The World Nuclear Supply Chain – An Overview

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Outline of Presentation

1. About WNA
2. Value of:
   - New construction
   - Early dismantlement
   - Operating revenues
3. The Supply Chain
4. Three challenges
   - Economics
   - Capability
   - Quality

1. About WNA


180 member companies
• Utilities
• Technology Vendors
• Orignial equipment manufacturers (OEMs)
• Professional services
Providing Public Information and News
Nuclear Fuel Market and Supply Chain
Enabling Industry Contacts and Cooperation
Representation in Key International Forums

International Technology Vendors

WNA Supply Chain Working Group

- Working Group was set up in 2010
- Tasks:
  - Maintain updated information on planned NPP construction;
  - Determine the market potential for key components;
  - Assemble a database of leading companies worldwide;
  - Identify possible “pinch points/ bottlenecks” in supply;
  - Develop ways to improve product qualification practices;
  - Issue a periodic Market Report that consolidates supply chain information.
- Task Force for Vendor Oversight and Control of Suppliers (VOCS):

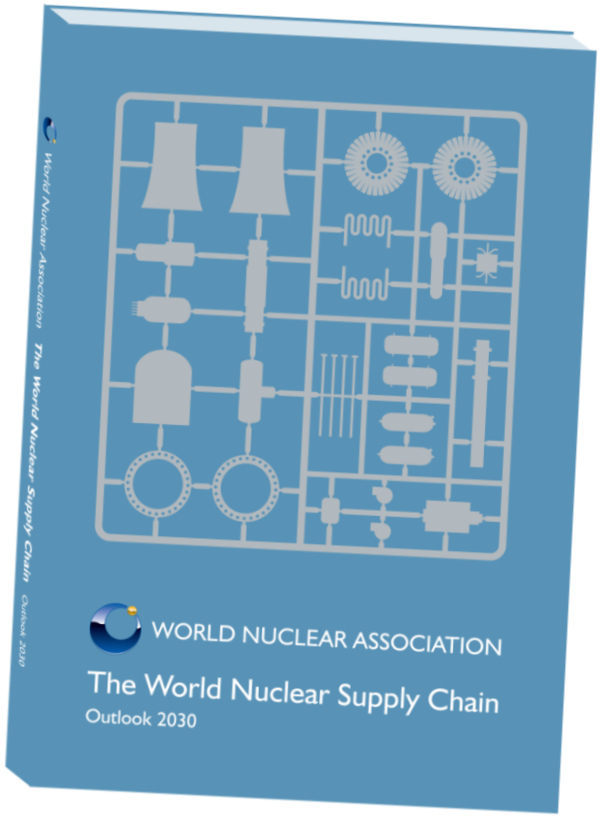
  Develop a framework for a **common process of supplier approval, oversight and quality control** that enhances industry efficiency and effectiveness in meeting regulatory requirements and promotes the public good through continual enhancement of the safety and security of nuclear installations.

Nuclear Supply Chain Market Report

Aims to provide the industry, energy suppliers, the investment community and policy-makers with:

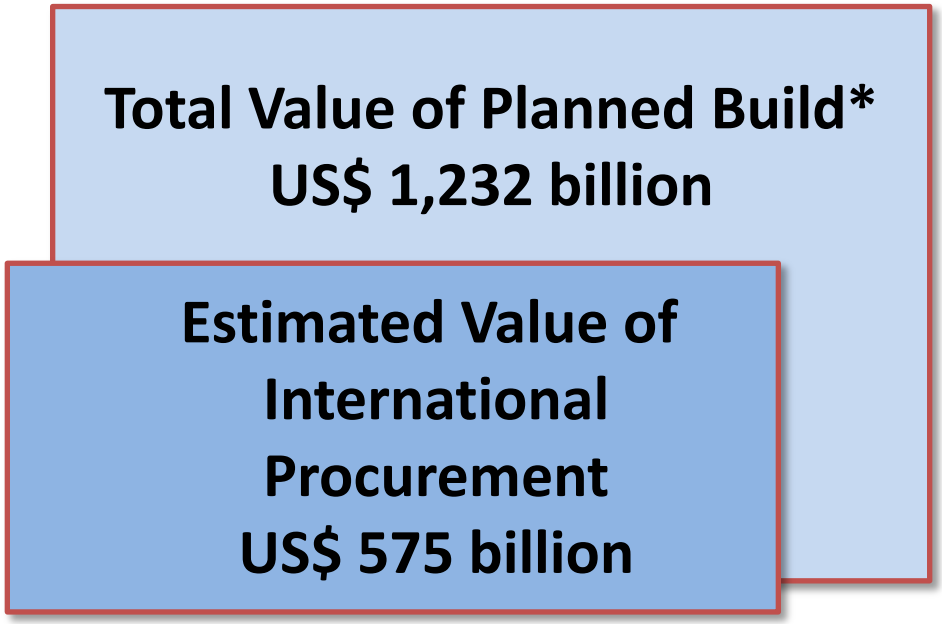
- An up-to-date picture of planned and on-going NPP construction;
- An analysis of the worldwide market for components;
- An analysis of supplier capacity;
- A review of trends in the market;
- A look at how the industry is addressing the challenges in the market;
- Recommendations for harmonization and standards.

Complements the WNA's Nuclear Fuel Market Report



2. Value of Nuclear Construction to 2030

- **295 new NPPs are under construction or planned**
- 50 in OECD countries
- 118 in China
- 42 in Former Soviet Union
- 21 in India

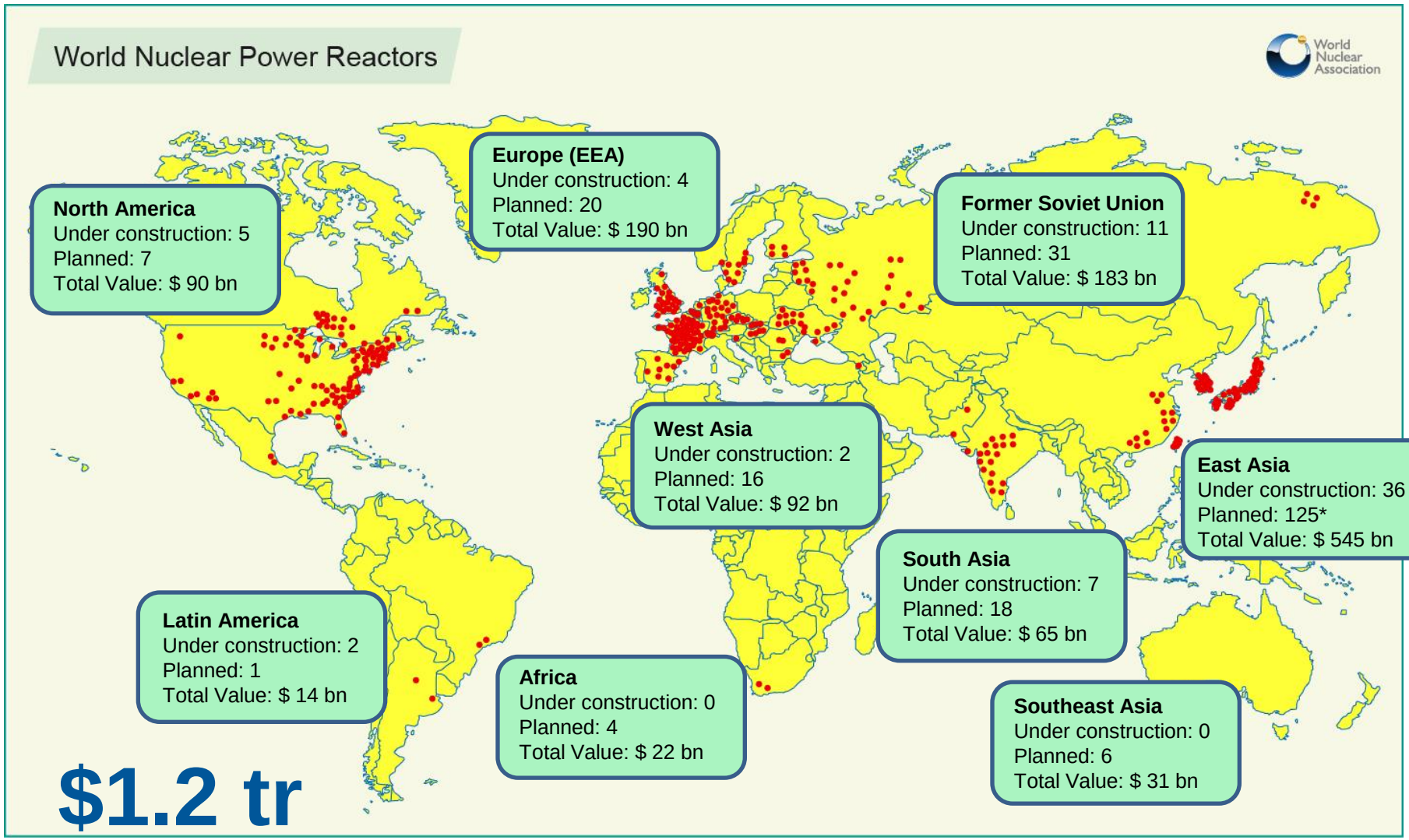


- Reactors currently under construction in China, India, UAE, USA, etc. have an aggregate project value of approx. US$ 232 billion.

- International procurement is worth approx. US$ 26 billion a year.
- Nuclear investment is a small proportion of the US$ 14-17 trillion needed for clean power (Goldman Sachs estimate) to stabilize CO_2 emissions.

Market Size – New Build

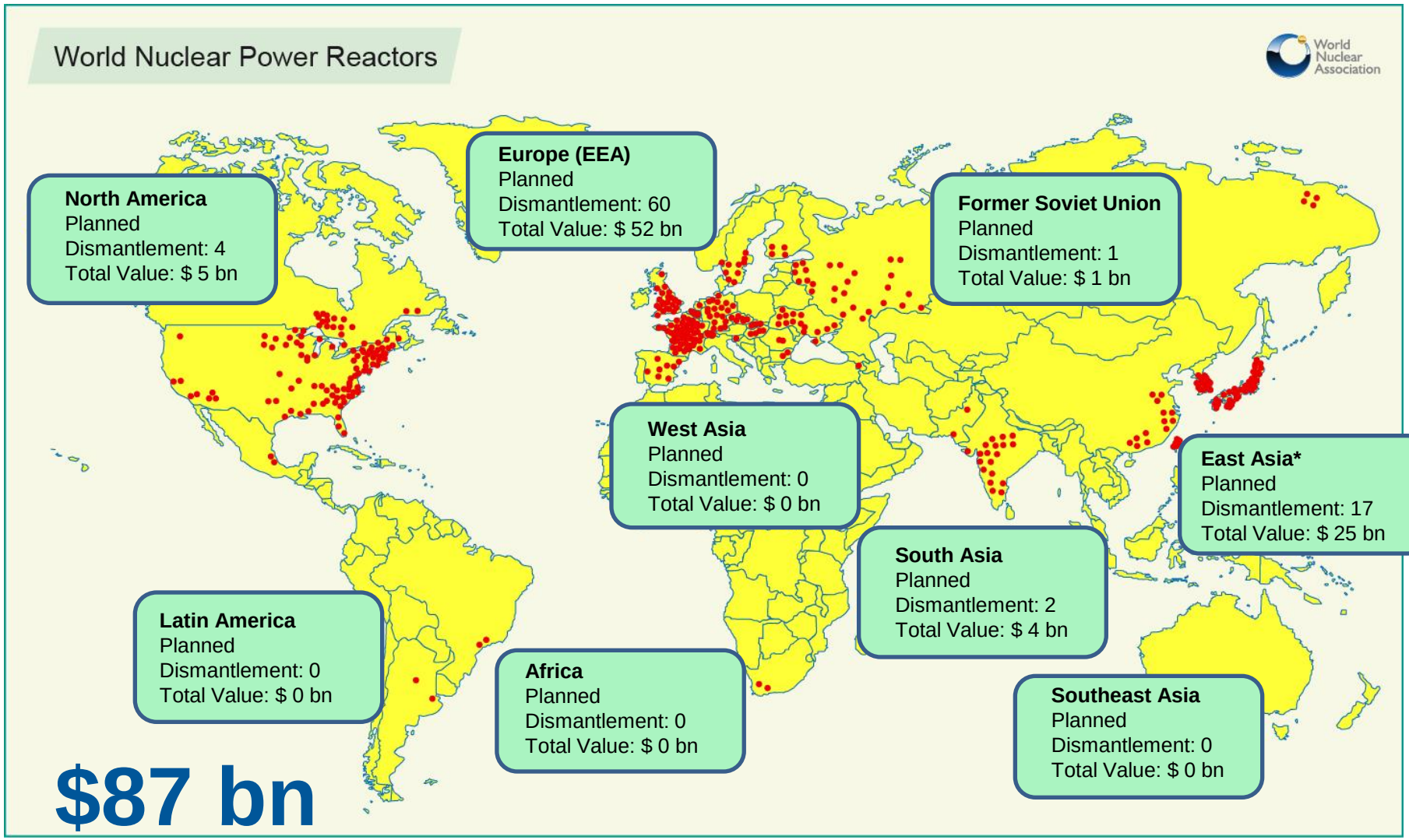
Under Construction + Planned to 2030



* WNA Reference Case

Market Size - Decommissioning

Planned to be under dismantlement by 2030



* 75% in Japan

Revenues from Nuclear Energy

US$ Billion

Output & revenues from nuclear power plants, 2010-2030

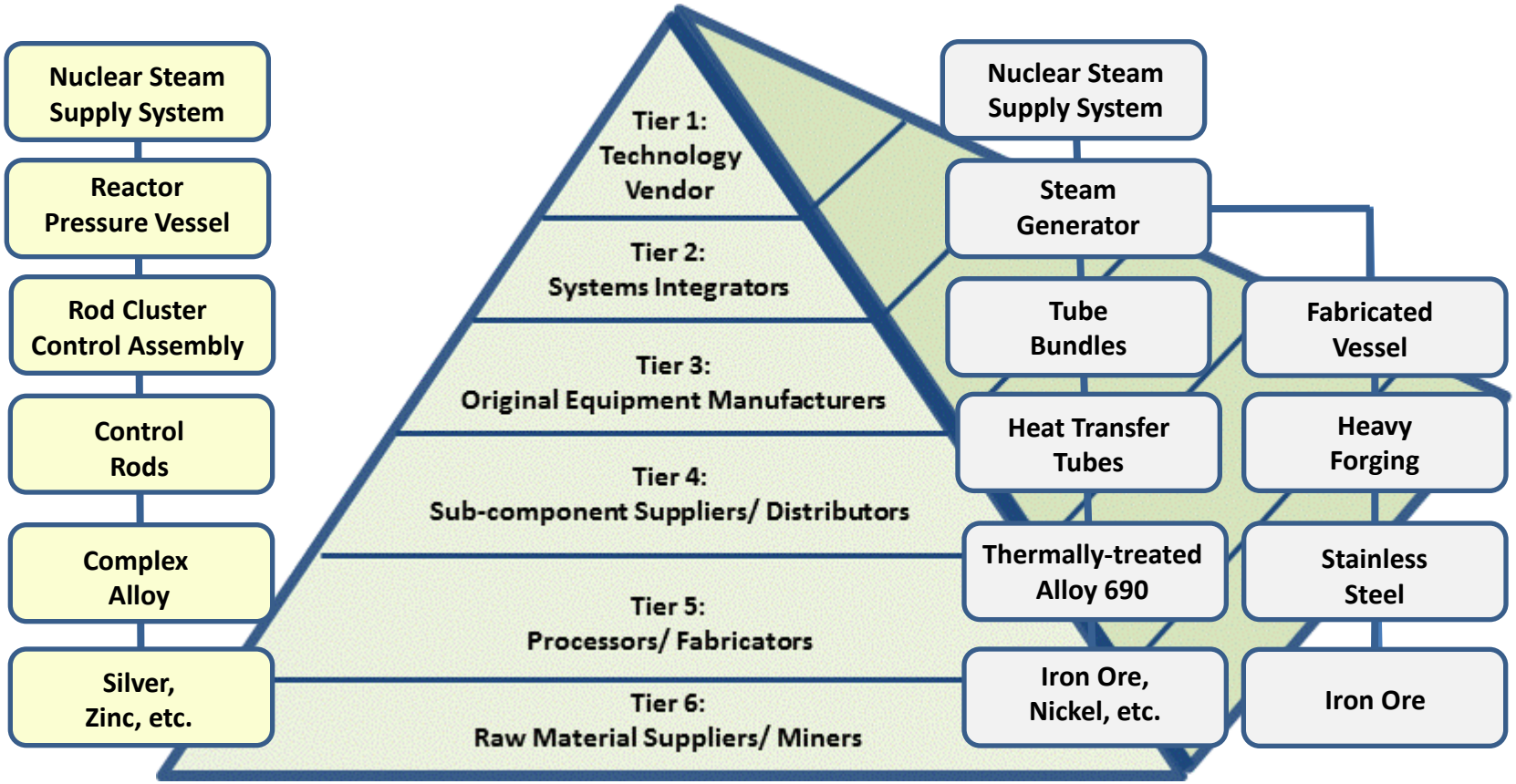
		2010	2015	2020	2025	2030
OECD	Output from NPPs (TWh)	2 192	2 092	2 228	2 262	2 357
	Revenues (US$ billion)	284.4	274.6	290.0	297.0	317.1
Non-	Output from NPPs (TWh)	436	737	1 005	1 440	1 936
OECD	Revenues (US$ billion)	41.2	56.7	82.4	121.4	164.7
World	Output from NPPs (TWh)	2 628	2 829	3 233	3 702	4 293
	Revenues (US$ billion)	325.6	331.3	372.4	418.4	481.8

Source: WNA estimates based on Reference case.

- WNA anticipate revenues from nuclear power plants to grow at approx. 2% a year in real terms.
- Capital expenditure at US$ 26 billion a year is 6-8% of annual nuclear revenues or <1% of all annual electricity sales worldwide.
- In general, nuclear investment appears feasible, but …

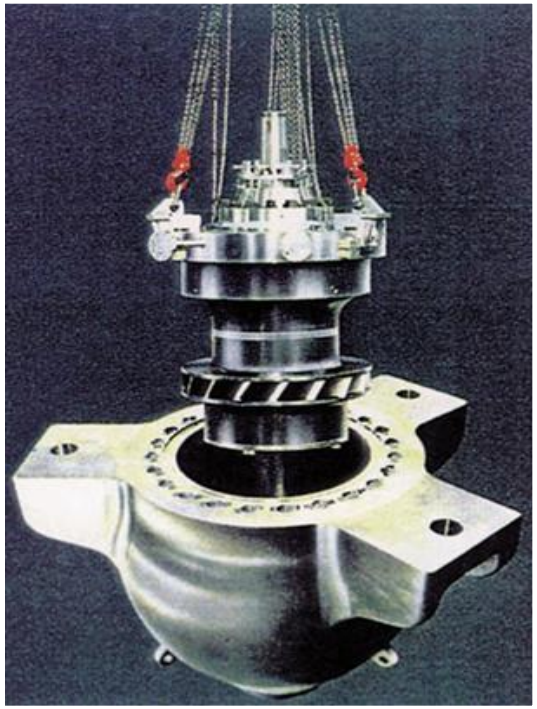
3. The Nuclear Supply Chain

All tiers need to qualified to high standards



Components: What is needed

- Typical amounts for a Generation III Nuclear Power Plant:
  - Basemat concrete (6 000 m^3)
  - Steel (61 000 t)
  - Forgings (4 000 t)
  - Pumps (~ 200)
  - Valves (5 000+)
  - Piping (~210 km)
  - Cabling (2 000 km+)
  - Welding seams (50 000+)

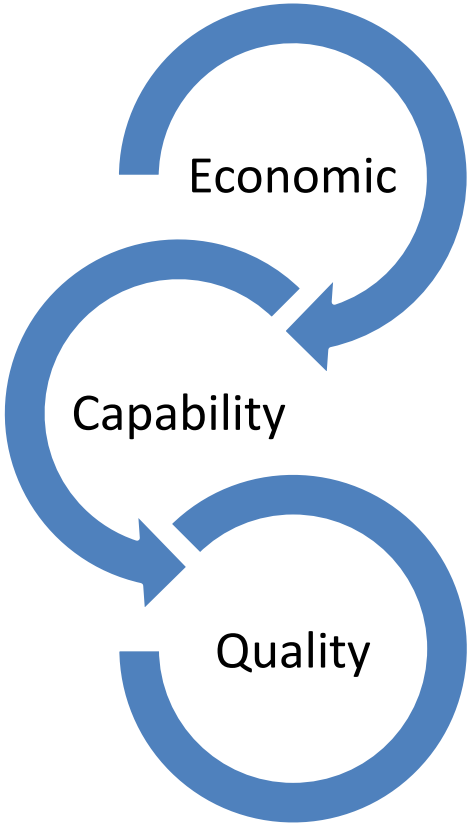


- Exceptional quality required from 'nuclear-grade' components (higher than normal 'industrial or commercial grade'):
  - Safety-related items – performance testing required
  - Safety-significant items – reasonable assurance of performance required
- Engineering: civil, mechanical, electrical, software

4. Three Industry Challenges

How can nuclear power stay competitive?

- Ensuring that the economics of nuclear power are competitive with other generating sources:
  - **Economic challenges**
- Developing reliable international supply chains:
  - **Capability challenges**
  - **Quality challenges**
- Challenges are inter-related



First-of-a-Kind Premium

The extra cost of a First-of-a-kind (FOAK) plant arises from the following factors:

- **Poor economies of scale**; with multiple orders manufacturers can offer bulk discounts;
- **Additional construction costs** reflecting the 'learning curve';
- A risk premium, reflecting the **contingency element** built into component and plant prices;
- A **profit element** that takes account that there may not be any follow-up orders.

The FOAK premium may account for 10-40 % of the price of the first plant built.

Conclusion: Build a **series of standard plants** that can take advantage of **global supply capacity**.

Addressing the Capability Challenge

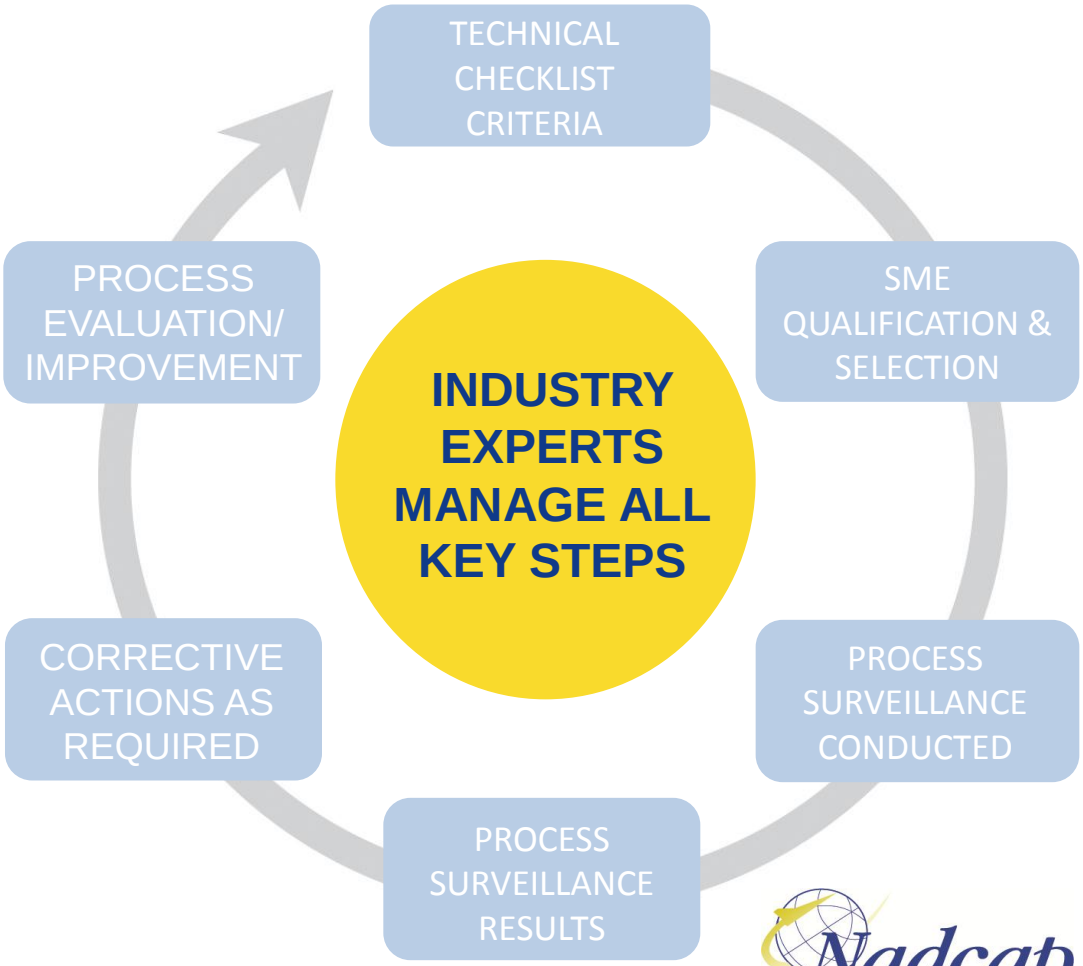
Develop the supply base:

- Clarify requirements to create joint understanding, e.g.
  - on safety culture,
  - on quality management, and
  - through the product realization process;
- Facilitate knowledge transfer;
- Build upon the existing capabilities of the workforce.

Addressing the Quality Challenge: Examples from other industries

"Industries where safety and quality are shared goals" (PRI)

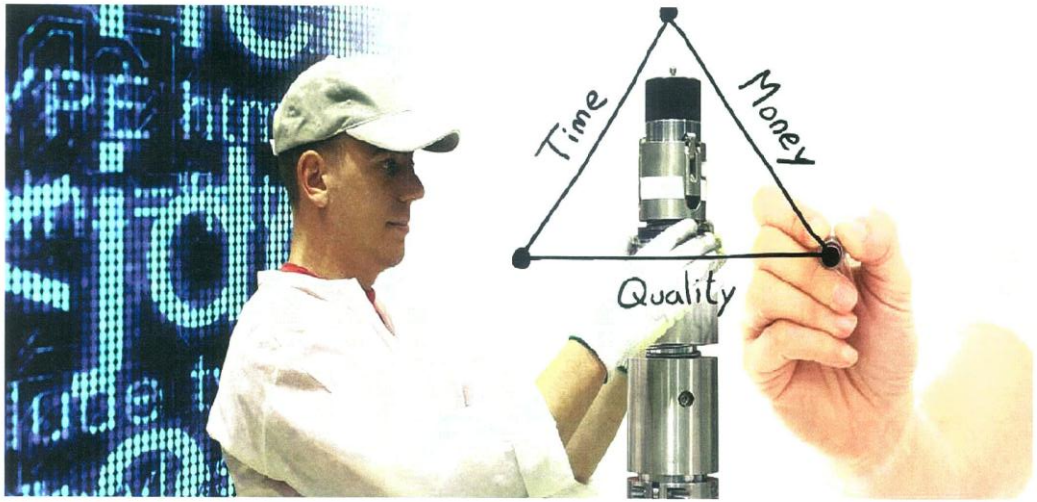
- NADCAP – formerly the National Aerospace & Defence Contractors Accreditation Program
- SAE AS-9100 standard for aerospace
- TPG – Transportation & Power Generation Accreditation Program (with GE Transportation)



PERFORMANCE Review Institute

Addressing the quality challenges: Nuclear Industry Initiatives

- Nuclear Quality Standard Association (NQSA) – established in 2011 by AREVA and Bureau Veritas
  - NSQ-100
- Nuclear Procurement Issues Committee (NUPIC) – established 1989 by US operators



NQSA

Which quality standard for the nuclear industry?

WNA Meeting, April 2013

NUPIC

NQSA Nuclear Quality Standard Association

Potential Solutions

Strengthen product realization/ conformity assessment processes along the supply chain:

- **Quality assurance** (QA): focus on an organization's quality management system (QMS), e.g.
  - IAEA GSR Part 2 (revision of GS-R-3: 2006) requirements on leadership & management for safety – "safety culture"
  - ASME NQA-1: 2008 (links to US Federal Code 10 CFR 50 Appendix B)
  - ISO 9001: 2008 + NSQ-100: 2011 (promoted by NQSA)
- **Quality control** (QC): focus on the product or process of production.
  - Industry consensus on "critical manufacturing processes" (aka "special processes")
  - Oversight (surveillance) of critical manufacturing processes
  - Advanced product quality planning
  - Reducing non-conformances
  - Learning from each other

VOCS Discussions since January 2013

Next Steps

- Deepen our understanding of the gaps in product realization
- Collaboration with NQSA (Nuclear Quality Standard Association) on developing the NSQ-100 quality management standard
- Pilot audits with suppliers to develop a common consistent audit checklist and guidance linked to NSQ-100
- Scoping out an industry-managed of supplier oversight & quality control:
  - 'Global NUPIC'?
  - 'Nuclear NADCAP'?

N.B. The Task Force does not expect ASME NQA-1 standard to be superseded where this is the relevant standard

World Nuclear Association



Thank you:

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