



D&D of Nuclear Power Plants - Global Emerging Issues and Strategies

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CONTENT

1. Timetable for the shut down of NPP`s
2. Decommissioning - emerging issues
3. Importance of access to a final disposal site
4. Summary

UPCOMING DEVELOPMENTS

- **Number of plants to be decommissioned will increase dependend on**
 - Political decisions (life time extension, early shut down)
 - Electricity market situation

- **The constraints in different countries are different with respect to**
 - Legislation framework
 - Waste management
 - Availability of respositories

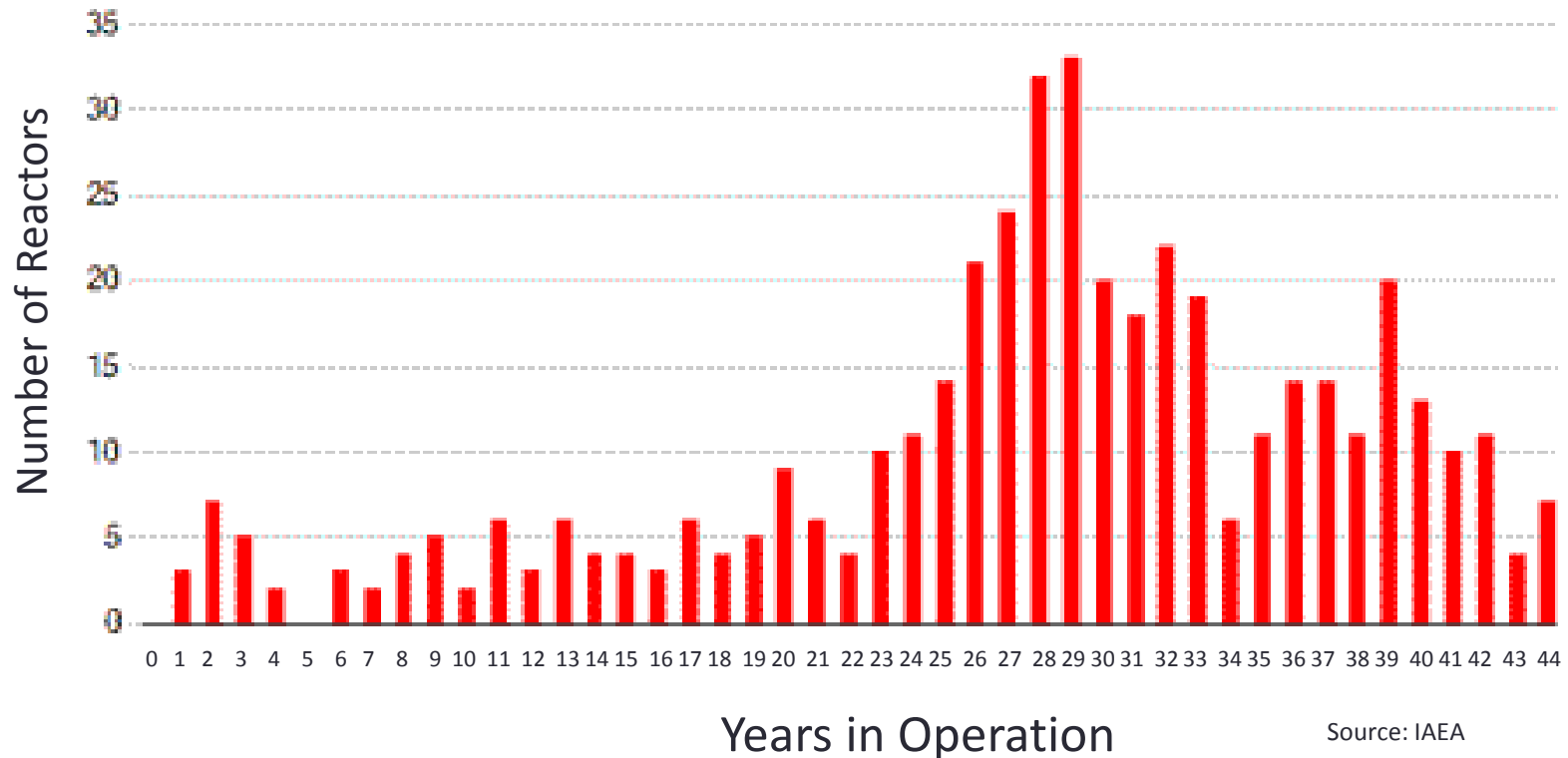
- **Harmonization of D&D - technologies**

- **Globalisation of the D&D - market**



TIMETABLE FOR SHUT DOWN OF NPP'S

AGE OF THE EXISTING NUCLEAR POWER PLANTS



70 % of the reactors are older than 25 years

INTERNATIONAL SITUATION

1. Existing NPP`s:

- 435 reactors in 34 countries, 370 GW_{el}
- **630 GW_{el} in 2035**

2. New build: 60 reactors in 13 countries

- China, Korea, France, UK, Finland, Sweden, Russia, ...

3. Life time Extension

- USA, France, UK, Sweden, Russia, ...

4. Capacity increase

- USA, Belgium, Sweden, Germany, Finnland,...

PHASE OUT IN EUROPE

- Germany by 2022
- Italy remains non-nuclear
- Switzerland and Spain: no new reactors
- Belgium phasing out its nuclear plants perhaps as early as 2015

SHUT DOWN

- **60 reactors (1996 - 2012)**
 - 11 in Germany

- **60 reactors (≤ 2030)**
 - 9 in Germany

(Source: WNA, March 2013)

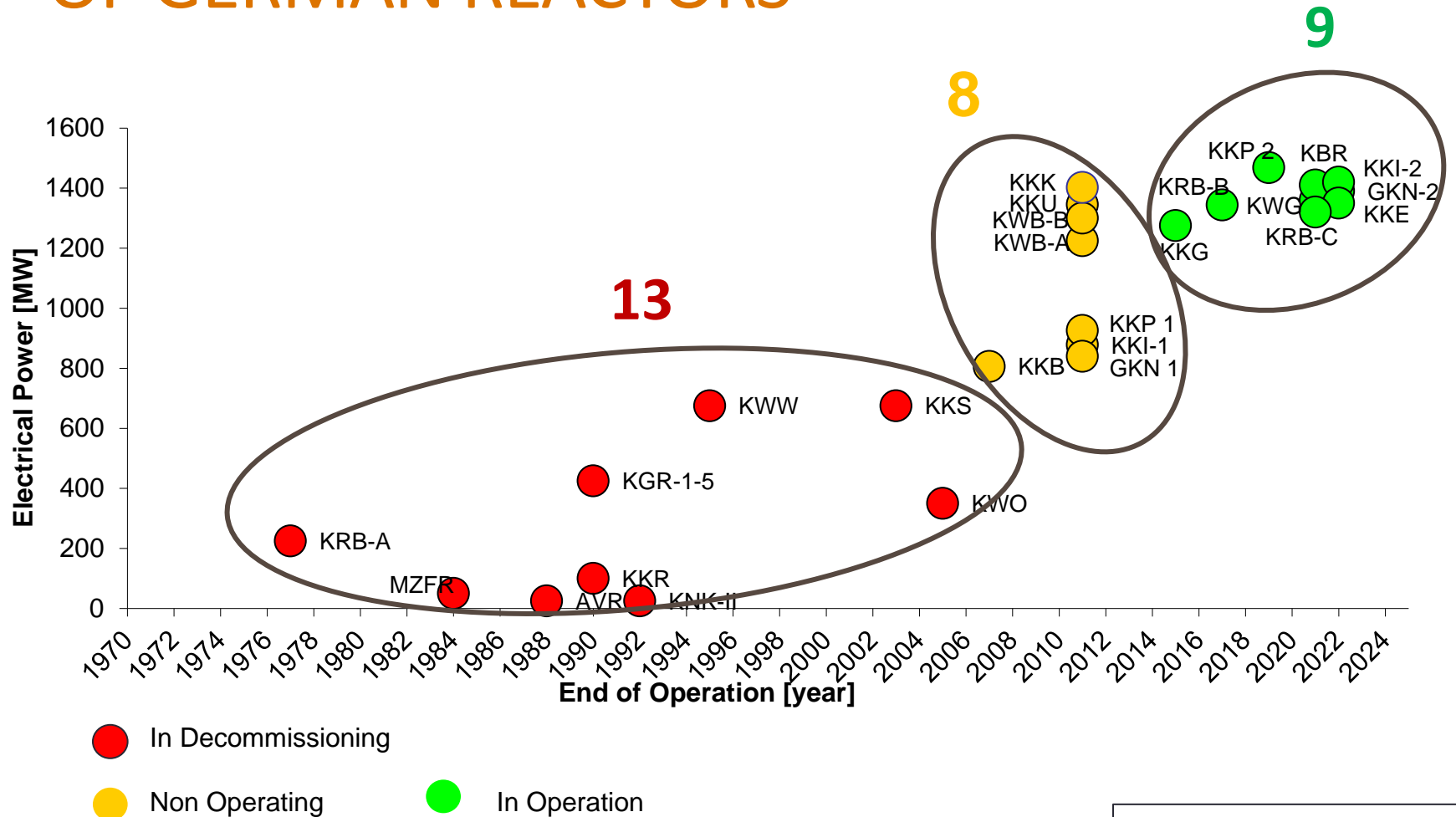
GERMAN SITUATION

- 2011: 19 NPP`s had been in operation

- Life Time Extension of German NPP`s 01.01.2011
- **Fukushima accident:** **03.11.2011**
- **Shut down of 8 NPP`s** 08.06.2011

Consecutively shut down of the remaining 9 NPP`s till end of 2022

DECOMMISSIONING OF GERMAN REACTORS



Based on:
Bernd Kaiser - E.ON Kernkraft GmbH
November 12th, 2013, ICOND 2013



DECOMMISSIONING

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DECOMMISSIONING STRATEGIES

1. Immediate Decontamination and Dismantling (D&D)
2. Safe Enclosure (Safestore):
de-fuelled plant is monitored for up to sixty years before complete decontamination and dismantling of the site
3. Entombment:
radioactive contaminants are encased in a long-lived material such as concrete
(e.g. Magnox reactors due to the absence of a solution for the disposition of activated graphite)

FACTORS OF INFLUENCE

The decommissioning strategies may depend on:

- Using expert knowledge of still existing operational staff
- Cost minimization (maintenance/surveillance cost over time)
- Waste minimization due to radioactive decay
- Access to a repository for radioactive waste
- Availability of funds - provisions – cash flow
- Limited resources
(own staff, money, contractors, authority, expert groups)
- Using a learning curve might lead to consecutive decommissioning

HUMAN RESSOURCES – ROLE OF THE STAFF

- Plant people are experts in reactor operation but are they also experts in decommissioning?
- Are they motivated to accelerate decommissioning or do they retard progress since they might loose their job after dismantling?
- Therefore they might need a job guarantee to become a driving force in decommissioning.
- Should the dismantling job be done by experts in D&D from external companies?

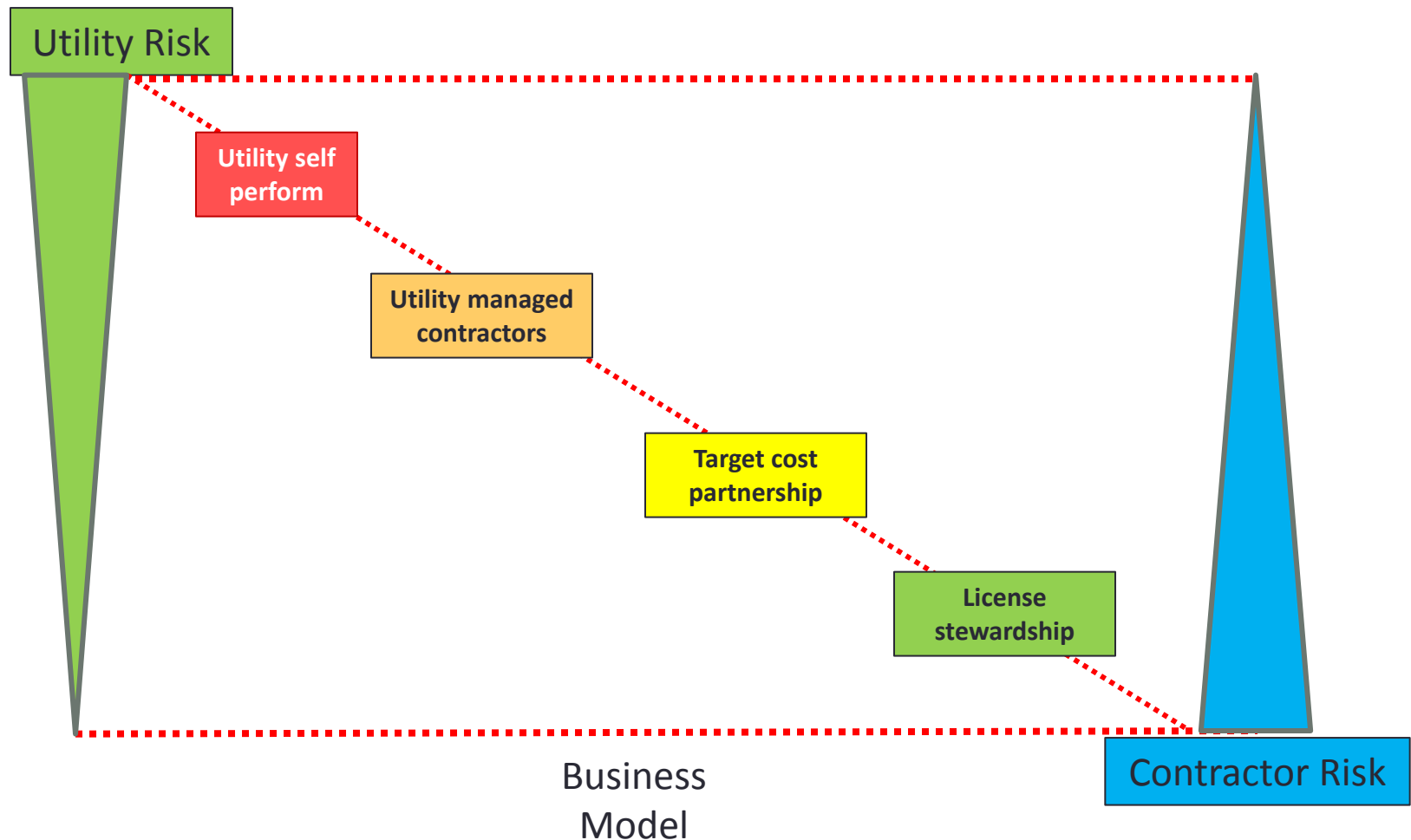
RISK MANAGEMENT

- **Targets for contract models:**
 - Cost reduction by risk sharing
 - Risk reduction for utilities
 - Incentives for the contractors dependent on time taken and costs

- **Industry can assist utilities to manage the risk**

- **Incentive model must be more profitable for the utilities than contractor model**

RISK SHARING BETWEEN UTILITIES AND CONTRACTORS





FINAL DISPOSAL

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DECOMMISSIONING AND WASTE MANAGEMENT

- **Decommissioning:**
 - Planning
 - Licensing
 - Construction of the infrastructure (cranes, ventilation, waste handling facility)
 - Decommissioning

- **Waste Management (LLW, ILW)**
 - Waste acceptance criteria/free release criteria
 - Waste management facility
 - Waste treatment onsite/offsite
 - Interim storage – repository

- **Optimization aspects**
 - Components cut in pieces or stored and disposed off in one piece
 - Minimizing waste volume/interim storage volume/saving final disposal space
 - Existing repository might reduce the need for a volume reduction



SUMMARY

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EMERGING ISSUES

1. How to reduce costs (time) for D&D
2. How to share risks between utilities and contractors
3. How to optimize waste management by intelligent waste treatment methods
4. What are appropriate organization concepts and how to keep the motivation of the staff high
5. Role of an appropriate repository dedicated for waste from decommissioning



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UTILITY SELF-PERFORM MODEL

The first model is the default position often taken by utilities. The **workforce is retrained** and, often under a new license issued for the purpose, **performs most of the D&D tasks itself** with **support from specialist contractors**. The utility can justify this approach on grounds of **short term cost minimization, socio-economic benefits from preserving employment and compliance benefits achieved through continuity of personnel**.

UTILITY MANAGED CONTRACTORS DECOMMISSIONING MODEL

The second example illustrates an extension of Utility Self Perform where the utility retains overall direction of the program but contracts with industry specialists to perform significant elements of the total scope. Thus the utility transfers by contract some of the financial risk to chosen partners, while retaining overall responsibility for performance.

TARGET COST PARTNERSHIP MODEL

In the third illustration, the liability owner has selected a contracting model that transfers much of the project risk to its contractor, while retaining the ultimate risk of ownership of the liability. The UK NDA has agreed “Target Cost” terms with *EnergySolutions* to perform decommissioning in preparation for C&M. The purpose of this model is to incentivize the contractor (in this case the PBO for Magnox Ltd) to perform an accelerated clean up program to meet demanding schedule and budget targets. Delivery of the targets will produce significant financial savings and other benefits. The contractor and funding agency share the benefits of success and the pain of any shortcomings.

LICENSED STEWARDSHIP MODEL

more of the risk is transferred to its contract partners, but retains the ultimate liability.

fuller transfer of risk and liability for the decommissioning from the utility to a selected specialist partner.