International collaboration for Maintenance Science and technology

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OUTLINE

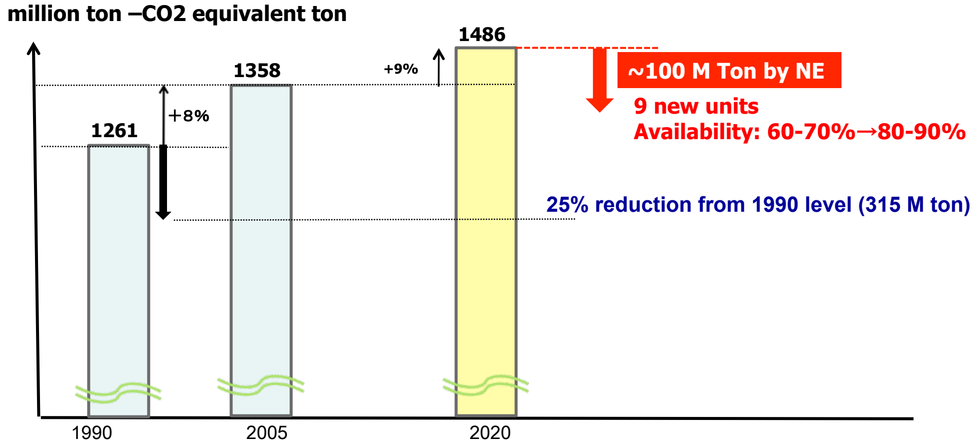
1. Introduction
2. Benchmarking for best practices and ….
3. International cooperation
4. Conclusions

To start with

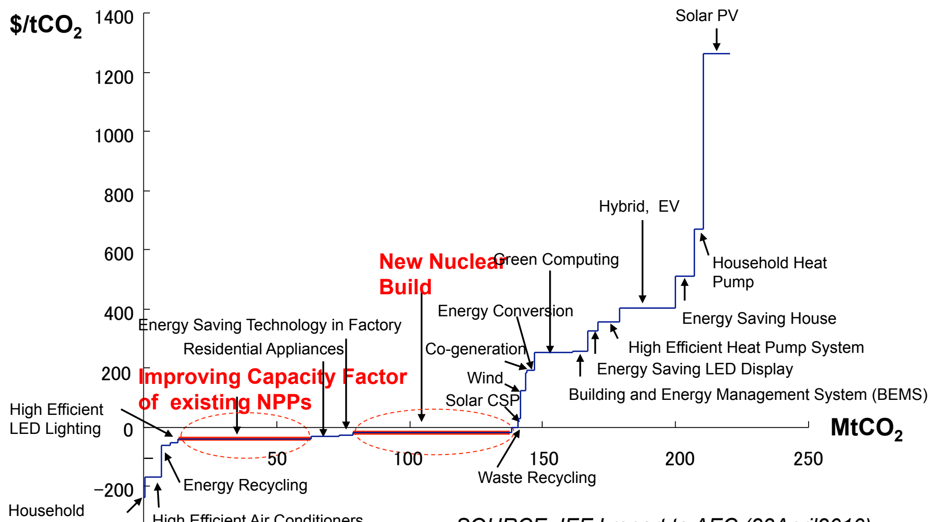
- **2020 target proposed in the draft law (2010)**

25% reduction from 1990 level of CO_2 emission by 2020, on the condition that all other major emitters agree on ambitious reduction targets

- **Difficult to achieve the ambitious transition to low carbon economy without nuclear power option**



Marginal Abatement Cost curve in Japan



SOURCE: IEEJ report to AEC (23April2010)
(The Institute of Energy Economics, Japan)

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Policy paper by AEC (25 May2010) discusses Contribution from NE to JAPAN's Growth Strategy

1) Contribution of nuclear power to "Green innovation" by 2020

- 1/3 of total reduction of GHG emission by nuclear power
- 1% increase of availability displaces CO2 emission by 3M Tons/Y
- One new unit displaces CO2 emission by 5M Tons/Y
- Current capacity factor of 54 LWRs: 60-70% due to earthquake and other reasons

(Note that the above three points imply 10% increase of capacity factor or power uprating of the current fleet is equivalent to 6 new units with no or minimum additional costs.)

- 9 units are expected to start operation by the End of FY2019

2) Contribution of nuclear applications to "Life innovation"

- Improved standard of life (medical use, food irradiation etc)

3) NPP projects in & out of Japan leading to job and economy

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Atomic Energy Commission of JAPAN

- **Five Commissioners**
  - **- Led by the Chairman (Prof. Kondo)**
  - **- Four out of five: newly assigned in January 2010**
- **Plan, Deliberate and Decide on basic policies**
  - **- R&D**
  - **- Use of NE (including nuclear applications)**

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Further "Basic Energy Plan" (8 June 2010) and "Action Plan for Nuclear Power" (4 June 2010) by METI

1) New build by 2030 : 14 units or more
2) Nuclear electricity by 2030: 50%
3) Low carbon power generation source (renewable and nuclear) by 2030: 70%
4) Practical actions for NP includes;
   - Availability increase and new build
   - Consensus building
   - Fuel cycle and HLW repository
   - Securing stable supply of Uranium
   - International relations

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Challenges to achieve the expected role

- **New build**
  - Loan guarantee?, Economic competitiveness of NP?, Licensing?: No
  - Societal issue: yes for some
- **To reach global standard level of capacity factor of NPPs**
  - Need to restart of remaining units at Kashiwazaki-Kariwa
  - Need to change: Operational cycle, Power uprating, outage duration, licensing procedures (pre-approval of standard design and fuel) etc
  - Without compromising safety
- **In general**
  - Need to revisit gaps from global standard practices such as;
    - Use best practices in the world in operation/maintenance of NPPs
    - Low mobility of experts among nuclear organizations

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1. Introduction

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Comparison of NPP Performance (Japan and the USA)

●**Un-planned Shutdown in JAPAN**
- Relatively low frequency of un-planned shutdown
- Nevertheless, once shutdown, longer time before restart

●**Duration of Planned shutdown time in JAPAN**
- 3 or 4 times longer
- Extensive preventive maintenance works and inspections
- Earthquake, Less on-line maintenance, etc.

	Cycle Length (Months)	Shutdown Frequency (Event/Reactor-year)	Ave. Shutdown Period (days)	Ave. Inspection Period (days)	Plant Availability (%) MEDIAN
Japan	13.0	1.02	78	143.5	71.6
USA	19.2	1.86	19	42.3	91.8

SOURCE: IAEA-PRIS, 2007 to 2009

An example: Steam leakage from HP Turbine

■ 2010 August, 1F1 (TEPCO) : After observing drop of water (1 drop/3 seconds, radioactive) from HP turbine seal, shutdown the reactor for inspection and remedial action

✓33 days (Shutdown: August 21 → Restart: September 24)
✓Suspected cause (TEPCO's report, 2010 September 20th)

Inappropriate surface polishing after HP turbine overhaul during the last outage (In the past, this overhaul and surface polishing was followed by confirmatory check if the surface is flat or any deformation exists. However, according to the TEPCO's report, in the last 5 such overhauls since year 2006, such confirmatory check of the surface smoothness was not done)

■ 1994 April, Similar event at Tsuruga-1(JAPC): 78 days

■ Similar Incident and course in the US?

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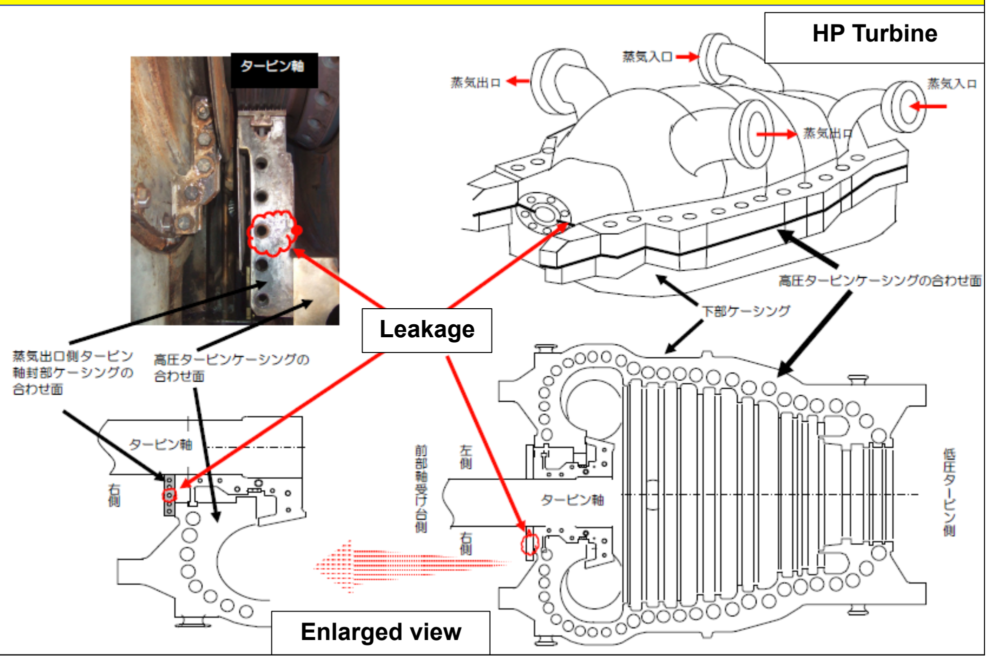
An example: Steam leakage from HP Turbine



An example: Steam leakage from HP Turbine

Communication with Dr. D. Chapin (MPR) and information from US Utilities revealed the followings;

1) **How frequent is such overhaul?**
   - Original Equipment Manufacturer (OEM)'s recommendation in the US for overhaul of HP turbine is 100,000 operating hours (10-12 years); no regulatory requirement directly on turbine overhaul frequency
   - Japan is doing overhaul 3-4 times more frequently
   - Consequential increased opportunity of damage during maintenance and "inappropriate surface polishing" in Japan
2) **Does this leakage lead to plant shutdown ?**
   - Not likely in US, depends on risk significance to safety and operation.
   - Cases Furmanite was applied for continued operation in the US.
3) **How many days to restart ?**
   - **US:** Likely restart much earlier; utility heavily focused on safe, prompt return of full power. 4 days (Hope Creek) for similar leakage.
   - **Japan**: Restart agreed upon by negotiation with Regulator & Local government.
   - 1F1 case: Other than the real work, additional 3 days spent for coordinated actions with the neighboring unit 1F2 (shared MCR) & 7 days for other reason (at a time of start of the first MOX plant).

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Benchmarking is the art of finding out – in a completely straightforward and open way – how others go about organizing and implementing the same things you do or that you plan to do.

The idea is not simply to compare your efficiency with others but rather to find out what exact process, procedures, or technological applications produced better results. And when you find something better, to use or copy it – or even improve upon it still further.

[SOURCE] Blake Harris, "Best Practices Emerge from the Synergy of Technology, Processes, and People," Emerging Technologies, Supplement to Government Technology, 8 (October 1995)

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A Five-Stage Benchmarking Process

Decide what to benchmark → Identify partners → Gather information → Analyze → Implement for effect

Impossible w/o international cooperation

Source: Bengt Karlof and Svante Ostblam, *Benchmarking: A Signpost to Excellence in Quality and Productivity* (New York: John Wiley & Sons, 1993).

....and benchmarking includes comparison with other industry as well

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2. **Benchmarking for best practices and ….**
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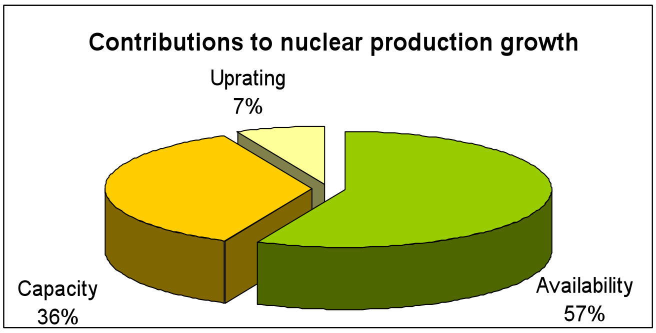
Sharing information so that best practices may prevail



Nuclear electricity increased by 40% (1990-2005)

Capacity factor improvement by:

✓Best practice prevailing
✓Consolidation to those who perform best
✓Risk-informed regulation

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Networking coordinated by the IAEA in the area of waste technology

- International Network of Underground Research Facilities for Geological Disposal
  - Established in 2001
- International Decommissioning Network *"IDN"*
  - Established in 2007
- International Network of LLW Disposal *"DISPONET"*
  - Established in 2009
- International Network of Environmental Remediation *"ENVIRONET"*
  - To be established in 2010

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Example of networking of higher education in Asia

ANENT
(Asian Network for Education in Nuclear Technology)

- Since 2004
- Networking regional educational institutions
- Fostering cooperation: reference curricula, exchange students and facilitating credit transfer, exchange information and teaching material, distance-learning
- 15 countries and 6 collaborating organizations.
- http://www.anent-iaea.org

Australia, Bagladesh, China, India, Indonesia, Korea, Malaysia, Mongolia

Pakistan, The Philippines, Sri Lanka, Syria, Thailand, Vietnam, UAE

ARCCNM, ASNM, ENEN, MEPhI, TIT, WNU

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International network in maintenance science and technology will help

- ✓ Benchmarking for best practices
- ✓ Sharing LL and best practice
- ✓ Sharing database
- ✓ Sharing resources

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Supporting database - Nuclear Power

DB Name	Contents	Status	In House Coordinatio n	Related Organization
PRIS	Data about the world's nuclear power plants	In operation since 1970	IRS(NSNI)	
CNPP	Narrative overviews of nuclear power development by country	Published since 1998	Safety profiles (NS), TC profile(TC)	
ENTRAC	E-Catalogue Information System on Training Services	In operation		
NEPIS	Nuclear Economic Performance Information System	In operation		EUCG(US)
PLiM	Nuclear power plant life management	In operation		KFKI (Hungary)
NPP I&C	World nuclear power plant instrument and controls	Under construction		
FR	plant parameters and design details	In operation	Pilot programme for KM	

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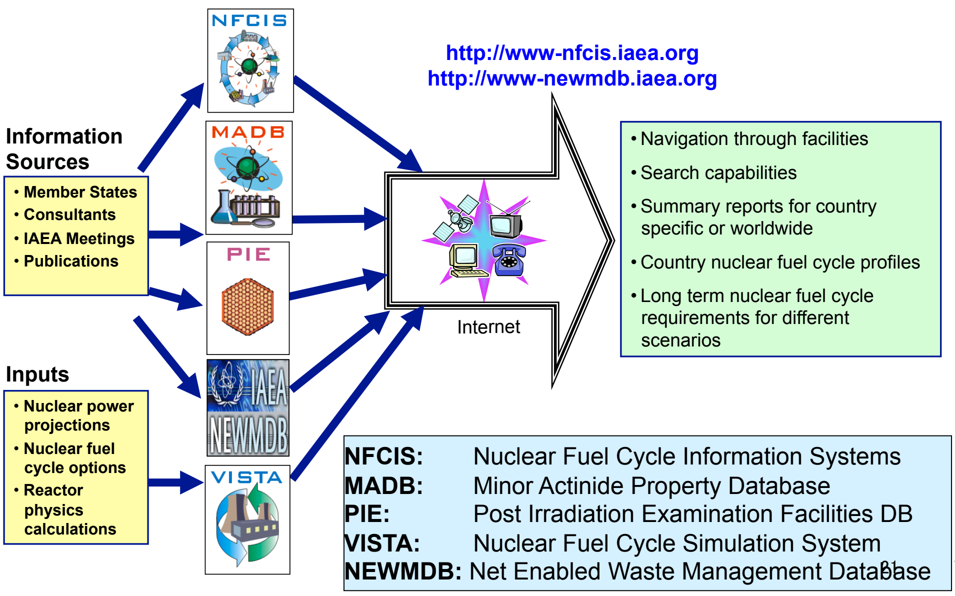
Supporting database – Fuel Cycle



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Database support

Database support for a good quality PSA for risk informed decision making and maintenance activity:

- Scarcity of data usable by countries with limited NP programme
- Methodology of data collection and evaluation: to be shared
- France, USA, UK, Canada, Spain, Germany, Japan
  - already have large operating databases
- Countries from Eastern Europe, Asia, South Africa, Latin America
  - do not operate large local component reliability databases

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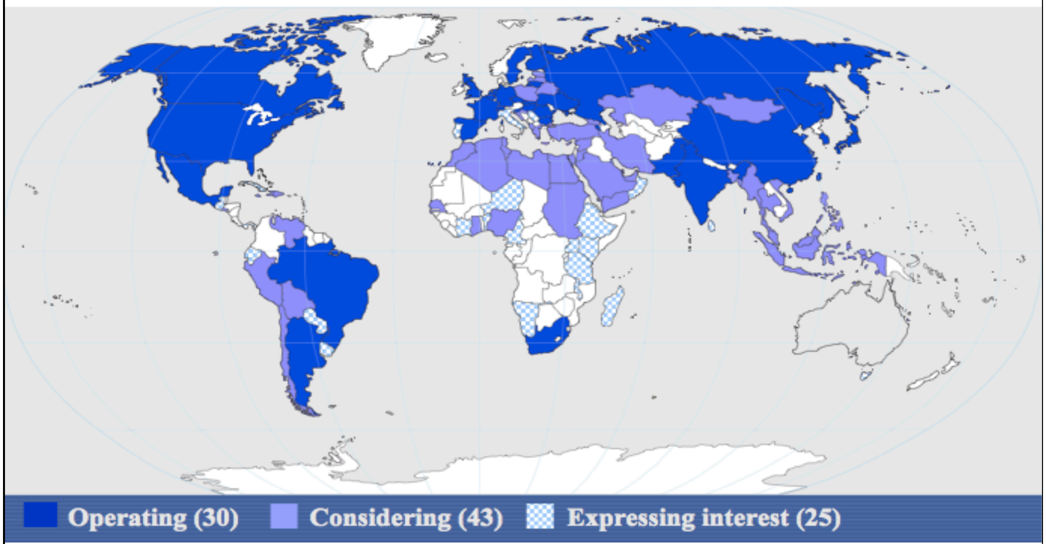

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[SOURCE] IAEA

Database support

- **Database potential**
  - Initiating event data
  - Component failure rate data
  - Component demand failure probability
  - Surveillance test interval (STI) data
  - Maintenance time (MTTR) data
  - Accident sequence time windows
  - Uncertainty parameters
- **Extension of PRIS**
- **Issues such as;**
  - Applicability of data to components of different design
  - IPR

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Conclusions

1. **Benchmark for best practices to maximize the benefit from the use of nuclear power and implement for effects**

2. **International cooperation for**
   - ✓ Benchmarking for best practices
   - ✓ Sharing LL and best practice
   - ✓ Sharing database
   - ✓ Sharing resources

3. **Sharing database for PSA and RCM through international organs would help countries with small nuclear power programme**

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Thank you for your attention
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