What is different about Asia?

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Factors explaining differences in lead-time and budgeting for new build in different regions!

- About CH2M HILL
- Discussion Area
  - Learnings gained from industry study tour to Japan in March 2011
  - Observed experiences from ENEC
  - Other observations world-wide
- Thoughts going forward

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Adrian J Worker BSc (Hons), CEng, MNucI, MAPM

- Chartered Engineer
- Honours Degree in Aeronautical Engineering
- Worked on many large complex multi-faceted international programmes in nuclear, aerospace, maritime and defence
- Experienced in commercial, supply chain and programme management
- Involved in the nuclear sector since 2006
- Deeply involved in EDF's nuclear projects at Hinkley Point and Sizewell
- Now Business Development lead for CH2M HILL Nuclear Group in Europe
- Has appreciation of new build world-wide
- Chairperson of Nuclear Task Force of Constructing Excellence
- Member of Nuclear Institute and Association of Project Management
- Member of the UK's Nuclear Industries Forum and Group Leader

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Founded in 1946 and the name continues to reflects its founder and their values

Holly Cornell

James Howland

Burke Hayes

Fred Merryfield

Clair Hill

Values Established
65 Years Ago,
Still Strong Today

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CH2M HILL is a global leader

in full-service programme/ project management, consulting, design, design-build, and operations

ENR Ranks #1 CH2MHILL in Program Management since 2004

ENR Ranks #1 CH2MHILL in Environmental since 2006

Support customers build a better and more sustainable world:

- Global company headquartered in USA
- 30,000 employees worldwide
- $6.4 billion in revenue (2011)
- 100 percent owned by employees
- Diversified across multiple business sectors
- Performing work in more than 90 countries
- More than 16,000 active projects (June 2012) including many high profile ones

Energy

Environmental

Facilities

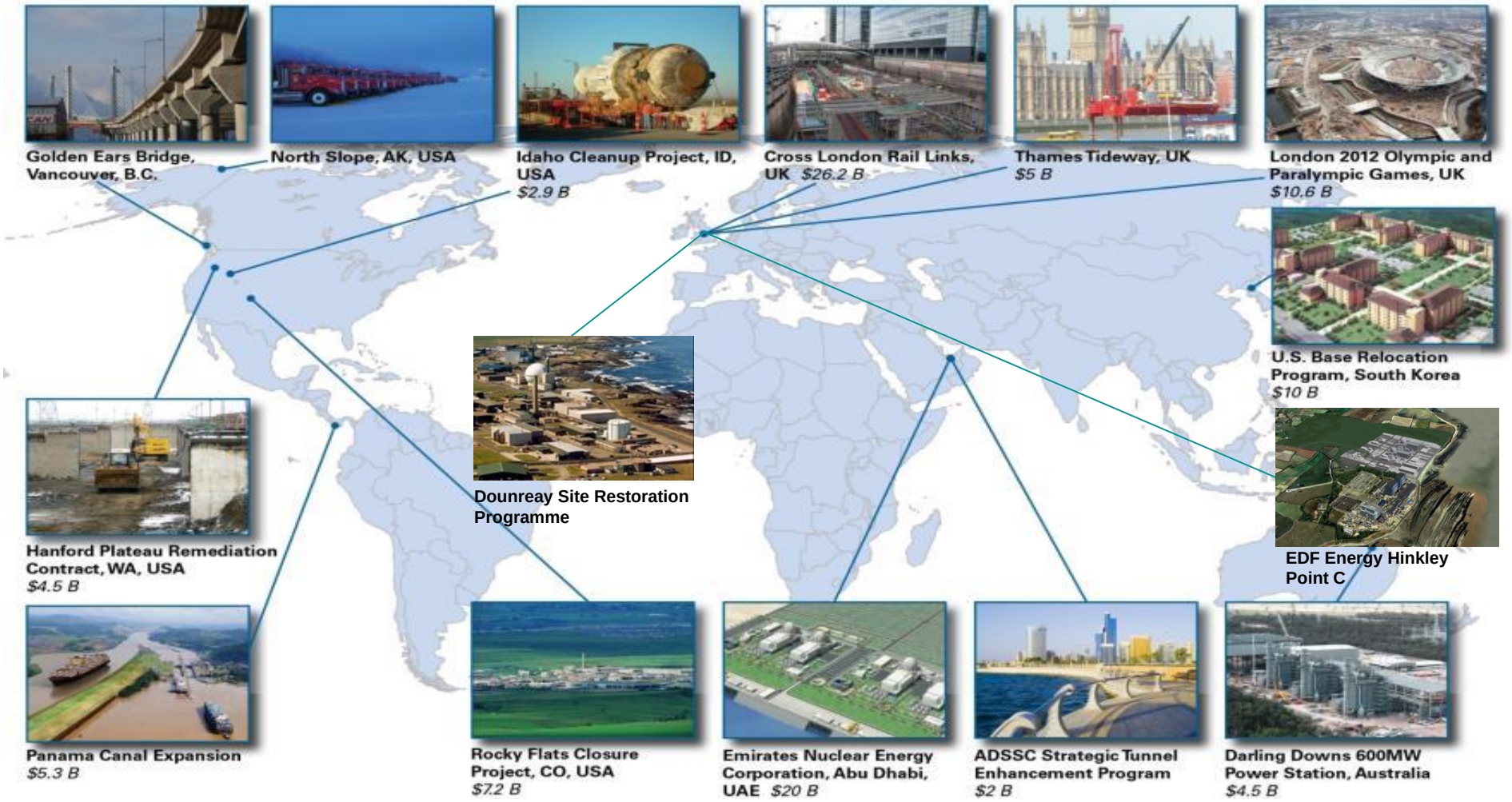
Resources

Transportation

Water

Nuclear

CH2M HILL manages large complex high profile programmes worldwide



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Context/ objective of study tour of Japan Nuclear

Context

- UK new build programmes gathering pace – 16GW by 2025
- Japan exhibits most efficient build programmes for new builds
- At the time Japan was in process of building 9 new reactors by 2020 and a further 14 by 2030
- Were operating 54 reactors with 18 being > 30 years or older

Tour objective

- Learn what is being done and how this can be translated into UK programmes
- Build relationships for potential business opportunities

Organisers

NIA and Constructing Excellence

Participants

Centrica, Balfour Vinci, Skanska, Keir, Synaps, HR Wallingford, DBD, Collaborative Working Centre, Ryder Levett Bucknall, Doosan Babcock and AMEC

Support from

The British Embassy and Mott MacDonald

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Visit schedule and participants

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Japan Briefing Structure of Japan's Nuclear Power Industry **Visit JAIF** Overview of Japan Nuclear Industry	**Visit Taisei** Overview and nuclear construction activities	**Visit Ohma** New build (J Power) MCW stage Single ABWR unit Started construction 2008	**Visit Shimzu** Overview and nuclear construction activities of particular note Seismic designs	**Round table** discussions with Japanese Industry
PM	**Visit Toshiba** • Overview of Toshiba and Isogo Engineering centre • Discussion of nuclear activities • Demonstration of design tools • See model of PWR, ABWR and 4S **Visit IHI** Observation of manufacturing of RPV, RCV and steam generators	Travel to Misawa	**Visit Higashi** Dori New build (TEP) EW stage Twin ABWRs 18m apart Started planning in 1993 1st concrete late 2012 **Visit JNFL** Rokkasho • Enrichment • Spent fuel storage • Reprocessing • Vitrification • MOX fabrication Travel back to Tokyo	**Embassy presentations**	2:46 M9.0 earth quake hits Fly out Sunday Morning

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Context and capabilities at the time

- Large nuclear operating base (54 reactors)
- Developing full fuel cycle capabilities all within Japan
- Fiercely competitive nuclear market and all levels and low margins claimed
  - Full and deep range of capabilities for new build activities all within Japan
  - 3 principal power generators that have nuclear capability - J Power*, TEP* and Kansai
  - 2 reactor technologies where being pursued from 3 technology suppliers - Toshiba (ABWR & PWR), Hitachi (ABWR) and MHI (PWR)
  - 5 prime contractor type organisations (Shimizu*, Taisei*, Obayahi, Nishimatsu & Kajima) all general contractors with nuclear capability and some international presence largely Asia
  - Clear drive to improve through technology and construction techniques
  - Largely relationship based business approaches
- Massive economic issues and looking to export way out with nuclear and rail
  - Where disappointed to loose Abu Dhabi leading to an industry cooperation group - ……
  - Export based approach being pursued with NEXI providing financing guarantees to support
  - Funding being provided by Mizuho, SMBC BTMU, JBIC
  - Targeting Vietnam, Jordan, Egypt and Turkey would like to see UK included (note Horizon)
- Shortage of nuclear engineers and difficulty in attracting young generation

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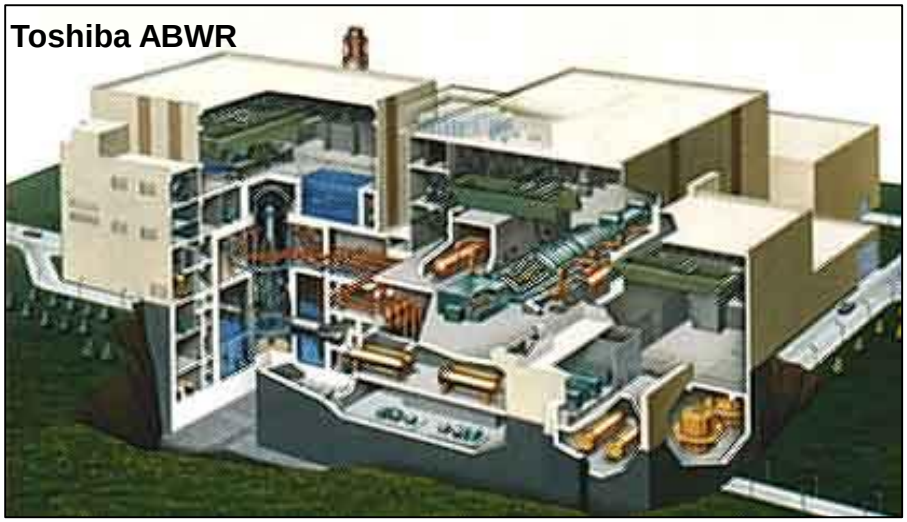
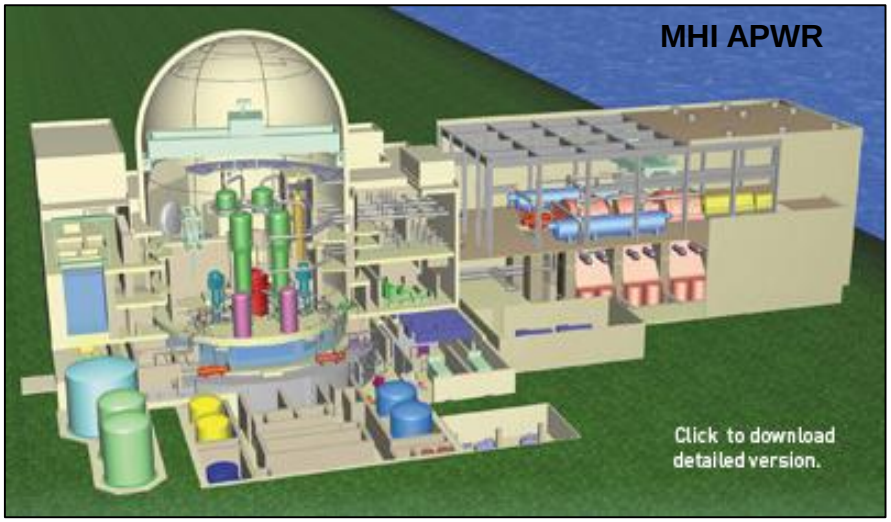
* All met in some manner

Japan's reactor types

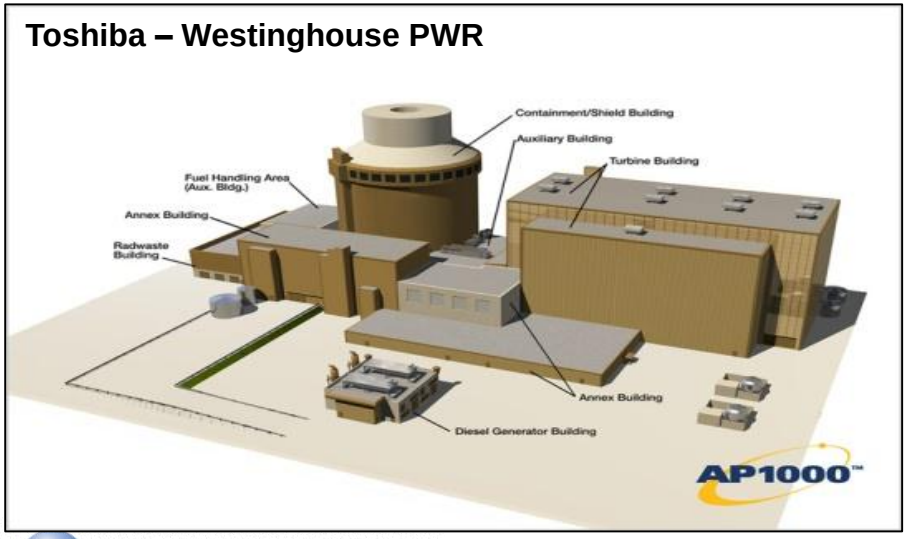
Toshiba ABWR



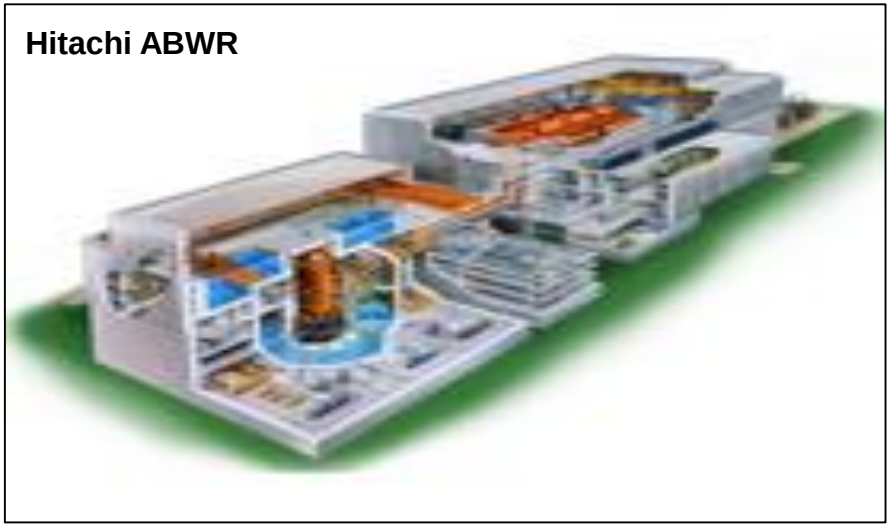
MHI APWR



Toshiba – Westinghouse PWR



Hitachi ABWR



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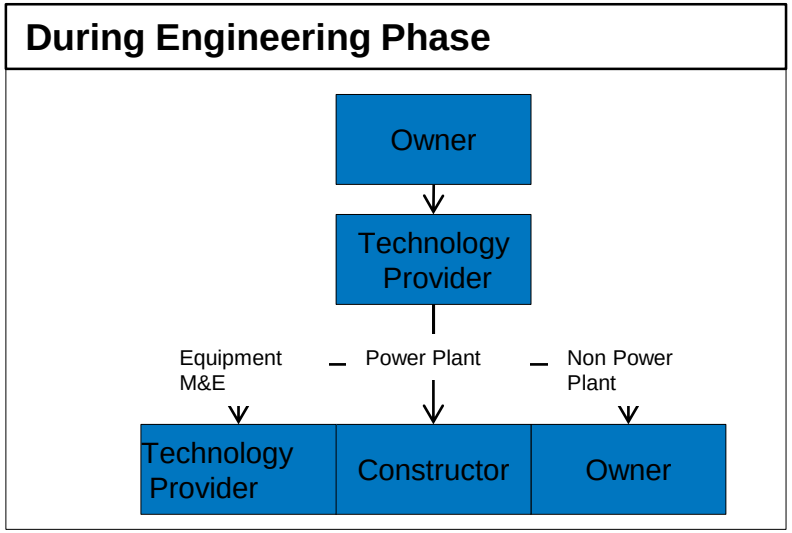
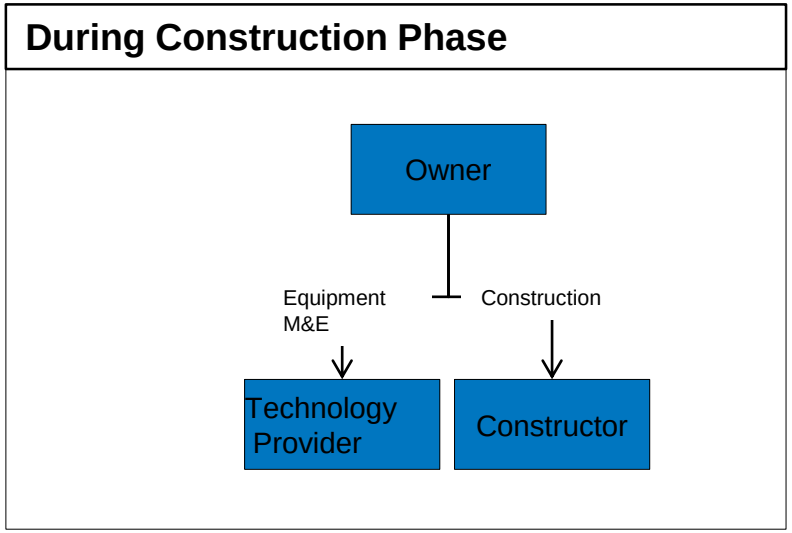
Typical structures deployed

- Mostly turn key (prime contracting model with JVs) including reactor vendors
- Lump sum/ fixed price with no share of savings with client
- Quality is a big focus
- Innovation seen as differentiator (0.5% of turn over spent)
- Beating the date is the mantra not simply achieving it
- Repeat business seen as the bedrock of Japanese business
- Relationship driven
- Punitive impact is seen as damaging relationships
- Huge emphasis on preplanning to infinite detail – but once they start on site very difficult to change anything.





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Engineering observations

- BWRs is a lot simpler than PWRs allowing greater simplification
  - Fewer major components (Piping, pumps, no Steam generators)
  - Reactor pressure vessel is lower pressure and can be manufactured in less specialised facilities
  - Reactor Island is more compact – making cranage and access easier.
- Client designs treated as design briefs
- O&M feed back taken into learning and future design
- Re-use of key design elements
- Designed and engineered to be built
- Integration of both Civil and M&E
- High use of information systems and design tools (e.g. 6D CAD)
- Close cooperation and information sharing between contributing entities
- Highly modularised in design
- Use of steel plate concrete solutions (easier to build)
- Have many Japanese standards (not internationally recognised)

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Construction observations

- Significant focus on construction planning and sequencing before construction starts (~1 year in planning activities)
- Construction and build:
  - Undertaken from inside out
  - Activities sought to be at ground level – “We avoid work at height- Toshiba
  - Seek to using large modularisation techniques
- Use of simulation and check builds (assemble in factory) before on site
- Build of permanent structures early to avoid temporary structures
- All contractors use same data tool/ systems
- Driving to 37* months construction timescale (note: lot done off site)
- Construct to print is quite a common approach
- Extensive multi-discipline modularisation with M&E and Civil contractors collaborating
- Drainage pipe work, cables and temporary flushing pipe work buried in base concrete to prevent construction openings being left open
- Using all weather construction temporary buildings over construction site – Nuclear Island was being built inside a massive temporary steel frame building
- Planned around weather constraints using all weather approaches

* This is from rock inspection to commercial operation (e.g. before rebar placement for base mat)

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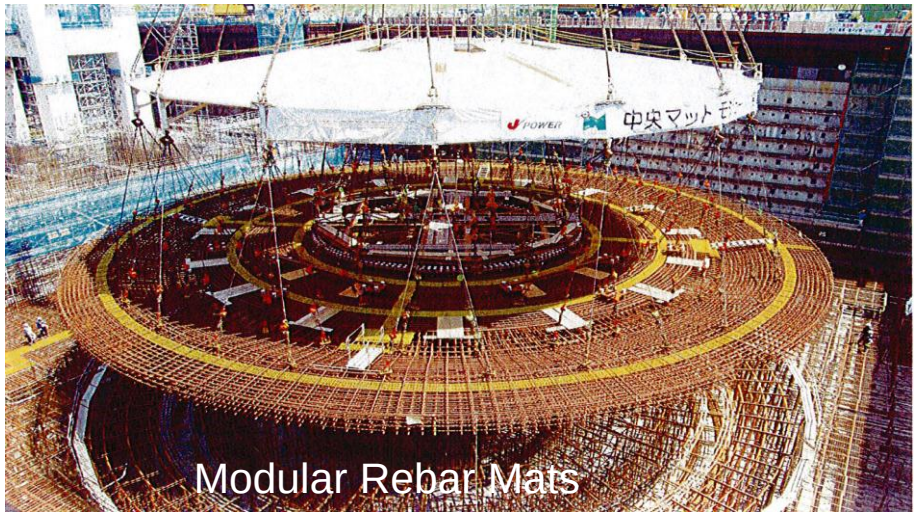
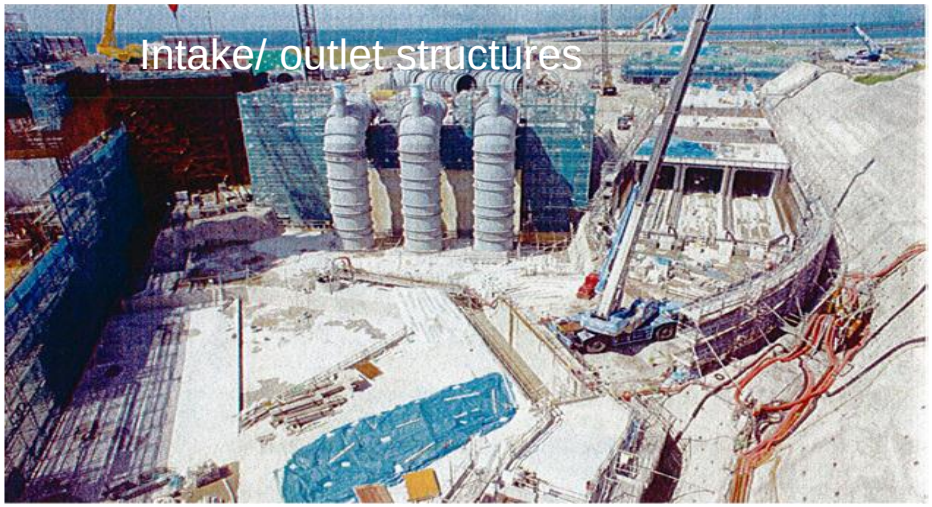
Some views



Modular Rebar Mats


Turbine/ generator structures


Large modular structures


Intake/ outlet structures

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Site management observations

- Infrastructure in place before construction starts
- Designed to be minimum time on site and do as little as possible on site
- Activities moved off site where plausible
- Very tidy organised sites
  - Temporary cables on racks off floor
  - Laydown areas racked
  - Very early metalled construction roads – even during earthworks
- Extensive use of modularised rebar cages.
  - Qualified techniques and tools for assembling cages and mats so they can be lifted.
  - Extensive use of engineered jigs (appear reusable for different sites) to enable lifting of rebar modules – eg base mat rebar lift and lift of reactor building containment roof rebar. rebar.
- Use of constructed “Harbours” for each site
- Use of very large cranes
- Not breaking ground in winter and weather pauses where appropriate

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Cultural observations

- Naturally collaborative despite contract and structure type
- Use of shared collaborative tools
- Data rich environment
- Highly visible metrics
- Morning briefing/ tool box talks to the team
- Rely on relationships primarily and they invest in this
- Shared focused on out turns to client
- Difficulty in reporting bad news as try to resolve
- A proud people and seek to be the best
- Deployed modern techniques
- Like and look for innovation

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Learning points from study tour

Have a clear robust strategies	The level of integration and the philosophy of the whole top to bottom process need to be based round clear policy aims and strategic thinking to achieve high levels of integration and collaboration with subsequent benefits.
Design for construction	Ensure the design process includes construction and commissioning considerations within the process. Designing simply for function and maintenance is not effective and will lead to non-productive sites. Take it into account at the beginning of the design life cycle not the end.
Integrate design	Design the whole, not just parts of; by integrated design elements e.g. civils and M&E. Out come will be simpler tidy designs that can be easily modularised and constructed (relatively).
Avoid temporary structures	Seek to avoid temporary structures developing a priority on establishing the permanent structures that could include key site buildings, roads, sewage etc.
Plan out and simulate	Don't rush into the build but plan it out and optimise sequencing. Simulate the construction process and optimise it before acting. Practice high challenge areas before reaching site if possible.
Construct from inside out	Sequence the construction from inside out rather than outside in or stuffing. Access is better and likely to be more productive.
Modularise construction	Seek to modularise the design and therefore construction. Seek to do as little on site as possible and as much in controllable environment as possible. Quality improves as does productivity.

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➢ ***All contribute to programme delivery certainty***

Observations from ENEC

- Demonstrated deliverability played a significant part in selection including in depth assessments
- Assumption of risk taken by plant vendor
- Vertical integration of supply chain
- Inclusion of constructability reviews early in the process
- Good/ realistic programme baselining with underpinning
- Integration of otherwise independent programme schedules
- Strict change control
- Pro-active corrective action
- Pro-active risk management including budget and schedule integration
- Implementation and disciplined use of forward looking project control tools
- Shared data environment (nothing hidden)

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➢ ***All contribute to programme delivery certainty***

Other world-wide observations

- Usually a clean sheet to start
- China and India have skilled labour in abundance and relatively cheap and readily deployable compared to the west
- Impacts unions?
- Construction safety standards not comparable
- Regulators new and developing – highly reliant on external methods
- Heavy reliance on design institutes
- Pre-selected construction companies
- Note Korea went from nothing to become nearly fully independent in NPP construction in about 20 years

➢ ***Probably help support programme delivery***

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Key characteristics in certainty of programme delivery

Many factors involved in delivering successful programmes but three key contributors CH2M HILL would argue are:

Establishing a Collaborative Environment	Developing Robust Programme/ Project Baseline	Controlling and Managing the Programme/ Project

• Culture and behaviours
• Vision and goals
• Charters
• Agreements
• Contracts
• Reward mechanisms
• Resolution process
• Selection processes
	• Strategies
	• Scopes
	• Boundaries
	• Assumptions
	• Structuring and packaging
	• Estimates
	• Underpinning
	• Optimisation
	• Accountabilities
	• Risk and allocations
	• Management processes
	• Information systems
		• **Don't start until ready**
		• **Rigor and pro-activeness**
		• Clear governance
		• Single source of truth
		• Scope control and change
		• Measuring, forecasting and trending
		  • Costs
		  • Timescales
		  • Risks
		• Reporting plan deviations
		• Corrective action

➢ ***Japan showed these qualities in abundance and recent programmes in UK demonstrate similar traits***

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Final thoughts – what can be done?

- How do we permit modern construction techniques to be used and encourage innovation – barriers seen as conservativeness driven by regulation
- European nuclear industry structuring- in that is the optimised? – observe significant vertical integration for complete NPP vs NI venders, largely small consultants and service providers ?
- Are the commercial approaches reflective of in encouraging collaborative behaviours – competition, more competition and then lump sum, transfer of inappropriate risk ……..
- Is programme/ project management deployed rigorously to structure, plan and pro-actively drive programmes to completion – is this appreciated?

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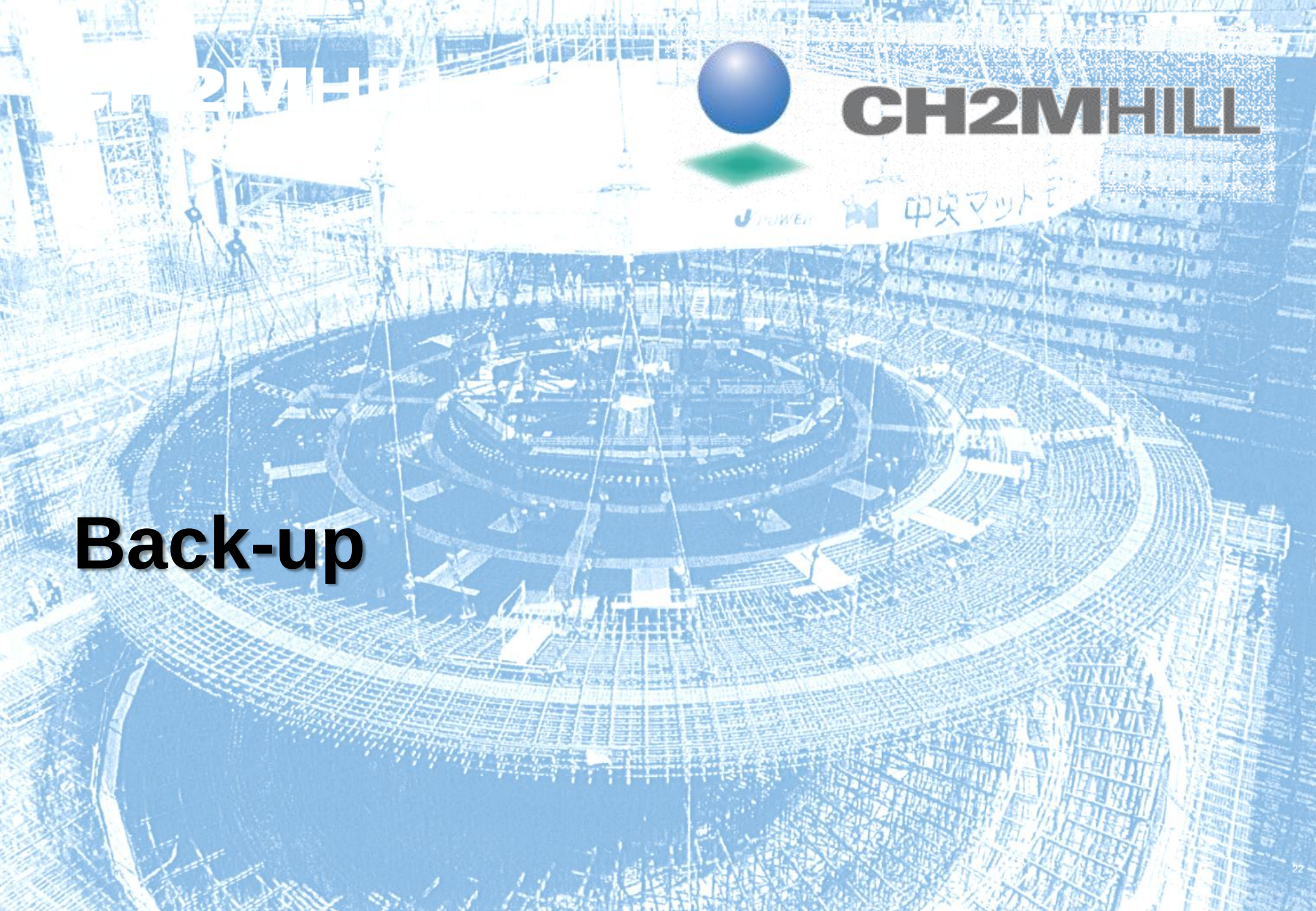

Back-up