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The Strategic Challenge of Capacity for German Decommissioning

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INTRODUCTION

This paper offers a strategic perspective on the rapidly developing European Nuclear Power Plant (NPP) decommissioning scene, with a particular focus on the German market. Strategic themes of interest to international companies in decommissioning:

- Market size, valuation and timing
- Strength and capacity of German nuclear industry
- Routes to enter the German market and risks to be overcome

EUROPEAN NPP DECOMMISSIONING OVERVIEW

Country	Pre 1986	1986-2009	2010-2025	later or unknown	Total
Belgium		1	7		8
Bulgaria		4		2	6
Czech Republic				6	6
Finland				4	4
France	3	6		60	69
Germany	6	13	17		36
Hungary				4	4
Italy	1	3			4
Lithuania		2			2
Romania				4	4
Slovakia	1	2		6	9
Slovenia/Croatia			1		1
Spain		2	6	2	10
Sweden	1	2		10	13
The Netherlands		1		1	2
United Kingdom	2	24	18	1	45
TOTAL	14	60	49	100	223

Source: European Commission report "EU Decommissioning Funding Data", dated March 8, 2013

Europe is predicted to become the world's largest market for Decontamination & Decommissioning (D&D) by the middle of the next decade. Over half of the European Union's (EU's) 223 NPPs are due to close by 2025, requiring expenditure by utilities on subsequent decommissioning of €60BN+ [1],[2]. 49 European NPPs will be added by 2025 to the pre-2010 stock of 74 shuttered units.

- Decommissioning strategies, budgets and schedules tend to be dominated by the national waste disposal readiness and capacity.
- National power security concerns are pushing some utilities into Life Time Extensions rather than closure at end of initially regulated generation.
- Utility cash flows, especially in these days of depressed electricity market prices, can impact readiness to commit to short term expenditure on D&D.

Table 1: European Power Reactor Closure Status and Prediction

The cost of decommissioning varies widely across Europe, a cause for recent concern for regulators [3]. Assumptions made by utilities vary due to:

- planned dismantling methods,
- uncertainty about licensing procedures,
- estimated cost of waste packaging, interim storage and eventual disposal,
- the planned time period of the project,
- use of utility personnel to manage and perform decommissioning projects.
- lack of experience in the dismantling of full-sized NPPs.

Recent reports place the range of unit budgets for decommissioning a full sized (500MWe+) European NPP at €200-860M per reactor [4],[5].

Consequently, the total European NPP decommissioning market may reach €60BN by 2025 assuming that some 123 reactors will be dismantled at an approximate cost of €500M each, plus waste disposal costs.

PROBABLE GERMAN PROGRAM

Germany's decision to phase out nuclear power generation in 2011 followed the Fukushima incident. A legislated schedule for plant closures shut eight reactor blocks in March 2011 with all 17 NPPs to be closed during the period 2011 – 2022. Figure 1 shows the phase out program in terms of generation capacity.

Overview: nine plants in decommissioning (three yet to finish); nine in post operations shut down pending D&D; and eight plants still operating. Few have reached "green field" status. Note early NPPs decommissioned were smaller or prototype plants; later units will be larger and more complex to dismantle.

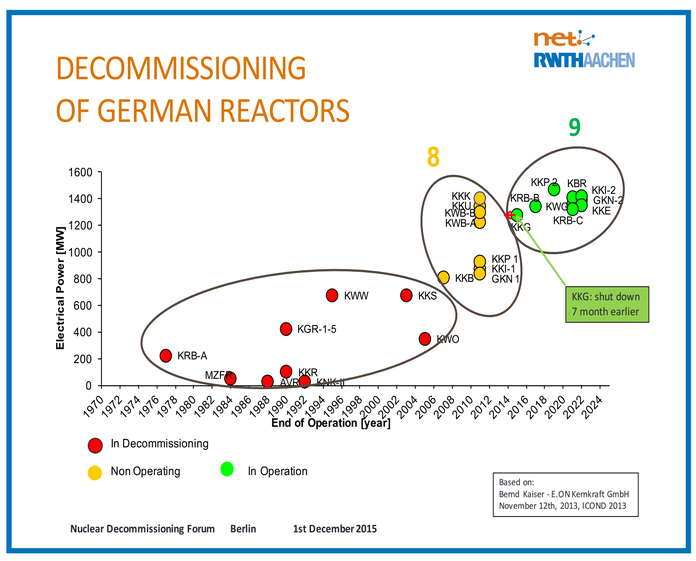


Figure 1: Nuclear Power Plant Closures in Germany (source: RWTH NET, 2015)

PHASING OF THE PROGRAM

Figure 2 estimates the aggregate NPP decommissioning schedule assuming:

- utilities adhere to the legislated closure program and do not close NPPs early
- political pressure obliges utilities to proceed with Immediate Dismantling strategies
- utilities manage decommissioning over a 15-18 year period from closure:
  - five years for post-operations (de-fueling, licensing etc);
  - then 10 to 13 years for dismantling.

The schedule peak in mid-2020s looks pronounced. Utility funding pressures, licensing delays, disposal facility delays and other factors may conspire to spread the program out over a longer schedule, flattening the peak; but the total volume of work remains the same.

The number of blocks entering active decommissioning in the 2020s will rise sharply, followed by decline in the 2030s towards zero. This program represents an interesting opportunity for the industry that supports the utilities, but some severe challenges also as the capacity required may strain the resources of all parties. Economies of scale and scope will offer efficiencies of deployment of resource; also, declining NPP upgrade, maintenance and outage work will make resources available for redeployment to D&D. Yet, the peak of 14 blocks in the mid-2020s will require a fourfold increase in capacity compared to 2014.

In addition to the German market peak, industry should consider the simultaneous requirements of other European countries throughout the 2020s. Sweden, Belgium and Switzerland will all seek industry assistance to decommission a further 5 – 10 PWRs or BWRs, calling further on the resources stretched to cover the German peak.

The cost of NPP decommissioning will be found from the balance sheets of the utilities, which accumulated funds to cover decommissioning during the generating life of the NPPs. In 2013, these amounted to €36BN [6]. These provisions remain subject to regulatory scrutiny to determine their adequacy. The German utilities did not however accumulate cash in segregated funds to cover decommissioning. Therefore, to finance D&D, the utilities will have to make significant calls on operating cash flow; or sell assets which can by their nature be rather illiquid.

The decommissioning program may run as follows:

- continuing work at Obrigheim (KWO), Würgassen and Stade,
- Philippsburg 1 (KKP1) and Neckarwestheim 1 (GKN1) will see a start to dismantling work by 2017;
- Isar 1 (KKI1) and Biblis A and B will follow soon after;
- other reactors closed in 2011 will follow as soon as licensing, resources and finances permit.

STRATEGIC CONSTRAINTS AND CHALLENGES

The German program faces a number of headwinds increasing uncertainty, delaying progress with dismantling and pushing up costs:

- **Law suits against governments** – the utilities have sued governments at various levels about the premature shut-down of their reactors with total damages sought ranging from €18BN to €24BN [7],[8]. The outcome of the law suits approaches.
- **Disposal uncertainties**, costs and technical requirements – a spent fuel repository has not yet been determined. The Konrad mine for low and intermediate level wastes is seriously late so utilities will be obliged to provide interim storage.
- **Cash flow of utilities** – low power prices in Europe and over-supply of renewables has undermined profitability, impacting the cash available to finance D&D.
- **Licensing procedures** – the scale of decommissioning work might overwhelm the regulatory departments of regional environment ministries, delaying projects.
- **Self-performance** – the German Works Council system gives employees a strong say in major decisions and normally results in utilities deciding to manage D&D work themselves.

EUROPEAN INDUSTRY RESPONSES

The EU has a qualitatively strong decommissioning industry with many of the big names in the trade firmly established in Germany: Areva, Westinghouse, Siempelkamp, GNS, EWN, etc. However, European industry and specifically German industry has not had to provide decommissioning resource capacity on anything like this scale before. D&D projects have previously been managed as one-offs, on a smaller scale, such as Kahl or Obrigheim, not in parallel large multi-site programs.

To compound the difficulties facing the German industry, most companies have been forced to downsize and consolidate activities. The Nuclear Phase Out terminated planned utility investments, and curtailed outage projects and operational support. Just when the industry needs to be investing to prepare for decommissioning, it is weakest in resources and financial strength.

The German nuclear industry is highly competitive and has successfully diversified into foreign projects in UK, China, USA and elsewhere. It will surely compete fiercely for the project scopes required by the utilities over the next 20 years. But right now, international players looking to enter the German market have their best opportunity.

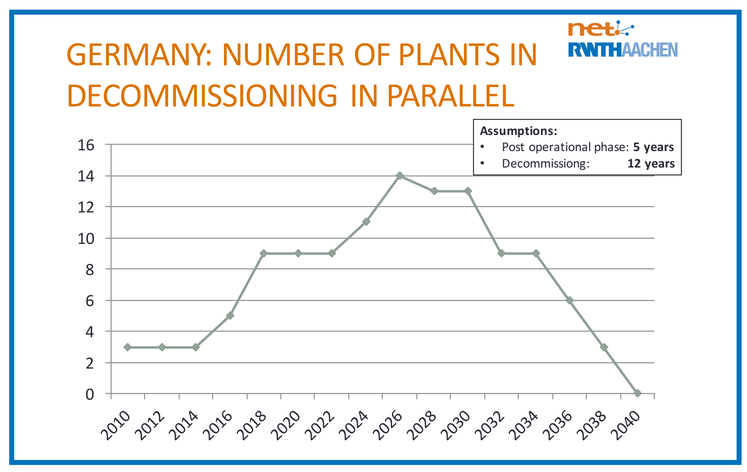
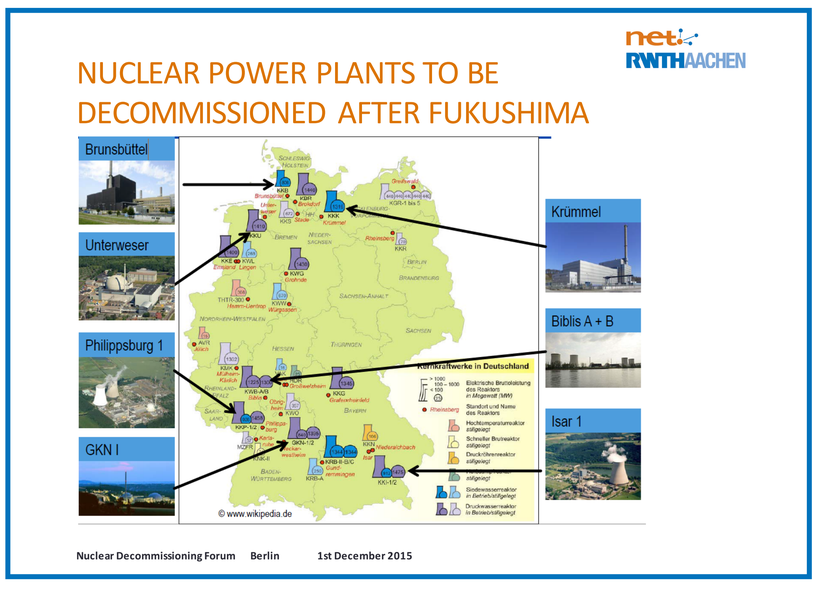


Figure 2: NPP D&D Timetable in Germany

STRATEGIES FOR SUCCESS IN GERMANY

It is tough to enter the German market in the face of determined indigenous competition, a language barrier that deters many and a regulatory culture that is quite unique in the nuclear world. Any company seeking to become a participant should understand the scale and length of marketing investment required to build successful customer relationships and to become accepted in the industry. The significant risks discovered by previous contenders:



- Time horizons for business development long
- Costs of local recruitment and complexity of local labor laws high
- Difficulties delivering projects profitably due to unforeseen regulatory or operational requirements or changing environmental conditions
- Determined local competition with broader customer relationships outflanking new entrants before they can become established.

Figure 3: Location of closed NPPs in Germany

Routes into the German market that mitigate these risks are:

1. **Partnering** – an international player brings both specialist capabilities in short supply and reciprocal access for a German company to an international market.
2. **Forming a Consortium** – teams have already formed to address large D&D scopes. Joining or forming a consortium or joint venture might share investment and risk.
3. **Local acquisitions** – while difficult for foreign investors to find M&A targets, a German acquisition can provide ready credibility, local resource and knowledge.
4. **Building a broader co-operation** with a utility customer to participate in D&D elsewhere. Most utilities want to offer their personnel a long term future.
5. **Founding a local company** with German personnel. Specialist companies may find it possible to set up business if supported by a strong overseas parent.

To succeed in the German market, an international company should become an accepted member of the industry, contributing to the broader success of the industry as it faces the enormous challenges of the Nuclear Phase Out. Participation in conferences and industry events is a good introduction to the German nuclear environment.

CONCLUSIONS

The European market for D&D services is approaching an inflection point. Within ten years, it may be the largest in the nuclear world with 123 closed NPPs requiring expenditure of €60BN+. Germany will be a large program in the coming two decades spending in total €30BN+ and offering examples of the challenges expected. Its program will require a sharp acceleration in decommissioning capacity in the 2020s, as the utilities and supporting industry move from D&D of one-off smaller reactors to managing multiple larger (>1GWe reactors) across many sites in parallel. Other European nations will add to the demand for capacity. This is a more complex challenge at an organizational level than seen before, and it is probable that international industry will play an important role in delivering the services required. Five routes to market offer international companies ways to mitigate the risks. Large consortia may form, perhaps creating consolidated players for the full European market.

1. Nuclear Energy Insider, November 2, 2012,
2. European Commission web site.
3. Cap Gemini, 17th Annual Energy Market Report, November 2, 2015
4. European Commission, "EU Decommissioning Funding Data", report dated March 8, 2013.
5. Siempelkamp paper ICOND 2015 Bonn, Germany November 24, 2015.
6. German Federal Ministry for Economic Affairs and Energy (BMWI) web site, February 2016.
7. Reuters UK, 27 January 2015
8. Reuters International, 3 February 2016.