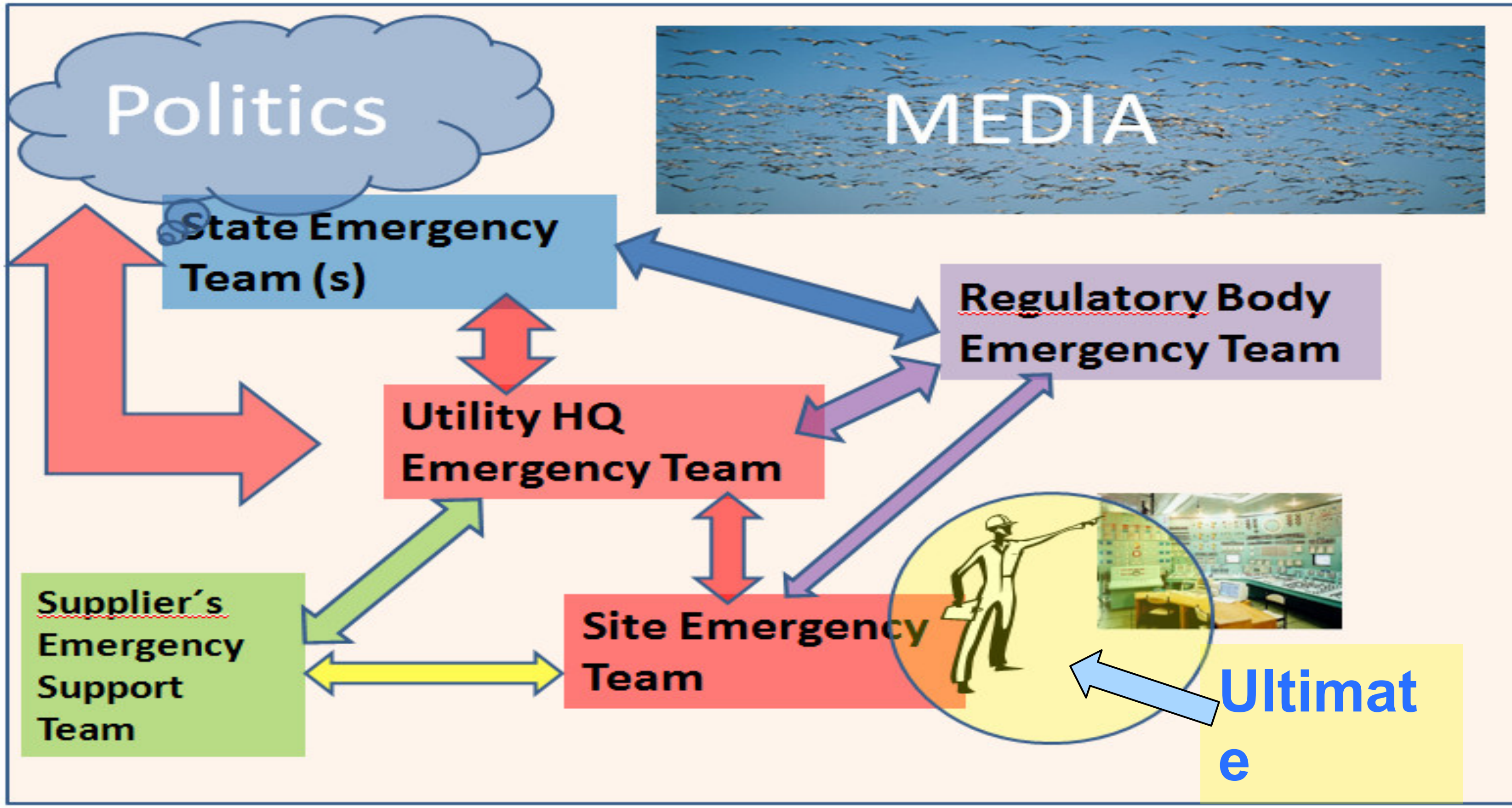
The Time Aspect

In Nuclear Emergencies some quite important mitigation measures have to be decided within the first 10 hours to minimize the consequences of the event

Some (sacrifice) decisions are rather difficult due to their consequences e.g.:

- Unit may lost for production (Utility !)
- Radiological Releases (Authorities !)

Managing Nuclear Events



Nuclear Emergency Management (simplified !)

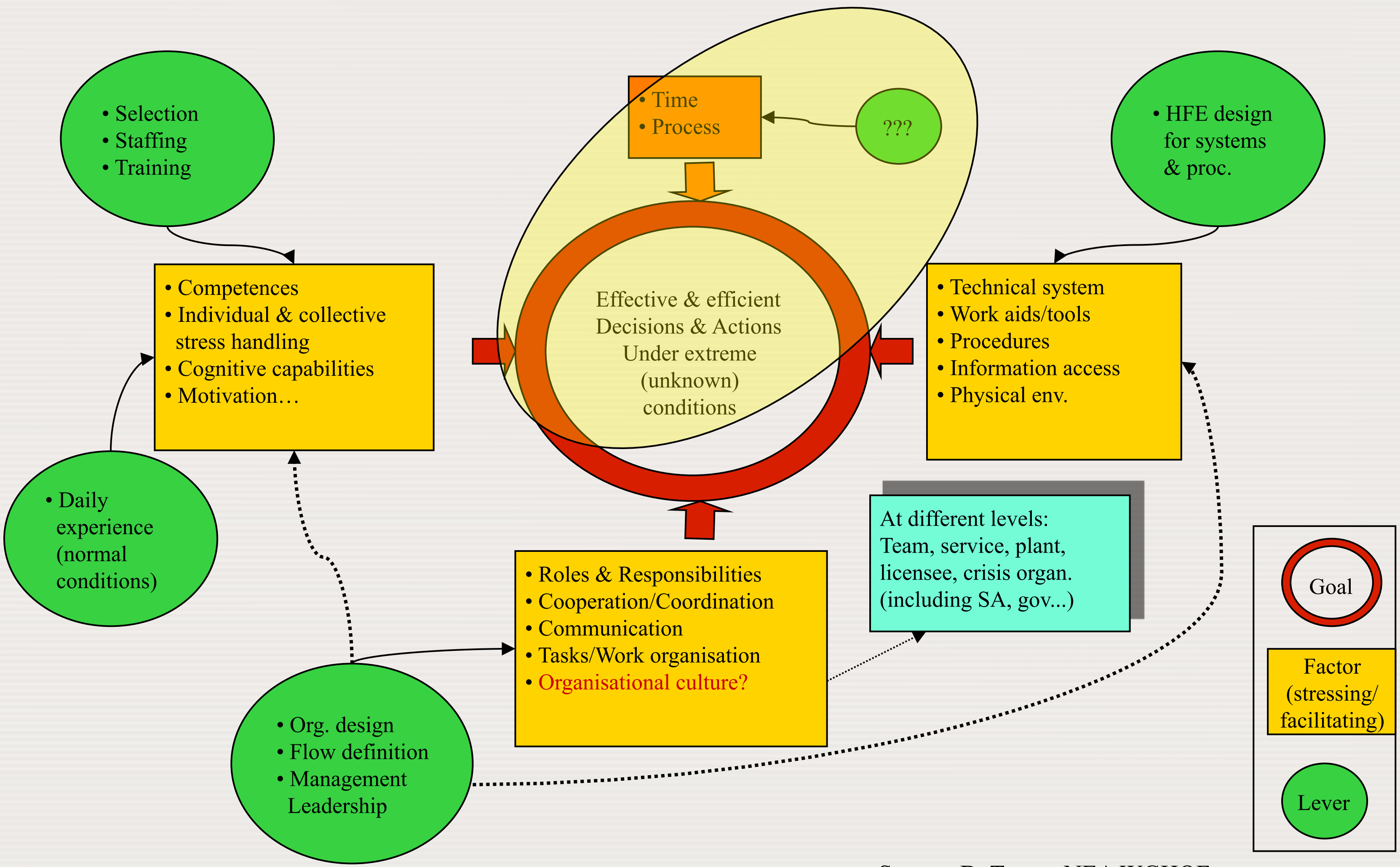
Ultimate responsibility

Question

Can we expect (realistically under worst case conditions) that this complex system of Emergency Management is able to make such kind of decisions within few hours ?

Worst conditions:
Holidays, Weekend, Night, extreme weather conditions ….
Communication broken or rather limited
….

Task Model : Key factors and relations



Source: D. Tasset; NEA WGHOF

A Plant Managers Opinion / Experience

Most systems are limited in their effectiveness for short term decision making on site.

In addition to experience with Emergency drills and other OPEX, the Fukushima event had provided us with some valuable experience:

→ **The success story of Fukushima Daini and other sites**

Fukushima Daini

– a remarkable success story

System Status after the Tsunami

System		Unit 1		Unit 2		Unit 3		Unit 4	
RHR(A) including cooling systems	RHR(A)	×	inoperable due to the loss of power source and cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system
	RHRC/RCRS(A,C)	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source and motor
	EECW(A)	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source and motor
LPCS		×	inoperable due to the loss of power source and cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system
EDG(A)		×	inoperable due to submerge	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system
RHR(B) including cooling systems	RHR(B)	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	○	stand-by	△	inoperable due to the loss of cooling system
	RHRC/RCRS(B,D)	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source	○	stand-by	×	inoperable due to the submerge of power source and motor
	EECW(B)	×	inoperable due to the submerge of power source and motor	×	inoperable due to the submerge of power source	○	operation	×	inoperable due to the submerge of power source
RHR(C)		△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	○	stand-by	△	inoperable due to the loss of cooling system
EDG(B)		×	inoperable due to submerge	△	inoperable due to the loss of cooling system	○	operation	△	inoperable due to the loss of cooling system
RWCU		△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system	△	inoperable due to the loss of cooling system
MUWC (alternative water injection)	MUWC(B)	○	stand-by	○	stand-by	○	stand-by	○	stand-by
RCIC		○	stand-by	○	stand-by	○	stand-by	○	stand-by

○ ; secure (power, pump and motor all working) △ ; malfunction (inoperable due to factor other than power, pump or motor)

× ; loss of function (power, pump or motor inoperable)

To transfer 4 units into a controlled state and a safe shut down state with only such few available safety systems is remarkable

The positive experience of Fukushima Daini and its success elements should be taken in consideration in further HU and Organizational evaluations .

Leadership, human performance and internal communication in stabilizing Fukushima Daini NPP after the Great East Japan Earthquake and Tsunami

November, 2012

Shinichi Kawamura

Tokyo Electric Power Company

IAEA

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Fukushima Daini; Important Facts

Decisions had been made <u>on site</u> *considering* EOP´s

Indication for sound competence (Know How / Know Why) within site ERC and MCR

Site access possible only after ~ 6 hours

Information about plant / equipment status and <u>possible</u> mitigation measures difficult to obtain and to communicate (internal and even more to external organizations)

Extreme worst case conditions but not all

Plant management was on site; Daylight at the beginning of the event

External support for Site ERC´s

No doubt: Generally any additional competence is helpful in an emergency situation <u>but</u> consider pro´s and cont´s

- **Requires Communication (Time consuming)**

- **Can delay decision making in particular in the early phase and in case of different opinions (ultimate responsibility?)**

- **Can foster „Delegation of responsibility“**

- **Can result in reduced investment into the staffing and competences (T&Q!) of on site ERC/<u>MCR</u> teams *„There is support from HQ ERC / supplier etc. when needed“***

Emergency Drills
Verification and Training

Real Emergencies to verify effectiveness of Emergency Response Capability are rare

→ **need for Emergency Drills**

Requirements:

Regular
Real Time scenarios (Use of Simulators!)
Worst case scenarios (Saturday night, lack of communication devices, etc.)
Without announcement (no exceptions !!!)

↳ **Numerous arguments why someone need to know about; but mainly : Fear of blame !**

Emergency Drill Requirements

If the basic rules related to effective emergency drills are not followed consequently, the organizations involved in a Nuclear Emergency Management persists in imagination about their emergency response capabilities and may experience a heavy wake up call when being confronted with an real emergency.

Severe Accident Management Training (SAMT)– for whom?

- To deal on site with SAMG´s requires additional knowledge (Procedures knowledge based ! >> educational background !)

- Core melt scenarios, Criticality risks, Steam explosion, Hydrogen etc.

- **Tendency that SAMT is provided mainly for Crisis Team Members or ERC support groups; rather seldom for Operating staff such as MCR staff (SSV).**

- **Is it sufficient ? considering possible worst case conditions at the time of the event !**

Are we prepared for the first 10 hours ?

Ask yourself:

Is Site ERC/MCR fully competent to make necessary decisions within first 10 hours with minor or no external support?

Are on site Human Resources adequate for Severe Accidents?

Is Responsibility for decision making unambiguous? *Conflicts; Seniority Principe in the organization !*

Can ERC / MCR rely on procedures (EOP; SAMG) with clear criteria and requirements for difficult decision making (Primary bleed, Containment venting, External RPV Flooding etc.)

Do we exercise under „sunshine“ or „severe weather“ conditions? Unannounced ?

Is 10 hours „independence“ for site ERC sufficient ?

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….Thank you for your attention!

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