FINNISH SUBCONTRACTING IN A FUTURE NUCLEAR POWER PLANT PROJECT

FinNuclear Ry

January 31rd, 2013

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PREFACE

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Finnish subcontracting in a future nuclear power project

FinNuclear ry has asked Pöyry Management Consulting Oy (Pöyry) to carry out a study to evaluate the opportunities and to recommend actions for the Finnish companies to strengthen their competitiveness to achieve more business from the future nuclear power plant project.

This document summarizes key findings and provides background for the establishing of a consortium in nuclear power industry. Pöyry has used its own expertise but also supportive interviews and expert meetings. As this report has been prepared specifically for the interests of a member of FinNuclear ry, the information may not be used out of context and has to be treated confidentially.

We thank FinNuclear ry project team for the excellent cooperation during the project, and trust that this work will support Finnish subcontractors to achieve more business from the future nuclear power project.

Olli Sipilä Jyrki Latvala

CONTENT

DEFINITIONS

BoP	Balance of Plant, all items typically not included in the Nuclear Island nor in the Turbine Island
CONSORTIUM	a coalition of separate companies to supply a full system to a NPP project
EPC-CONTRACTOR	a company contracted to provide engineering, procurement and construction services
HVAC	Heating, ventilation and air-conditioning
NDA	Non-disclosure agreement
NI	Nuclear island
OWNER	The power company/operator ordering the nuclear power plant
RFQ	Request for Quotation
SC	Safety Class
SUPPLIER	The Supplier is the party responsible for delivery of the NPP (NI- TI- or complete unit supplier)
SUBCONTRACTOR	Company furnishing materials, equipment or engineering services to the Supplier in the project
SYSTEM	An assembly of equipment and components, which constitute a technological entity capable of performing a specific function (or functions).
TI	Turbine Island
TURN-KEY CONTRACT	The plant is delivered in a completed state by the Supplier and the project is turned over to owner only once it is fully operational

EXECUTIVE SUMMARY

PROJECT OBJECTIVES

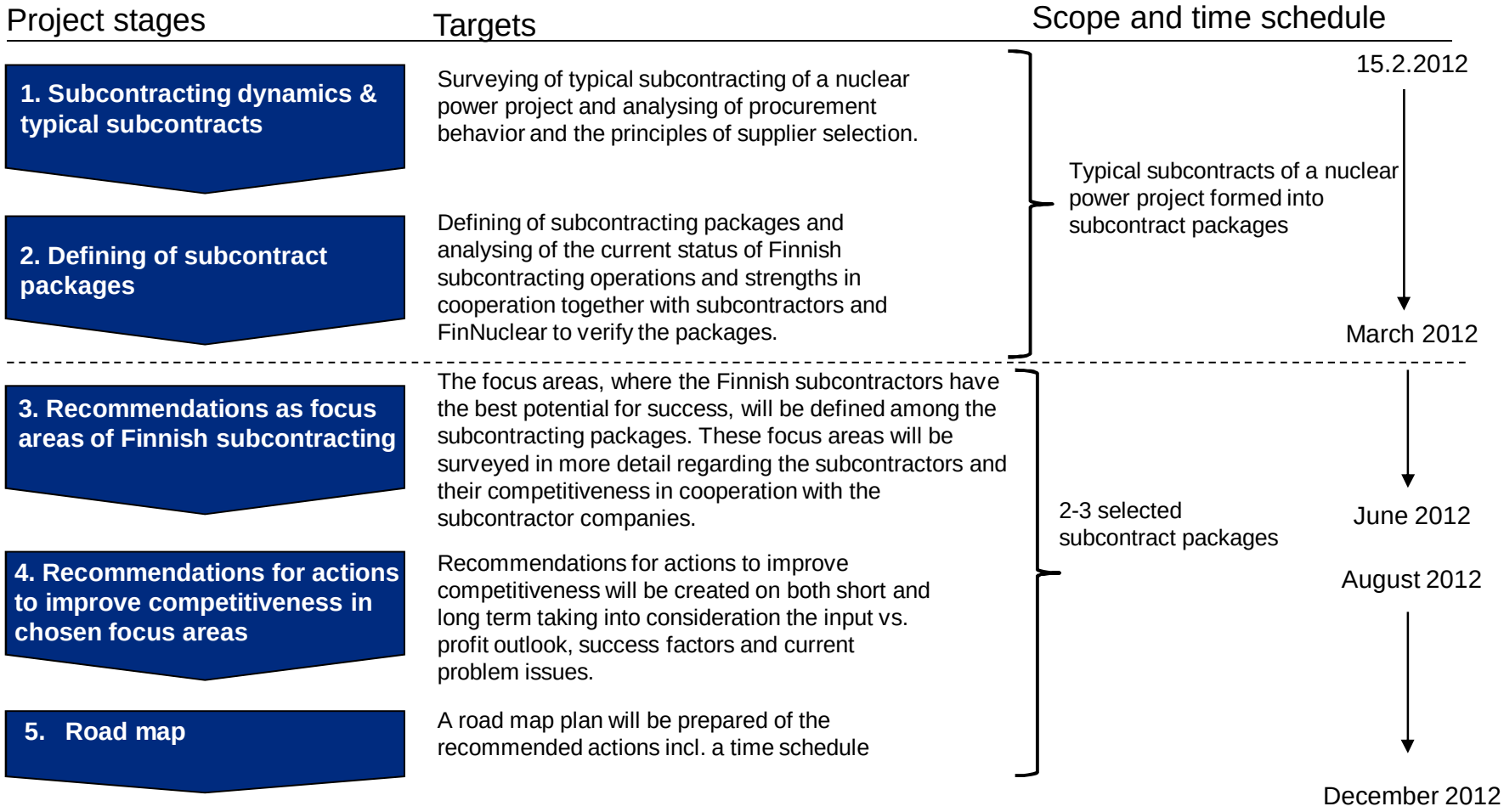
The main objective for the project was to find recommendations for actions to improve Finnish subcontractors' competitiveness in a future nuclear power plant project by clarifying the subcontracting packages where Finnish subcontractors have the best potential for success.

Project's intermediate targets:

- Surveying typical subcontracting of a nuclear power project
- Defining of 2-3 subcontracting packages as a focus areas, where the Finnish subcontractors have the best business potential for success
- A road map plan for the selected subcontracting packages including clarifications for the following topics:
  - the Finnish subcontractors on selected focus areas
  - means for a potential consortium or alliance models, taking into account potential partnerships with foreign companies
  - recommendations for the collaborative combinations on the selected focus areas with explanations and considering supplier's contractual liability and their dispensation of justice.
- Proposal for actions
  - clarification on products and concepts to improve competitiveness on both short (1-5 years) and long term (5-10 years) on the selected focus areas. Recommended action will be tested with a project interest group for getting feedback from potential subcontractors of their interest to develop business on selected focus areas

PROJECT APPROACH AND INTERMEDIATE TARGETS

The project was divided into five steps with their intermediate targets. After each step results were presented and approved by project steering group.



SUMMARY – FOCUS SYSTEM SELECTION

The most interesting systems were mainly selected due to their high delivery value with a good extension potential.

- The following five main criteria were used for selecting the focus areas for supply packages:
  1. delivery value > MEUR 10
  2. existing national supply to conventional or nuclear projects
  3. extension potential (other business sectors or European NPPS)
  4. capability
  5. other criteria: one full and partial delivery system were selected for further analysis
- There were 9 systems above the price of MEUR 10 which were selected for further ranking. Some systems were eliminated due to limited amount of potential Finnish suppliers (e.g. emergency diesel generators and lifting devices)
- After sales value has been estimated to follow a proportion of the delivery value. Decision of after sales services belongs to owner.
- Main cooling water system, piping and waste management were selected as a focus area, where the Finnish subcontractors have the best potential for success
- Piping was handled as a consortium including SC3 and EYT Piping, coating, piping supports and potentially insulation
- Waste management came up as an interesting potential future technology area, but it requires owner's support and co-operation with the concept design.
- Radiation protection and monitoring system as a combined supply package is a second option
- BoP as a large combined supply package could be supplied e.g. by some large Finnish construction company

SUMMARY – RECOMMENDED CONSORTIUM MODEL

In case the main subcontractors would not be found to lead the consortiums, an optional subcontractor pool consortium has been presented

Finding the main subcontractors for each selected system package is the most critical and challenging task in establishing consortiums in a large scale. As a backup option Pöyry has recommended two kinds of consortium models for each selected system. Consortium model principles are similar for all systems. These models are presented in more detail in this report.

Option 1 (Main subcontractor(s) found):

- The main subcontractor would be the leader (over 50% of project value) in a consortium and key interface with the supplier.
- In a piping and waste management consortium, the supply packages are divided into three main areas and thus there also would be three main subcontractors, but one of them will be the main contract partner (over 50% of project value) with buyer
- Serving the main subcontractors and under their responsibility would be a pool of sub contractors covering all other areas included in the consortium packages (e.g. detail engineering, material supplier, installation)

Option 2 (subcontractor consortium):

- All subcontracting, excluding main contracts, would be offered by the subcontractor pool
- One of the main subcontractors will be the main contract partner / coordinator
- Subcontractor pool would cover e.g. detail engineering, material supplier, installation

REQUIREMENTS FOR THE COMPETITIVE CONSORTIUM

Requirements from the supplier side based on the discussion with Areva, other suppliers' procurement principles might differ of these

Drivers	Requirements from the supplier (Areva interviewed)
Structure of consortium	• Consortium needs to have one leader which would be as a key contact and contractor for the supplier. • Its advisable that the largest company (and if possible has >50% share) is a leader in the consortium. • Normally 3-5 key consortium partners cover 70 % of a consortium's project value rest managed by sub contractors. • Consortium doesn't need to be own independent registered company. • Teaming up with European companies recommended to limit the risks and to increase competitiveness (Finnish supplier for lower SC's and European for higher ones). • Consortium agreement will be reviewed by supplier.
Size of consortium	• Suppliers don't have any requirements for a critical size for the consortium • Optimal amount of companies in the consortium is 2-4 key suppliers. • Size of consortium companies total turn over to be compared against the project value. Needs to be in a feasible proposition.

REQUIREMENTS FOR THE COMPETITIVE CONSORTIUM CONT.

Capability / references	• As Finland does not have a continuous NPP new build program, it is not reasonable to focus on SC2 (or higher) component manufacturing as this would require too high investments
	• Supplier qualify carefully consortium's nuclear and conventional project references.
	• Areva's procurement policy is to have full EPC service from Consortium, which means that Areva delivers only functional specification and basic/detail design will be done by Consortium
	• Selection criteria for the consortium
	  • References
	  • Number of consortium partners (to be limited to 3-5) and own share of consortium partners high (>70%)
	  • Organisation and division of responsibilities
	  • Realistic cost break down

Project management	• Liability, scheduling, document management, quality, organization, project management needs to be managed by the consortium • Needs to have clearly decided responsibilities, e.g. who has responsibility of delays • Consortium needs to have the common KPIs for the performance measuring • Cost breakdown requested from Consortium and supplier to review/approve it (mitigation of risk, e.g. enough engineering hours has been considered)

REQUIREMENTS FOR THE COMPETITIVE CONSORTIUM CONT.

Quality systems	• All companies in the consortium needs to have audited ISO9001 quality system, no need to launch own quality system for the consortium itself • Each activity (not only manufacturing facilities) will be audited by supplier, which means that the amount of companies in the consortium should not be extended too large. • Not any critical size of project value used when quality system should be in place?

SUMMARY - BUSINESS OPPORTUNITIES

A successful delivery with the established consortium in a nuclear power plant project can create new opportunities to continue the work in both domestic and international projects.

- The potential projects, where business opportunities for Finnish consortiums could exist are:
  - European countries and especially those located in the Northern Europe or Baltic countries would be most potential for extending the business.
  - Nuclear power is increasing rapidly in Middle East and it does not have existing capabilities for constructing nuclear power plants which is why it is found attractive.
- Piping consortium's strengths are in Northern Europe and in countries where the shipment of material is easy.
- The value of cooling water system depends on the location of the unit (e.g. whether direct or indirect cooling, single plant or multiple units which may have common cooling system etc.)
- Waste management system is more emphasized on the concept and not that dependent on the location of the unit, thus it has the largest extension potential.
- In addition to new nuclear power plant projects, consortiums may provide their services in other business sectors such as
  - Other power plants (Steam power plants, Thermal power plants, CHP-plants)
  - Industry (Metallurgy, Chemicals and petrochemicals, Paper and pulp)
  - Underground piping (Pipelines, District heating, Gas reservoirs and stations)

SUMMARY - ACTION PLAN / NEXT STEPS

The most critical task in establishing a consortium is to find the main subcontractors to the system-specific consortiums who will take a key responsibility there

- It is very important that the establishing of the consortium would be started as soon as possible, since companies are planning their budgets for 2013 and thus they need to take the development investment costs into account. Keeping this is mind, Pöyry has tried to get recommendations for the establishing of consortiums already in early autumn.
- Companies are rather sensitive to talk about of the consortium related issues on a public forum and thus system-specific groups within the members of FinNuclear should be launched.
- For getting an initial consortium group established, Pöyry recommend that FinNuclear send a letter asking companies' interest to join a system-specific meeting and also to indicate the system and specific area their companies would be the most interested in.
- Due to potential confidentiality issues within companies, it is recommended to ask companies to sign an NDA prior to more serious discussions in the sub group meetings.
- It is also critical for the consortium launching that the main system-specific subcontractors would be found as soon as possible. It became clear from the vendor interviews that the consortium needs to have just one interface towards the vendor.
- Discussions around the selected systems are to be continued in sub groups and as a first step they should clarify the coverage of their competence to fill the system offering. External companies are to be invited by sub group if needed.
- Pöyry sees that FinNuclear would have the key role in establishing of the consortium and should remain as an assembler in the process and market the consortium to potential vendors.

SUMMARY - ROAD MAP FOR CONSORTIUM DEVELOPMENT

It is essential to get consortiums established this autumn and introduced to the potential vendors by the end of this year

Main milestones	Key tasks	Timing
Workshop	**Introduce the project for potential FinNuclear participants**	September 5th
	Additional discussions & Internal decision to participate in a group	
Potential consortium group - FinNuclear members	**Sign NDAs** **Kick off the consortium group**	End of September
	Introduce potential consortium to vendors Discussions with potential "external" companies	
Potential consortium group – All participant	**Sign NDAs** **Kick off the final consortium group**	Mid-October
	Formulate & launch the consortium	
Consortium established	**Sign consortium agreements**	November
	Introduce consortium for supplier	
RFQ from vendor	**Prepare an offer**	Year 2013

DEFINING OF SUBCONTRACT FOCUS PACKAGES

APPROACH TO FIND SELECTED SYSTEMS

Approach for finding the key focus areas was an interactive process with the project steering group

Project steps	Main tasks / work method
Step 1: Identifying the nuclear power plant systems and components within the scope of the project	• List of typical subcontract systems under the safety class 3 and EYT in the nuclear power plant was created (long list in Excel). • Subcontracts were put to packages which represent specific systems • Systems were divided into two categories: full / partial delivery, depending on Finnish companies' delivery capability.
Step 2. Defining of subcontract packages	• The main drivers for defining the main focus areas were analysed: – delivery value > MEUR 10 – existing national supply to conventional or nuclear projects – extension potential (other business sectors or European NPPS) – capability – other criteria: one full and partial delivery system were selected for further analysis
Step 3. Recommendations as focus areas of Finnish subcontracting	• The 3 most potential systems were prioritized based on total scoring emerged by evaluating the drivers • Recommended focus area systems were presented and approved by project steering group

STEP 1 - LIST OF SYSTEMS

Nuclear power plant subcontracts were combined into around 30 different system packages from the safety class 3 and EYT

Systems (TI, NI and BoP) and partial components	System delivery	
	Full delivery	Partial delivery
Main cooling water system	x	x
Sampling system (module-delivery)	x	
Technical circle	x	
Clean water utility	x	
Sewage treatment and neutralising system	x	
Auxiliary boiler system OR Temporal heating system if layout allows (module-delivery)	x	x
Emergency power supply	x	
Pneumatic systems (module-delivery)	x	
Gas storage system	x	
Air removal system for steam turbine condenser (module delivery)	x	x
Chemicals feeding systems	x	
Drain collection systems	x	
SC3 and EYT Piping	x	
SC3 and EYT Painting and coating	x	
SC3 and EYT Piping supports	x	
SC3 and EYT Piping insulation	x	x
SC3 and EYT pumps	x	x
SC3 and EYT valves	x	x
SC3 and EYT heat exchangers, pre-heaters and containers	x	x
Fireprotection systems and fire fighting systems	x	x
Air-conditioning systems	x	
Waste management	x	
Condensate treatment system	x	
Condensator cleaning system	x	x
Lifting devices	x	
Laboratories	x	x
Radiation monitoring systems and equipment	x	x
Radiation protection of workers	x	x
Radiation monitoring in the environment of a nuclear power plant	x	
Steam generator blowdown demineralizing system	x	
Essential service water system	x	
Closed cooling water system (TI & NI separate)	x	

System delivery was divided into two categories

- Full delivery means that the system can be delivered by Finnish subcontractors and the components are manufactured in Finland
- Partial delivery means that the Finnish subcontractors can deliver the whole system, but some of the important components have to be supplied from abroad (e.g. main cooling water pumps)

The important components of the systems were identified to adjust the ranking

- For example IAEA TRS 396 “Economic Evaluations of Bids for Nuclear Power Plants” was considered
- Mainly safety class 3 and EYT components and equipment are included in the list

STEP 2 - SELECTED DRIVERS

Target was to find the focus areas from the turbine island sector having the project value over MEUR 50. Nuclear island was excluded mainly due to the demanding safety class, whereas in balance of plant the Finnish suppliers have already competitive advantage.

- Delivery value classification was done on a system level
  - 0: < 5 MEUR
  - 1: 5-10 MEUR
  - 2: 10-50 MEUR
  - 3: >50 MEUR
  - The values are preliminary and used just for guidance at this phase of the project
- Division of the system in the NPP
  - NI – Nuclear island
  - TI – Turbine island
  - BoP – Balance of Plant
  - This is not important in the ranking of the 2-3 systems, but it is most likely that the Finnish suppliers will have advantage in delivering systems that belong to BoP

STEP 2 - SELECTED DRIVERS

Future business opportunities for the selected system were evaluated in the other European countries, but also in other business sectors where existing or developed capability could be utilized.

- Extension potential was divided into two categories
  - Other business sectors – whether the systems (or consortium?) may be utilised in other business sectors or are they nuclear specific
  - European NPPs – whether it is likely and profitable to supply the systems or components further to Europe considering the existing local capacity in Europe. Two points were given to systems that can be supplied to whole Europe and one to the neighboring countries
- Capability
  - Existing capability means that there is already such capacity to supply the necessary system completely from Finland
  - Organic growth means that the company's own capability and capacity can be increased by additional investment
  - Acquisition means that some parts of the system require procurement from abroad
- Existing national supply was divided into two categories
  - Conventional – in SC 3 and EYT it is not required to have operating experience from NPPs, but proven technology from even conventional power plants have an advantage
  - Nuclear - the possibilities to be chosen as a supplier are higher since the quality has already been approved by STUK and other nuclear requirements

STEP 3 - IDENTIFYING THE 2-3 MOST POTENTIAL SYSTEMS – DRIVER PRIORITIZATION

Project delivery value was prioritized as the main driver when selecting systems for further analysis. Due to the project's pilot type of nature, different type of systems were emphasized.

Priority 1.	Delivery value > MEUR 10
	9 systems passed
Priority 2.	Existing national supply to conventional or nuclear projects
Priority 3.	Extension potential (other business sectors or European NPPS)
Priority 4.	Capability – Existing with a good growth opportunity (not just acquisition)
Other criteria	One full and partial delivery system will be selected for further analyzing
	System from NI or TI area – BoP systems will be supplied most likely by Finnish suppliers anyway

Selected 2-3 systems for further analyzing

DRIVER ANALYSES – EVALUATION OF DELIVERY VALUE

Nine systems have over MEUR 10 project delivery value and the highest, over MEUR 50 project value, would be in emergency power supply and piping.

Systems (TI, NI and BoP) and partial components	Delivery value classification				Rating	
	<5 [Me]	5-10 [Me]	10-50 [Me]	>50 [Me]	Low	High
Main cooling water system			x			
Sampling system (module-delivery)	x					
Technical circle	x					
Clean water utility	x					
Sewage treatment and neutralising system	x					
Auxiliary boiler system OR Temporal heating system if layout allows (module-delivery)	x					
Emergency power supply				x		
Pneumatic systems (module-delivery)	x					
Gas storage system	x					
Air removal system for steam turbine condenser (module delivery)	x					
Chemicals feeding systems	x					
Drain collection systems	x					
SC3 and EYT Piping				x		
SC3 and EYT Painting and coating	x					
SC3 and EYT Piping supports	x					
SC3 and EYT Piping insulation		x				
SC3 and EYT pumps			x			
SC3 and EYT valves			x			
SC3 and EYT heat exchangers, pre-heaters and containers			x			
Fireprotection systems and fire fighting systems		x				
Air-conditioning systems			x			
Waste management			x			
Condensate treatment system	x					
Condensator cleaning system	x					
Lifting devices			x			
Laboratories	x					
Radiation monitoring systems and equipment		x				
Radiation protection of workers	x					
Radiation monitoring in the environment of a nuclear power plant	x					
Steam generator blowdown demineralizing system	x					
Essential service water system	x					
Closed cooling water system (TI & NI separate)	x					

DRIVER ANALYSES – EVALUATION OF EXISTING NATIONAL SUPPLY

There are just a couple of systems where Finnish suppliers do not have existing experience of delivering to the nuclear or at least conventional power plant.

Systems (TI, NI and BoP) and partial components	Existing national supply		Rating	
	Conventional	Nuclear	Low	High
Main cooling water system	x			
Sampling system (module-delivery)	x			
Technical circle		x		
Clean water utility	x			
Sewage treatment and neutralising system	x			
Auxiliary boiler system OR Temporal heating system if layout allows (module-delivery)	x			
Emergency power supply	x			
Pneumatic systems (module-delivery)	x			
Gas storage system		x		
Air removal system for steam turbine condenser (module delivery)				
Chemicals feeding systems	x			
Drain collection systems		x		
SC3 and EYT Piping		x		
SC3 and EYT Painting and coating		x		
SC3 and EYT Piping supports		x		
SC3 and EYT Piping insulation		x		
SC3 and EYT pumps	x			
SC3 and EYT valves	x			
SC3 and EYT heat exchangers, pre-heaters and containers	x			
Fireprotection systems and fire fighting systems		x		
Air-conditioning systems	x			
Waste management		x		
Condensate treatment system	x			
Condensator cleaning system				
Lifting devices	x			
Laboratories	x			
Radiation monitoring systems and equipment		x		
Radiation protection of workers		x		
Radiation monitoring in the environment of a nuclear power plant		x		
Steam generator blowdown demineralizing system	x			
Essential service water system	x			
Closed cooling water system (TI & NI separate)	x			

DRIVER ANALYSES - EVALUATION OF EXTENSION POTENTIAL

Several systems have good business opportunities in European NPP projects and also in other sectors outside nuclear power.

Systems (TI, NI and BoP) and partial components	Extension potential		Rating		
	Other business sectors	European NPPs	Low	Medium	High
Main cooling water system	1	2			
Sampling system (module-delivery)	1	1			
Technical circle	1	0			
Clean water utility	1	2			
Sewage treatment and neutralising system	1	0			
Auxiliary boiler system OR Temporal heating system if layout allows (module-delivery)	1	2			
Emergency power supply	1	2			
Pneumatic systems (module-delivery)	1	0			
Gas storage system	1	0			
Air removal system for steam turbine condenser (module delivery)	1	0			
Chemicals feeding systems	1	0			
Drain collection systems	1	0			
SC3 and EYT Piping	1	2			
SC3 and EYT Painting and coating	1	0			
SC3 and EYT Piping supports	1	0			
SC3 and EYT Piping insulation	1	0			
SC3 and EYT pumps	1	1			
SC3 and EYT valves	1	1			
SC3 and EYT heat exchangers, pre-heaters and containers	1	0			
Fireprotection systems and fire fighting systems	1	0			
Air-conditioning systems	1	1			
Waste management	0	1			
Condensate treatment system	1	0			
Condensator cleaning system	1	0			
Lifting devices	1	2			
Laboratories	0	0			
Radiation monitoring systems and equipment	0	1			
Radiation protection of workers	1	2			
Radiation monitoring in the environment of a nuclear power plant	1	2			
Steam generator blowdown demineralizing system	0	1			
Essential service water system	1	1			
Closed cooling water system (TI & NI separate)	1	1			

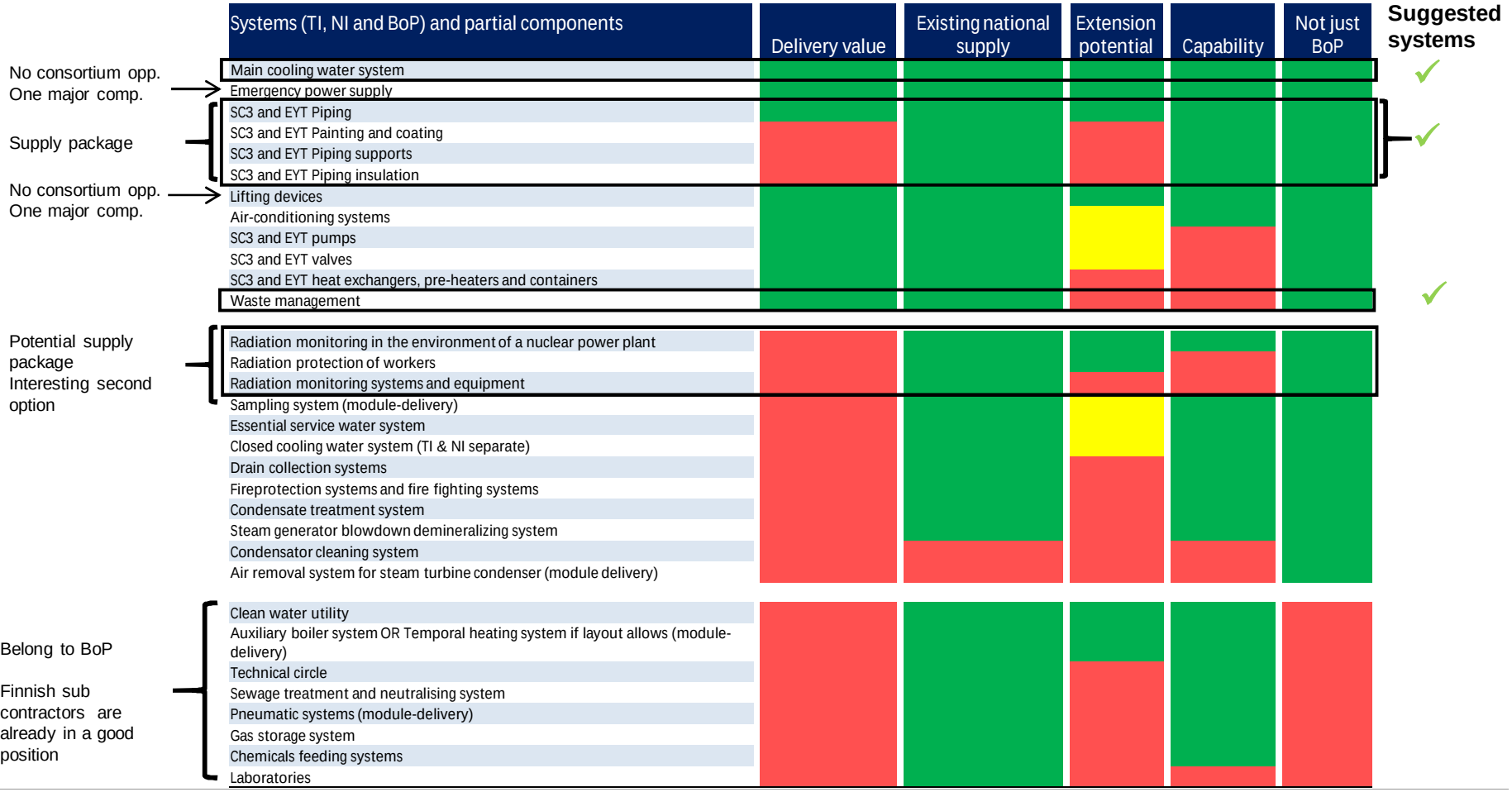
DRIVER ANALYSES - CAPABILITY EVALUATION

In most systems the Finnish suppliers have good existing capability to offer sub-contracting in future nuclear power plant projects.

Systems (TI, NI and BoP) and partial components	Capability			Rating	
	Existing capability	Organic growth	Acquisition	Low	High
Main cooling water system	x		x		
Sampling system (module-delivery)	x				
Technical circle	x				
Clean water utility	x				
Sewage treatment and neutralising system	x				
Auxiliary boiler system OR Temporal heating system if layout allows (module-delivery)	x		x		
Emergency power supply	x				
Pneumatic systems (module-delivery)	x				
Gas storage system	x				
Air removal system for steam turbine condenser (module delivery)			x		
Chemicals feeding systems	x				
Drain collection systems	x				
SC3 and EYT Piping		x			
SC3 and EYT Painting and coating	x				
SC3 and EYT Piping supports	x				
SC3 and EYT Piping insulation	x				
SC3 and EYT pumps			x		
SC3 and EYT valves			x		
SC3 and EYT heat exchangers, pre-heaters and containers			x		
Fireprotection systems and fire fighting systems	x				
Air-conditioning systems	x				
Waste management			x		
Condensate treatment system	x				
Condensator cleaning system			x		
Lifting devices	x				
Laboratories			x		
Radiation monitoring systems and equipment			x		
Radiation protection of workers			x		
Radiation monitoring in the environment of a nuclear power plant	x				
Steam generator blowdown demineralizing system	x				
Essential service water system	x				
Closed cooling water system (TI & NI separate)	x				

DRIVER ANALYSES - SUMMARY OF THE EVALUATION

In addition to the selected systems, there are several other interesting consortium opportunities such as air condition system and radiation monitoring.



SUMMARY - THE 3 MOST POTENTIAL SYSTEMS BASED ON TOTAL SCORING EMERGED BY EVALUATING THE DRIVERS

The most interesting systems were mainly selected due to their high delivery value with a good extension potential and need for different consortium model.

The selected systems:	Reason behind the selection
• Main cooling water system	• High delivery value • High extension potential • Several companies from different sectors to be included in a consortium
• Consortium - SC3 and EYT Piping, coating, piping supports and insulation	• High delivery value • A large supply package • Combines several companies from similar business sector
• Waste management	• High delivery value • Potential for innovative technology development • Several companies from different sectors to be included in a consortium

SELECTED SYSTEMS

PIPING

Scope and boundaries for the Finnish consortium

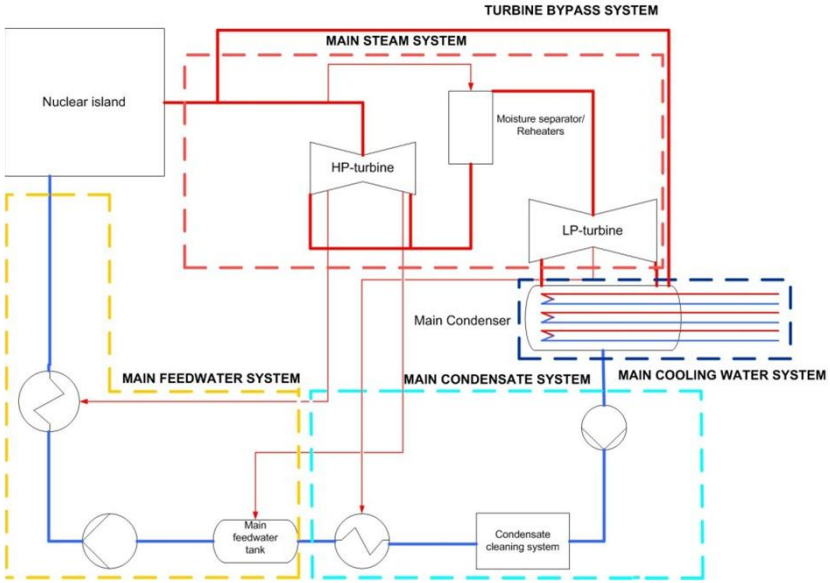
SCOPE AND BOUNDARIES

Piping consortium is divided into three large supply packages and those include all piping in TI which belongs to lower safety classes.

Scope

- All piping in NPP which belongs to lower safety classes. Some SC2 piping is included (parts of the Main feedwater system and Main steam system in BWR plants)
- Piping and supports prefabrication, installation (incl. valves and measuring devices), painting and coating, insulation
- Piping value chain covers all functions throughout the NPP lifecycle including pressure test and after sales
- The consortium shall include companies from different sectors like engineering, manufacturing and installation

MAIN PIPING IN TURBINE ISLAND



- Largest amount of SC3 and EYT piping is located in TI
- TI piping could be divided into large supply packages, for example to
  - Main steam system
  - Main cooling water system
  - Main condensate system
  - Main feedwater system

MAIN SC3 AND EYT PIPING IN NPPS

Parts of the main feedwater system and main steam system in BWR plants include some SC2 piping

PIPING SYSTEM	BUILDINGS	SAFETY CLASS	SIZE	MATERIALS, TYPES, OTHER	INTERFACE LIMITATIONS
Main steam system	TI/NI	3 (PWR) 2 (BWR)	DN800	Carbon steel, size depends of the amount of loops	Steam generator outlet-turbine inlet valves
Moisture separator steam piping	TI	EYT	DN500	Carbon steel	
Moisture separator drain piping	TI	EYT	DN400	Carbon steel	
Main feedwater system	TI/NI	3 (PWR) 2 (BWR)	DN900	Carbon steel, size depends of the amount of loops	Feedwater tank-steam generator inlet
Main condensate system	TI	3 or EYT	DN800-DN900	Carbon steel	
Turbine bypass system	TI	3	DN700	Carbon steel, size depends of the amount of loops	
Extraction steam system	TI	EYT	DN500-DN1200	Carbon steel	
Extraction drain system	TI	EYT	DN500	Carbon steel	
Main cooling water system					
Circulating water system	TI, BoP	3	DN2400-DN3000	Rubber lined carbon steel/fibreglass	
Service water system	TI, BoP	3	DN500-DN800	Rubber lined carbon steel	
Closed cooling water system	NI, TI, BoP	2, 3	DN25-DN700	Stainless steel	Safety class depends on the component connected
Auxiliary piping BoP	BoP	EYT	DN100-DN300		
Demineralized water piping	NI, TI, BoP	EYT	<DN200	Stainless steel	
Plant drainage piping	NI, TI, BoP	EYT	<DN200	Carbon steel	
Potable water	NI, TI, BoP	EYT	<DN100	Stainless steel/Plastic	
Gas piping	NI, TI, BoP	EYT	<DN100	Stainless Steel	
Pressurized air piping	NI, TI, BoP	EYT	<DN100	Stainless Steel	
Fire water piping	NI, TI, BoP	3, EYT	DN25-DN200	Stainless steel, fiberglass-composite pipes	Containment penetrations SC1
Chemicals feeding systems	NI, TI, BoP	3, EYT	<DN100	Stainless steel	
Chilled water systems	NI, TI, BoP	EYT	DN50-DN600	Carbon steel or stainless steel	
Radioactive waste management	NI, BoP	3, EYT			
Gaseous waste management piping	NI, BoP	3, EYT			
Liquid waste management piping	BoP	3, EYT			
Waste water management piping	NI, BoP	3, EYT	DN50-DN100		
Auxiliary boiler system piping	BoP	EYT		Carbon steel/stainless steel	Inside auxiliary boiler building

SUPPLY CHAIN

Highest delivery value for piping consortium is during the project delivery phase. After sales and maintenance contracts will be done by owner

Phase	Value	Supply packages	Comments
Design	High	Basic engineering Detail engineering	Depending on scope and safety class Customer interfaces (NI supplier, TI supplier, Owner…) In BoP most likely both done by same company, in TI and NI basic engineering might be done by the plant supplier
Manufacturing	High	Supports Piping pre-fabrication Insulation	SC always one lower than in the pipeline they're attached to Materials e.g. Stainless steel, (lined) carbon steel, fiberglass composite pipes Can be thousands of pieces
Installation	High	Supports Piping Piping components Insulations Painting and coating	Division to primary and secondary, can be connected to other structures by means of anchor plates or other fastenings Piping consortium installs also valves, measurement devices etc. Removable/reusable RMI-cassettes may be favoured inside the containment since they minimize the risk of screen and strainer blockage Outside containment work at a nuclear plant is more similar to work at a fossil-fueled power plant (materials eg. calsium silicate (major part), mineral wool and fibreglass on austenitic stainless steel pipes For pipelines and at least to all secondary supports
Maintenance	Medium	Painting and coating Insulations	To be confirmed whether it's separate contract
After sales	Low	Long term replacements	To be confirmed whether it's separate contract

PROCUREMENT PRINCIPLES

Owners most likely prefer turnkey contracts and the main contractor takes overall responsibility of procurement. The TI-contractor is typically in charge of TI-piping procurement.

Company	Main overall procurement principles	Piping procurement – typical approach
Fennovoima	Most likely turn-key contract (NI/TI contract) and main contractor takes responsibility of procurement	Most of the piping in Supplier's scope, owner procures just a minor part of scope (technical ring)
TVO	Most likely turn-key contract (NI/TI contract), main contractor takes responsibility of procurement	Most of the piping in Supplier's scope, owner procures just a minor part of scope (technical ring)
Areva	Delivery of NI, prefers component oriented procurement, existing supply chain	Procurement of TI-piping from TI-subcontractor
Toshiba	Engineering partner will most likely take overall responsibility of procurement, prefers modular procurement approach	Strong support to local companies in procurement, no existing supplier network in Europe

The consortium shall have one common quality system and one key counterparty towards the client.

INTERNATIONAL COMPETITORS

Main international competitors for the Finnish piping consortium are central European companies having large existing experience in NPP with a full delivery offering for the piping systems

Company	Country	Core business	Turnover (EUR)	Existing experience in NPP	Competitive assets
BIS VAM Anlagentechnik GmbH	Austria	industrial plant engineering and pipework construction as well as apparatuses, vessels and tanks	2,9 billion (BIS Group)	• Maasvlakte Power Plant 3 High pressure - Piping systems / The Nederlands • PP Westfalen – Generating unit D+E / Germany (Consortium MCE ET/BIS VAM) PP Neurath „BoA power plant units 2/3“ Generating unit F+G / Germany (Consortium MCE ET/ BIS VAM) PP Neurath „BoA power plant units 2/3“ Generating unit F+G / Germany • Olkiluoto 3 – NPP – Lot 3 / Finland	Full delivery • Detail engineering • Manufacture • Erection • Assembly • Commissioning Large company Partnerships Consortium experience
BHR Hochdruck-Rohrleitungsbau GmbH (joint Mannesmann Anlagenbau AG)	Germany	the construction of high-pressure pipes for water-steam circuits in power stations	n.a	• Not available • Olkiluoto 3. the piping systems for the reactor building and ancillary buildings.	Full delivery for the primary and secondary piping systems • Planning • Calculation • Construction • Procurement • Supply • Prefabrication • Assembly • Documentation
Montcommerce	Croatia		n.a.	• *Für „Kraftanlagen ARGE Olkiluoto 3“ München* Projekt „OL 3 Nuclear Island“ • *Für „BHR Hochdruck-Rohrleitungsbau GmbH“ Osterode* Projekt „OL 3 Nuclear Island“	

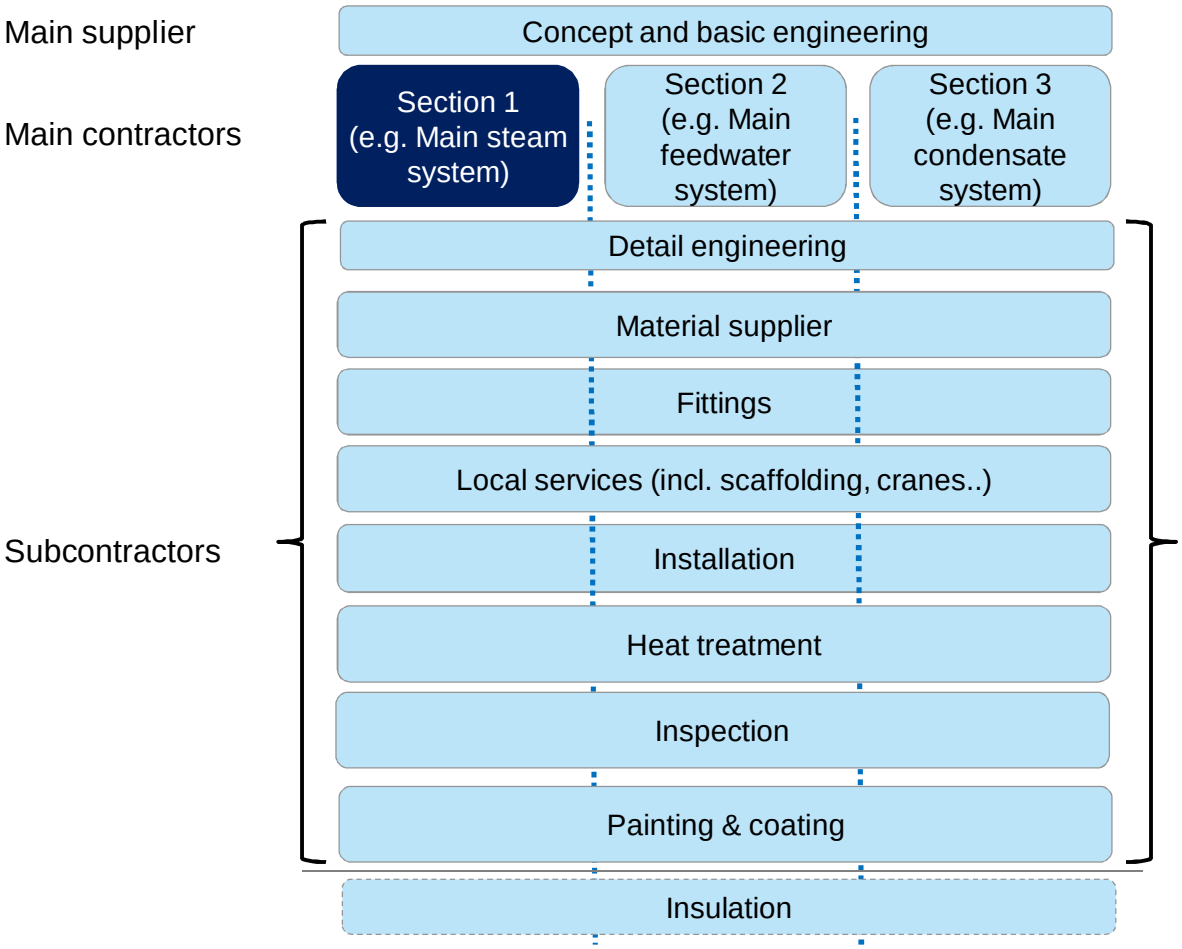
FINNISH VS. COMPETITORS

Main weaknesses of the Finnish suppliers are lack of capacity and supplier network, which are required for serving a large piping system package

	Strengths	Weaknesses
Finnish suppliers	Existing local manufacturing facilities within short delivery distance including materials Understanding the local requirements	Limited capacity and supplier network Lack of experience in SC1&2 piping Lack of experienced personnel (e.g. welders, inspectors…)
Competitors	Large capacity and supplier network Experienced and qualified suppliers	Getting qualified work force to Finland for relatively long period Understanding local requirements Distance from manufacturing facilities to Finland

CONSORTIUM MODEL FOR PIPING (OPTION 1)

In option 1, the main subcontractor would be the leader (over 50% of project value) in the consortium and a key interface with supplier.



Main responsibilities

- Prefabrication: pipes and pipe supports
- One of main subcontractors will be main contract partner

All subcontracting for piping consortium

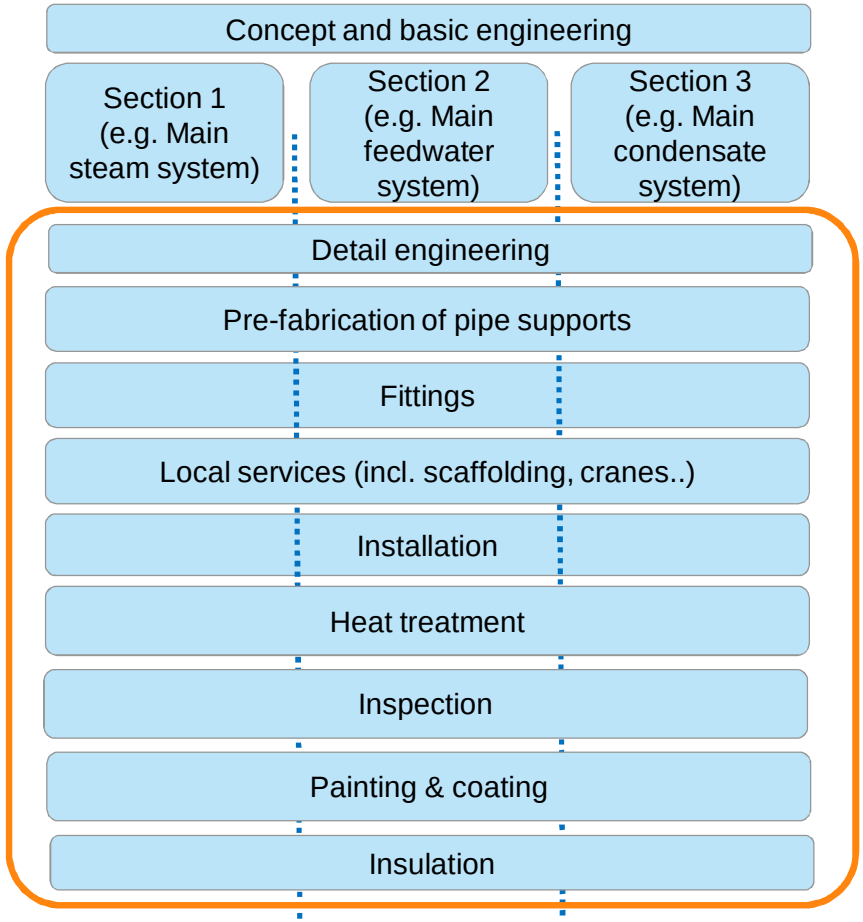
CONSORTIUM MODEL FOR PIPING (OPTION 2)

Option 2 represents a case where a Finnish main contractor(s) would not be found and the consortium would be built around the subcontractors serving potential foreign main contractor(s)

Main supplier

Main contractors

Subcontractors consortium



Main responsibilities

- Prefabrication: pipes

- All sub-contracting
- Prefabrication: pipe supports
- One of the subcontractors will be main contract partner

VALUE OF PIPING SUPPLY PACKAGES

The total value of the piping supply package is over MEUR 50, where material supplies and installation are the largest items

VALUE OF PIPING PACKAGES		~xx M€
Division of supply	**Details**	**%**
Materials	Including pipes, pipe supports and fittings[1)]	40-50
Design	Detail design, Including licensing documentation[2)]	5-10
Installation	Including heat treatment, painting and coating[3)]	20-30
Local services	including scaffolding, lifting	~3
Inspection	Covers the whole supply chain[1)]	5
Insulation	Can be separated from the supply package	15-20

[1)] Prefabrication included
[2)] Concept and basic design from the plant supplier
[3)] If any

The estimations vary depending on the scope of the supply packages

FINNISH SUBCONTRACTORS

There are a couple of potential Finnish companies having enough competitive assets to take a main contractor role in consortium

Company	Core business in piping	Size of business	Potential role in consortium	Competitive assests
Kraftanlagen	Piping, installation	366 M€	Main contractor	Existing nuclear experience world wide, existing supply chain
YIT	Piping, installation	2 333 M€	Main contractor	Existing nuclear experience, capasity of the company
Hollming works	Heavy sheet metal work, welding, machining, heat treatment, surface treatment and installation	55 M€	Subcontractor	Existing nuclear experience (nuclear related certificates and manufacturing licenses)
Technip	Welded structures	150 M€	Subcontractor	Existing nuclear experience
Ruukki	Materials	2 400 M€	Subcontractor	Existing nuclear experience
Outokumpu	Materials (SS)	4 229 M€	Subcontractor	Existing nuclear experience world wide
Bureau veritas	NDT inspection	8 M€	Subcontractor	Existing nuclear experience world wide
Dekra	NDT and DT inspections	2 000 M€	Subcontractor	Existing nuclear experience world wide
Högfors Oy	Butterfly valves	8,0 M€	Subcontractor	
Kymppi eristys	Insulation and scaffolding	23,4 M€	Subcontractor	
HL Insulation	Insulation, scaffolding	22 M€	Subcontractor	
Haapasaari Works	Welding works, process piping	4,2 M€	Subcontractor	
Telinekataja	Scaffolding		Subcontractor	Existing nuclear experience
Ramirent	Scaffolding	39,2 M€	Subcontractor	Existing nuclear experience
Heatmasters	Heat treatment	5 M€	Subcontractor	
Inspecta	Inspection	130 M€	Subcontractor	Existing nuclear experience world wide
Peikko	Fastenings, embedded parts for concrete connections	120 M€	Subcontractor	Existing nuclear experience
Halikko Group	Heat treatment, welding	20 M€	Subcontractor	Existing nuclear experience
Arme Oy	Insulation and scaffolding	20 M€	Subcontractor	
Leinolat Group	Pipes	25 M€	Subcontractor	
Karjalan konepaja/Karelia works	Manufacturing of welded steel constructions, surface treatment, installation	7 M€	Subcontractor	

SELECTED SYSTEMS

MAIN COOLING WATER SYSTEM

Scope and boundaries for the Finnish consortium

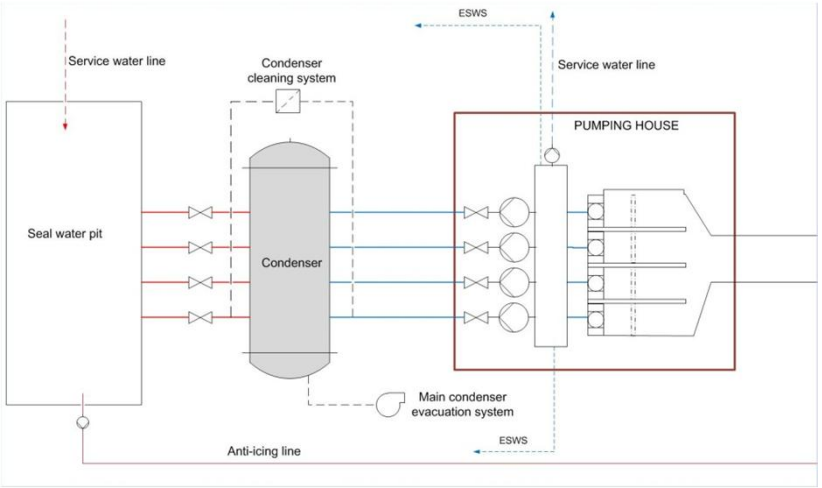
SCOPE AND BOUNDARIES

Main cooling water supply package requires expertise from several sectors and have interconnection with many other systems

Scope

- Safety class of the system and all components is limited to 3 and EYT
- Other cooling lines connected to main cooling water system in SC 2 excluded from the scope (e.g. essential service water system)
- Main parts of the system
  - Water intake structures
  - Pumping house
  - Outfall culvert
  - Anti-icing system
  - Components
    - Piping
    - Valves and Pumps
    - Screens
    - Sluice gates
    - Measuring devices
    - Cathodic protection

MAIN COOLING WATER SYSTEM



Interconnections with other systems

- Piping from piping consortium
- Civil works from construction consortium
  - Channels and tunnels
  - Pumping house
  - Underground pipelines, water basins
  - Water intake structures

MORE DETAILED LISTING OF COMPONENTS

Due to a rather complex supply package, the list of required components and materials is also long

MAIN COOLING WATER SYSTEM	INTERFACE LIMITATIONS	SAFETY CLASS	MATERIALS, TYPES, OTHER	POSSIBLE FINNISH SUPPLIER
Water intake structures	Owner	EYT		
Floating pontoons		EYT	For e.g. oil prevention	
Coarse screen		EYT		Hollming Works, Technip
Construction (dredging, tunnels etc.)		EYT		Destia, YIT
Pumping house	Owner or TI supplier	EYT		
Equalising pond		EYT		
			Amount of pumps usually 3-4 (vertical concrete pumps)	
Circulating water pumps		3		Flowserve (foreign)
Driver		3	Electric motor, fixed speed	ABB, Siemens
Drum screen/fine screen		3		MKP-RIP Teräs Oy
Device for measuring the level of filtered water inside filter (I&C)		3		
Three-speed rotating drive device		3		
Chain filter/basket filter		3		MKP-RIP Teräs Oy
Device for measuring the level of filtered water inside filter (I&C)		3		
Two-speed rotating drive device		3		
Washing stations for filter panels		EYT		
Low-pressure pump		EYT		
High-pressure pump		EYT		
Fixed pre-filtering grids		EYT		
Device for measuring the head loss		EYT		
Sluice gates		EYT		MKP-RIP Teräs Oy
Piping	Owner & TI supplier	3, EYT		Hollming Works, Technip
Fibre glass piping		3	DN3000	
Rubber coated steel piping		3	DN2000-DN2400	Hollming works, YIT, Technip, Kraftanlagen?
Piping supports		EYT		Peikko, Hollming works, YIT, Technip, Kraftanlagen
Coating/painting		EYT		Teknos
Expansion joints		3		
Vents and drains		EYT	DN50-DN200, including small valves	
Valves	Owner & TI supplier	3		
Pump discharge valve and actuator		3		Metso
Butterfly valves		3	DN80-800 controll valve and On/OFF valve	Högfors Oy, Metso
Cathodic protection	Owner & TI supplier	EYT		Savcor, Lein Oy
Measuring devices	TI supplier	3		
Temperature measurement		3		
Pressure measurement		3		
Surface level measurement		3		
Outfall culvert	Owner	EYT	DN3300 concrete pipe, underground routing	Destia, YIT
Construction		EYT		
Seal water pit		EYT		
Tunnels		EYT		
Anti-icing system		EYT		
Rubber coated steel piping		EYT	DN800-DN2000	Hollming works, YIT, Technip, Kraftanlagen
Pumps		EYT	Vertical, 3x50%	KSB, Sulzer
Butterfly valves		EYT		Metso
Check valves		EYT		Metso
Pressure measurement		EYT		
Temperature measurement		EYT		
Construction (tunnels)				Destia, YIT

SUPPLY CHAIN

There are also good business opportunities after the project delivery due to the many replaceable components included in the supply package

Phase	Value	Supply packages	Comments
Design	High	Basic engineering Detail engineering	Most likely both done by the same supplier
Manufacturing	High	Piping pre-fabrication Pumps, valves, screens, steel structures, measurement devices	Materials e.g. Stainless steel, (lined) carbon steel, fiberglass composite pipes
Installation	High	Piping Piping components Painting and coating Pumps, valves, screens, steel structures, measurement devices	Piping forms a major part of the systems installation. It is expected that the system supplier will purchase the piping from the piping consortium
Maintenance	Medium	Components Painting and coating	Many replaceable components included in the supply package (filters, valves, electrical devices) To be confirmed whether it is a separate contract
After sales	Medium	Components Long term replacements	Many replaceable components included in the supply package (filters, valves, electrical devices) To be confirmed whether it is a separate contract

PROCUREMENT PRINCIPLES

The main cooling water system typically belonged to the TI-suppliers' scope, but willingness for outsourcing exists

Company	Main overall procurement principles	Main cooling water system procurement – typical approach
Fennovoima	Most likely turn-key contract (NI/TI contract) and main contractor takes responsibility of procurement	Most likely the main cooling water system in TI Supplier's scope, owner 's scope underground works
TVO	Most likely turn-key contract (NI/TI contract), main contractor takes responsibility of procurement	Most likely the main cooling water system in TI Supplier's scope, owner's scope underground works
Areva	Delivery of NI, prefers component oriented procurement, existing supply chain	Most likely the main cooling water system in TI Supplier's scope
Toshiba	Engineering partner will most likely take overall responsibility of procurement, prefers modular system-oriented procurement approach	Strong support to local companies in procurement, no existing supplier network in Europe

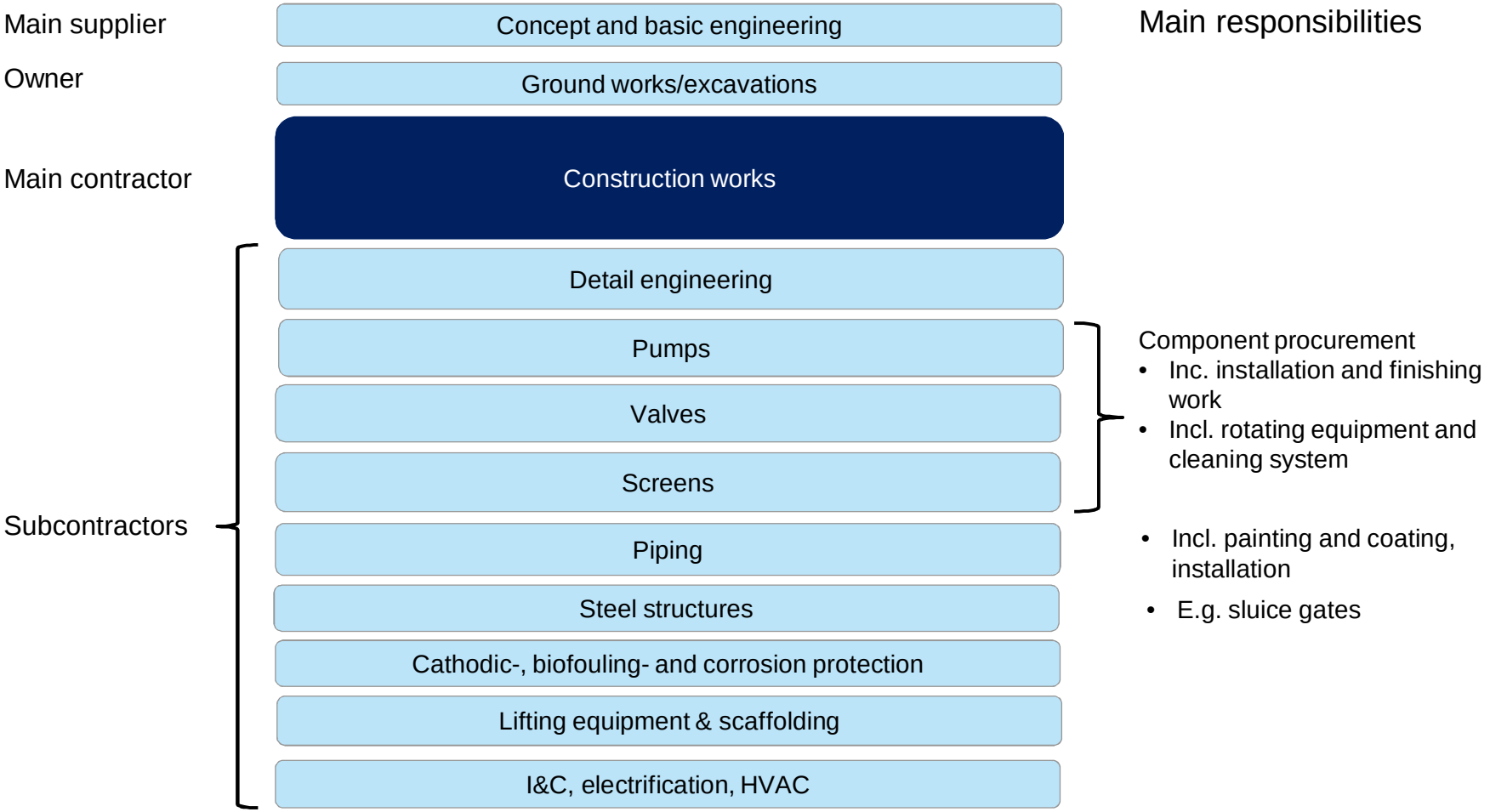
FINNISH VS. COMPETITORS

Main international competitors for Finnish companies are large European EPC-contractors with existing experience of consortium models, delivery capacity and supplier network

	Strenghts	Weaknesses
Finnish suppliers	Existing local civil construction capacity Understanding the local requirements Knowledge of environmental conditions	Limited capacity and supplier network Lack of experience in consortium model
Competitors	Large capacity and supplier network Experienced and qualified suppliers	Understanding local requirements and environmental conditions

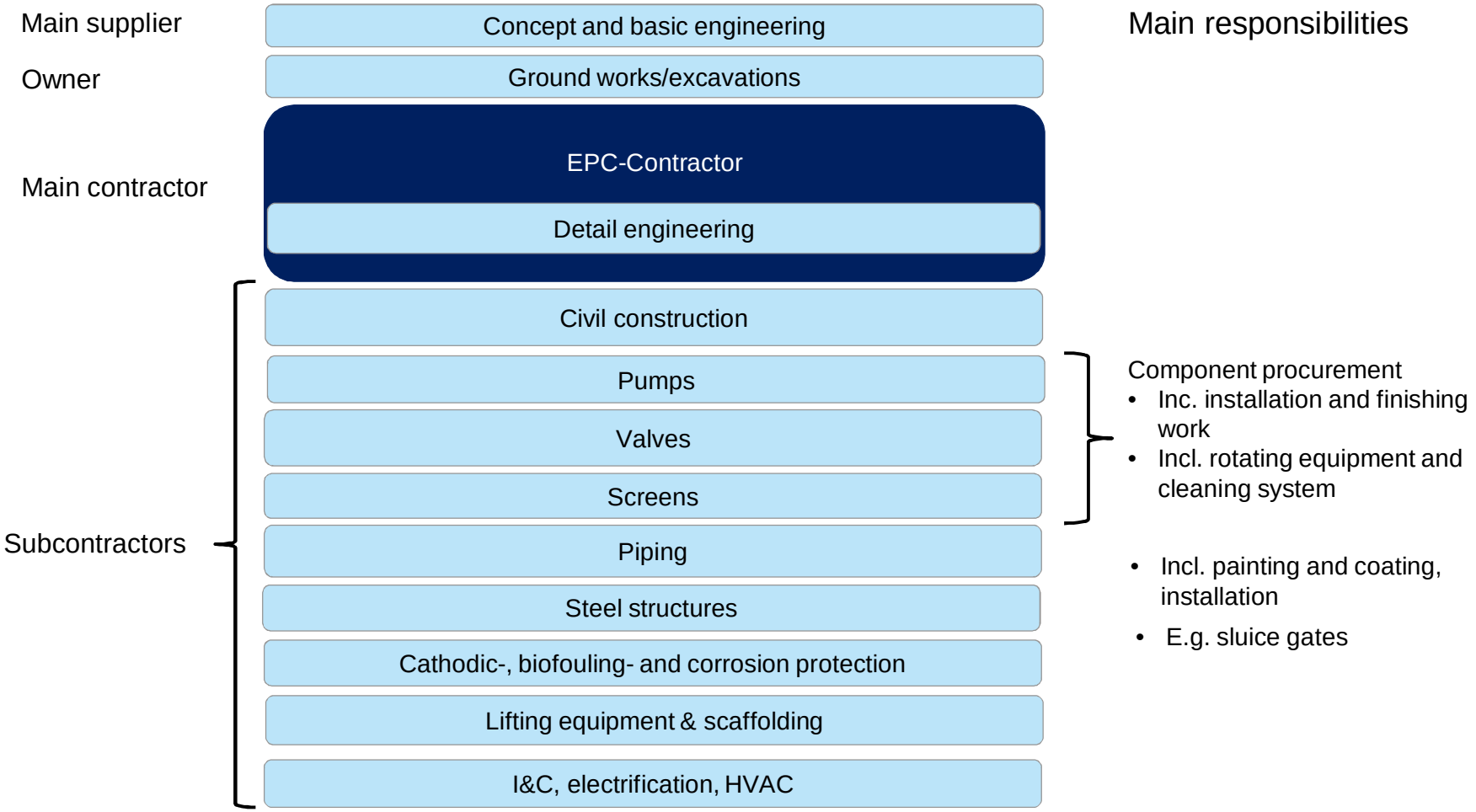
CONSORTIUM MODEL FOR COOLING WATER SYSTEM (OPTION 1)

Due to a large share of construction work in the supply package, it would be natural to have a construction company as the main contractor in a consortium



CONSORTIUM MODEL FOR COOLING WATER SYSTEM (OPTION 2)

In option 2, EPC-Contractor would be the main contractor in a consortium and a key interface with supplier.



VALUE OF MAIN COOLING WATER SUPPLY PACKAGE

The total value of main cooling water supply package is over MEUR 50, but enclosing underground structures of the service water systems (NI and TI) could add even > MEUR 20 to the total value (value depends on the plant concept and layout)

TOTAL VALUE OF THE SYSTEM (rough estimation)		~50 M€[3)]
Division of supply	**Details**	**%**
Civil works	Pump station, outlet structures[1)]	50-60
Components	Pipes, pumps, filtering equipment, cranes, HVAC	30-40
Electrical and I&C		1
Installation	Process and mechanical	5
Design	Detail and basic engineering, including licensing documentation [2)]	5-10

[1)] Civil works including supporting steel structures and concrete structures
[2)] Concept design from the plant supplier
[3)] Ground works and excavations not included in the estimation

FINNISH SUBCONTRACTORS

Some Finnish construction or engineering companies could have enough competitive assets to take the main contractor's role in the main cooling water consortium

Company	Core business in cooling water system	Size of business	Potential role in consortium	Competitive assests
YIT	Construction, installation	2 333 M€	Main contractor	Existing nuclear experience, capasity of the company
Hollming works	Heavy sheet metal work, welding, machining, heat treatment, surface treatment and installation	55 M€	Subcontractor	Existing nuclear experience (nuclear related certificates and manufacturing licenses)
Technip	Welded structures	150 M€	Subcontractor	Existing nuclear experience
Ruukki	Materials	2 400 M€	Subcontractor	Existing nuclear experience
Outokumpu	Materials (SS)	4 229 M€	Subcontractor	Existing nuclear experience world wide
Metso, Högfors Oy	Valves		Subcontractor	
Dekra	NDT and DT inspections	2 000 M€	Subcontractor	Existing nuclear experience world wide
Destia	Ground works	198 M€	Subcontractor	
MIK-RIP Teräs Oy	Manufacturing and installation of screens, filters and sluice gates	1 M€	Subcontractor	
Leion	Cathodic protection	137 000 €	Subcontractor	
Ramirent	Scaffolding	39,2 M€	Subcontractor	Existing nuclear experience
			Subcontractor	
Inspecta	Inspection	130 M€	Subcontractor	Existing nuclear experience world wide
Peikko	Fastenings, embedded parts for concrete connections	120 M€	Subcontractor	Existing nuclear experience
Halikko Group	Heat treatment, welding	20 M€	Subcontractor	Existing nuclear experience
Arme Oy	Insulation and scaffolding	20 M€	Subcontractor	
Leinolat Group	Pipes	25 M€	Subcontractor	
Kraftanlagen	Piping, installation	366 M€	Main contractor	Existing nuclear experience world wide, existing supply chain
Karjalan konepaja/Karelia works	Manufacturing of welded steel constructions, surface treatment, installation	7 M€	Subcontractor	

SELECTED SYSTEMS

WASTE MANAGEMENT SYSTEM

Scope and boundaries for the Finnish consortium

SCOPE AND BOUNDARIES

There are different waste management systems depending on owner's preferences and experience on existing facilities, which affects also the scope and boundaries of the supply package

Scope:

- Waste water management
- Liquid waste management
- Solid waste management
- Gaseous waste management
- Decontamination system
- Auxiliary systems such as:
  - Handling, lifting and transport equipment
  - Waste tracking
  - Grouting system
  - Radiation monitoring systems
  - Waste packing system
  - Auxiliaries

Open areas in the scope:

- Size of the structures depends on:
  - The amount of waste produced (reactor type and plant design)
  - If some operations are out of scope (e.g. solidification), much smaller structures may be required
  - Some waste management functions may be integrated to other buildings
- Differences of the customer
  - Owner's existing facilities (e.g. liquid waste conditioning) in the site?
  - Owner's preferences with the waste management system
  - Plant supplier's existing experience

MORE DETAILED LISTING OF COMPONENTS

WASTE MANAGEMENT SYSTEMS	INTERFACE LIMITATIONS	SAFETY CLASS	MATERIALS, TYPES, OTHER	POSSIBLE FINNISH SUPPLIER
	Plant systems producing/collecting radioactive			
Waste water management	waste waters	SC3, EYT		Siemens Oy, Galvatek, Elomatic (engineering)
Filters				Watman, Hyxo, Parker
Column filters			SS-vessels with internal structures	Watman, Hyxo, Parker
	Alternative to reverse osmosis (partly also to			
Cartridge filters	ion exchangers)		SS-vessels with replaceable cantridges	Watman, Hyxo, Parker
Ion exchangers			deep-bed and pre-coat	Japrotek, Watman, Hyxo
Columns			SS-vessels with internal structures	Japrotek, Watman, Hyxo
Resins			bead & powder resins, support media	Finex
Charcoal filters	Not included in all plant designs			Japrotek, Hyxo
Columns			SS-vessels with internal structures	Japrotek, Hyxo
Charcoal media			granulated activated charcoal	Hyxo
Reverse osmosis system	Alternative to evaporator		A complete autonomous system	Watman, HOH Separtec, Hyxo
				Japrotek, Sahala Works, Hyxo, Galvatek, GEA
Evaporator			Heat exchanger, compressor, material is special SS alloy	Process Engineering, FläktWoods
				Japrotek, Technip Offshore Finland, YIT, Estanc,
Tanks			From small vessels to large storage tanks	AJ-Metals and many others
Piping			All SS, mostly sizes DN50 - DN100	West Welding, Kraftanlagen
Valves			All SS, mostly sizes DN50 – DN800	Högfors Oy, Metso Automation, Danfoss Suomi
Pumps			ALL with SS base, sizes DN50 - DN100	Sulzer Pumps Finland, Grundfos, Danfoss
	Systems producing radioactive ion exchange			
Liquid waste management	resins and evaporator concentrates	SC3, EYT		Galvatek, Elomatic (engineering)
				Japrotek, Technip Offshore Finland, YIT, Estanc,
Tanks and other process equipment			As for waste water management	AJ-Metals and many others
Packing and storage equipment			Various mechanical equipment for manoeuvring waste packages	
Drying equipment	Alternative to solidification facility			
Solidification facility	Alternative to drying equipment		Tailor-made special design, solidification media e.g. cement or bitum	
In-line mixing equipment	Altenative to in-container mixing equipment		key komponent is the mixer itself	No
In-container mixing equipment	Alternative to in-line mixing equipment		incredients dosing system, mixer turning, etc.	Engineering: Fortum, Platom
			A system to cast clean concrete cap or encapsulate waste (basically a	
Grouting system		EYT	small concrete station)	
Solid waste management		SC3, EYT		
			Various mechanical equipment for manoeuvring waste and waste	
Packing equipment			packages	
Sorting equipment			Sorting tables, glove boxes	
Volume reduction equipment				
Compactor			Standard waste baler or compactor	Kapasity
Cutting equipment			Band saw, alligator shear, etc.	Maxtec
Shredding equipment			Standard waste shredder, e.g. Weima	Tana, Kapacity, Enerec, Vimelco
Gaseous waste management	Plant ventilation system	SC3, EYT	Typically not integrated with other waste management facilities	
Recombinator			Hydrogen/oxygen	Chemitec Consulting (catalyst), Japrotek (vessels)
Activated charcoal (decay) adsorbers	Solid waste management			Japrotek (vessels)
HEPA-filters	Solid waste management			M-Filter, Airfil, Ilma-Arena
Drier	Waste water management			
Tanks	Waste water management		for drains, condensate	Japrotek, Technip, YIT, Estanc, AJ-Metals...

MORE DETAILED LISTING OF COMPONENTS

WASTE MANAGEMENT SYSTEMS	INTERFACE LIMITATIONS	SAFETY CLASS	MATERIALS, TYPES, OTHER	POSSIBLE FINNISH SUPPLIER
Handling, lifting and transport equipment		EYT		
Overhead cranes				Konecranes
Forklift trucks				Konecranes
Transport packages			Over-packs for intermediate level waste packages	Siimet
Other transport and lifting equipment			Carriage, tractor, lifting auxiliaries, etc.	Konecranes, Siimet
Waste tracking		SC3, EYT		
Waste sampling equipment				Mirion Technologies (RADOS), Kytölä
Process measurement equipment				Mirion Technologies (RADOS), Kytölä
Waste package characterization equipment				Mirion Technologies (RADOS)
Free-release measurement equipment				Mirion Technologies (RADOS)
Laboratory equipment				Mirion Technologies (RADOS)
Labeling and record keeping system				Fortum
Radiation monitoring system		SC3, EYT		
Monitoring equipment of discharges/releases				Mirion Technologies (RADOS), Kytölä
Process monitoring equipment				Mirion Technologies (RADOS)
Room monitoring equipment				Mirion Technologies (RADOS)
Personnel monitoring equipment				Mirion Technologies (RADOS), Ekonia
Vehicles monitoring equipment				Mirion Technologies (RADOS), Ekonia
Environments monitoring equipment				Mirion Technologies (RADOS), Ekonia
Auxiliaries				
I&C and control room		SC3, EYT		Metso Automation, Etteplant, Siemens Oy
Ventilation	incl. tank ventilation	SC3		Leinolat Group, FläktWoods, Airfil, Parker (not known if these can deliver SC3 systems)
Drains		SC3		West Welding, Kraftanlagen
Conventional HVAC systems		EYT		Leinolat Group, Elomatic (engineering)
Security and access control equipment				Tamtron Group, Flexim Security
Fire protection equipment				HB Paloturva, Marioff Corporation (fire suppression systems), Kraftanlagen ARGE Olkiluoto 3, Flexim Security
Decontamination		EYT		Conlog Group
Washing/high-pressure washing equipment				Finnsonic (ultrasoundwashers)
Chemical and electro-chemical baths				Many
Media blasting				Finnblast, Rowema
Waste packages				
LLW packages	primary package		most likely reinforced concrete, with or without sacrificial mixer	Many
ILW packages	primary package		most likely reinforced concrete, with or without sacrificial mixer	Many
Standard drums	secondary package		standard 200 l drum	Schütz Nordic AS (no manufacturers in Finland?)

SUPPLY CHAIN

In the waste management system, there are good business opportunities throughout the nuclear power plant's life cycle

Phase	Value	Supply packages	Comments
Design	High	Basic engineering Detail engineering	Amount of "expertise engineering" depends somewhat on the approach: e.g. tailor-made/BAT or existing design (could be somewhat obsolete) Also large amount of "conventional" design (civil, auxiliaries, piping, process, etc.) is required
Manufacturing	High	Piping Tanks Equipment	Materials mainly stainless steel
Installation	High	Piping Tanks Equipment	Piping is expected to be purchased from the piping consortium
Maintenance	High	Components and equipment Usage Calibration	Many replaceable components included in the supply package Outsourcing of functions
After sales	High	Components Technology development	Many replaceable components included in the supply package To be confirmed whether after sales will be done in separate contract

PROCUREMENT PRINCIPLES

Owner's preferences with the waste management system affect on selected solution; however, the main contractor takes overall responsibility of procurement

Company	Main overall procurement principles	Waste management procurement – typical approach
Fennovoima	Most likely turn-key contract (NI/TI contract), main contractor takes responsibility of procurement	New company: not yet established
TVO	Most likely turn-key contract (NI/TI contract), main contractor takes responsibility of procurement	No specific approach: open for the contractor to propose/arrange? Known interfaces enable disintegrated approach
Areva	Delivery of NI, prefers component oriented procurement, existing supply chain	Long-term partnerships emphasized which gives advantage to existing partners although some partners have failed and may be rejected. All waste components, piping, etc. procured externally
Toshiba	Engineering partner will most likely take overall responsibility of procurement, prefers modular procurement approach	Westinghouse (Sweden) expected to take responsibility of waste management related deliveries. This could lead to opportunities to local suppliers. Advantage if existing modules available.

INTERNATIONAL COMPETITORS

Main international competitors for the Finnish waste management consortium are large EPC-contractors with extensive experience in nuclear business

Company	Country	Core business	Turnover (EUR)	Existing experience in NPP	Competitive assets
Energy Solutions	USA	Services for the decommissioning and remediation of nuclear sites and facilities, management of spent nuclear fuel, the transportation of nuclear material and the environmental cleanup of nuclear legacy sites	117 M€	Extensive experience especially in the USA	KEPCO contractor in UAE
Nukem Technologies	Germany	Management of radioactive waste and spent fuel, decommissioning of nuclear facilities, engineering and consulting	770 M€	International extensive experience in waste management	World leading radwaste management specialist
Westinghouse Electric Sweden	Sweden	Supplier of nuclear fuel and components, plant upgrades including nuclear automation	300 M€	Experience from Swedish and Finnish NPPs	Owned by Toshiba
AMEC	UK	Consultancy, engineering and project management services to its customers in the world's oil and gas, minerals and metals, clean energy, environment and infrastructure markets	4045 M€	International extensive experience in nuclear business	Extensive resources
JGC	Japan	Consulting, planning, basic and detailed design, materials and equipment procurement, construction, commissioning, operation and maintenance, Investment, technology development services	4150 M€	Extensive experience in radwaste management in Japan	Extensive resources

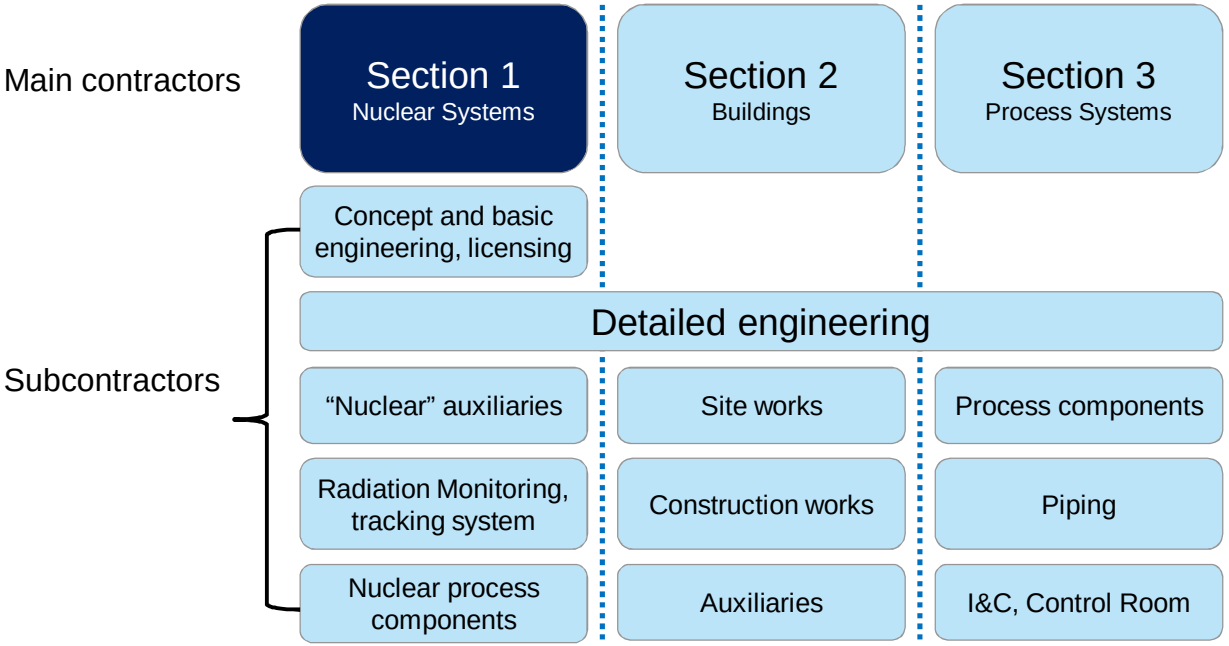
FINNISH VS. COMPETITORS

Main strengths for the Finnish suppliers include good understanding of local conditions and ability to support after construction period

	Strengths	Weaknesses
Finnish suppliers	Good understanding of local conditions, including regulations Established local resources Support organization available after project realization No responsibilities in other similar projects > good availability	No existing alliances with reactor suppliers Limited experience in nuclear field No existing designs, e.g. modules to offer
Competitors	Existing alliances with reactor suppliers (“Why fix it if ain’t broken?”) Existing design, e.g. modules available	Limited ability to support after construction period Overlapping similar projects may limit resources Limited understanding of local conditions, e.g. regulation (if not involved with OL3)

CONSORTIUM MODEL FOR WASTE WATER MANAGEMENT (OPTION 1)

Due to a demanding nuclear system expertise requirement in the supply package, it would be natural to have a waste management specialist company as the main subcontractor in the consortium



Main responsibilities

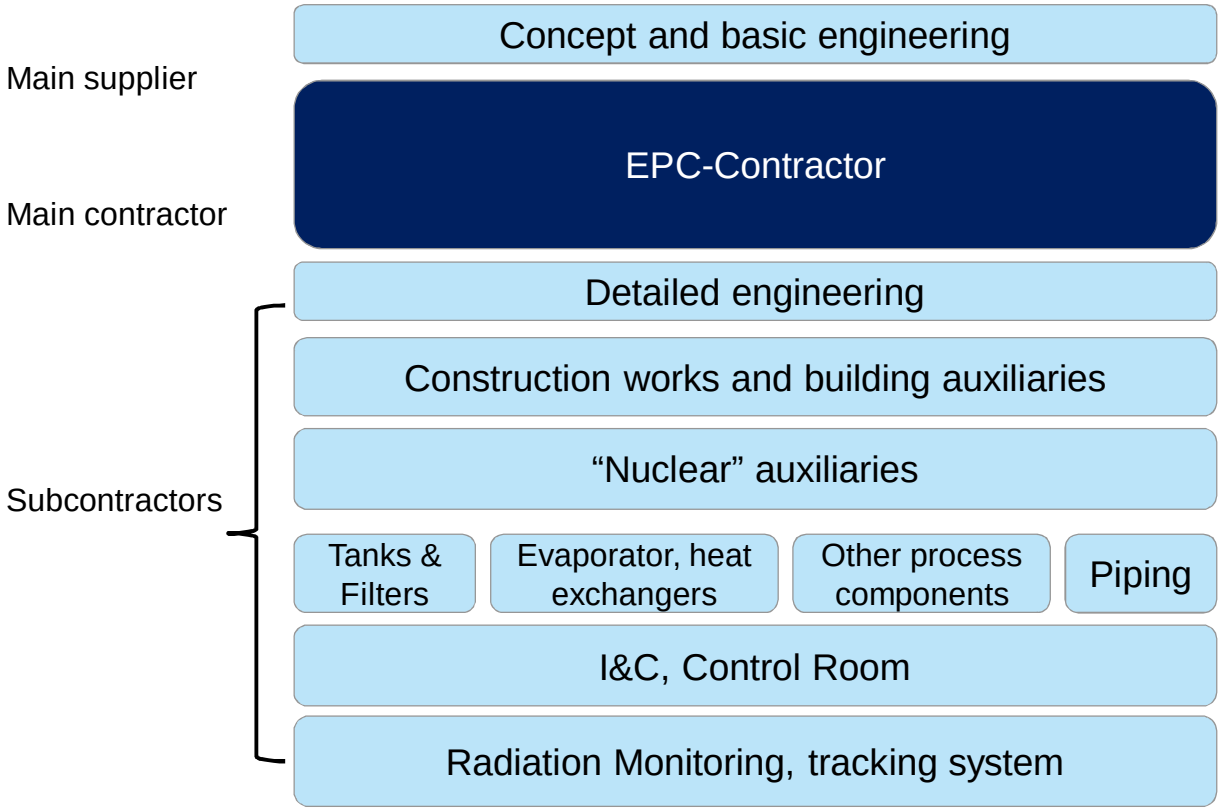
- Each contractor would have an EPC responsibility of the dedicated scope
- Section 1 contractor expected to take leader role

- Technologies, layout, PI&D, licensing, etc.

Waste water management is selected for the most potential and separate supply package, since the solid waste management value is relatively small and the gaseous waste management system will most likely be a separate supply package.

CONSORTIUM MODEL FOR WASTE WATER MANAGEMENT (OPTION 2)

In option 2, EPC-Contractor would be the main contractor in the consortium and key interface with the supplier.



Main responsibilities

- Technologies, layout, PI&D, licensing, etc.

- One of main subcontractors will be the main contract partner
- Main contractor could form a consortium to form main supplier
- Building, piping, HVAC, etc.

- Buildings, HVAC, lighting, security, etc.
- Controlled area drainage, ventilation, etc.

- Delivery of process components

- Design and delivery of process control, control of “nuclear” auxiliaries
- Area, personnel, waste, process monitoring, database & tracking

VALUE OF WASTE WATER MANAGEMENT SYSTEM

The total value of main waste water management supply package is in the range of MEUR 25-60, but depends highly on owner's preferences

TOTAL VALUE OF THE SYSTEM (rough estimation)		~25 – 60 M€[3)]
Division of supply	**Details**	**%**
Civil works	Processing plant, storage facilities[1)]	10 – 15 %
Building auxiliaries	HVAC, power supply, lighting, etc.	10 %
Process systems	Water cleaning equipment, tanks, pipes, pumps, etc. (max. figure includes solidification, minimum drying) [2)]	40-50%
Other systems	I&C, control room, security, radiation control and monitoring	10 %
Design	Basic and detailed design (nuclear & non-nuclear	15 %
Other	Project management, QA/QC, licensing support, supervision, 3rd party cost	10 %

1) Ground works and excavations not included in the estimation (assumed client's scope)
2) Solidification covers the largest value, but can be easily limited out of the scope, but minimum drying is required in liquid waste management
3) Scope of supply covers the nuclear waste water management system (both treatment and storage) and liquid waste management (solidification or drying)

FINNISH SUBCONTRACTORS

There are a couple of potential Finnish companies with enough competitive assets to take the main contractor's role in the consortium

Company	Core business in waste water management	Size of business	Potential role in consortium	Competitive assets
YIT	Civil and process desing, project management	4 400 M€	Main contractor or leader in consortium	26 000
Empower	Process, I&C, etc design, project management	405	Main contractor or leader in consortium	3300
Fortum Power	Nuclear engineering	1 700 M€	Subcontractor	1700
Mirion	Radiation monitoring, dosimeters	?	Subcontractor	One of 2 biggest operators in the world
Japrotek	Process design, tanks, evaporators, heat exchangers, piping	15 M€	Subcontractor	70
Technip Offshore	Tanks and steelworks	150 M€	Subcontractor	800
Sahala Works	Heat exchangers, evaporators	18 M€	Subcontractor	Ability to construct large components 230
Siemens Osakeyhtiö	I&C, control room	287 M€	Subcontractor	640
West Welding	Heat exchangers, piping	15 M€	Subcontractor	85
Kraftanlagen	Piping	366 M€	Subcontractor	2300
Metso Automation	I&C, control room	6 600 M€	Subcontrator	+30 000
Etteplan	I&C, control room	99 M€	Subcontractor	1700
ÅF Consult	I&C, control room	570 M€	Subcontractor	200
All large construction companies, e.g. NCC, SRV, Skanska	Civil design, project management		Main contractor or leader in consortium	

SELECTED SYSTEMS

BUSINESS OPPORTUNITIES AND NEEDED DEVELOPMENT ACTIONS

BUSINESS OPPORTUNITIES AND NEEDED DEVELOPMENT ACTIONS

A successful delivery with the established consortium in a nuclear power plant project can create new opportunities to continue the work in both domestic and international projects.

- Piping consortium's strengths are in Northern Europe and in countries close to Finland due to local manufacturing and labor.
- The advantage of going to other countries with the main cooling water system is a well organized and effective project completion. It shall be noted that in central Europe and warmer countries it is more common to have different solutions for main cooling system (e.g. cooling towers) which may have some impact on the financial relationships inside the consortium.
- The first step for the waste management consortium to enter the markets is to have a clear solution for waste water management system which they can promote, or they should create their plans based on existing design from the utility.
- In addition to new nuclear power plant projects, consortiums may provide their services in other business sectors such as
  - Other power plants (Steam power plants, Thermal power plants, CHP-plants)
  - Industry (Metallurgy, Chemicals and petrochemicals, Paper and pulp)
  - Underground piping (Pipelines, District heating, Gas reservoirs and stations)
- The following tables presents potential projects, where business opportunities for Finnish consortiums could exist.
  - European countries and especially those located in the Northern Europe or Baltic countries would be most potential for extending the business.
  - Nuclear power is increasing rapidly in Middle East and it does not have existing capabilities for constructing nuclear power plants which is why it is found attractive.

ON-GOING NUCLEAR POWER PLANT PROJECTS IN EUROPE

The following countries have on-going new nuclear power plant projects and these countries have already established nuclear infrastructure, but this does not necessarily weaken Finnish consortiums' possibilities in the project, since the capacity required is large if the projects start simultaneously

	REACTORS						
COUNTRY	**OPERABLE 2012**	**UNDER CONSTRUCTION**		**PLANNED**	**PROPOSED**	**TOTAL**	
	MWe net	No.	MWe gross	MWe gross	MWe gross	No.	
Bulgaria	1906	0	0	950	0	1	Government commitment to the future of nuclear energy is strong, though finance is lacking. A third unit will be added to the present plant.
Czech Republic	3764	0	0	2400	1200	3	Temelin project on-going, plant contract assumed to be signed 2013
Finland	2741	1	1700	0	3000	2	Olkiluoto 3 under construction, Olkiluoto 4 and Hanhikivi 1 decision in principles approved
France	63130	1	1720	1720	1100	2	Flamanville EPR 1750 under construction, operation 2016, Penly EPR 1750 planned, construction not started
Hungary	1880	0	0	0	2200	2	Paks 5&6, with a decision in 2013 the first unit is expected to begin operation after 2020, the second after 2025. Capacity would be 2500-3400 MWe
Romania	1310	0	0	1310	655	3	Cernavoda 1&2 under construction (total 1440 MWe, Candu) in operation 2016-2017
Slovakia	1816	2	880	0	1200	1	2 NPPs under construction, in operation 2013-2014, Construction of a new reactor block at Bohunice by 2025 (1200 MWe gross).
Ukraine	13168	0	0	1900	12000	13	Planned new build 5 PWR plants, replacements for old reactors total 9 PWR plants, total capacity of 14000MWe,l construction between 2012-2035
Russia	24164	10	9160	20000	24000	41	Strong support for nuclear

PLANNED NUCLEAR POWER PLANT PROJECTS IN EUROPE

There is a large number of nuclear power plant projects, which are in a planning phase or on hold due to financial problems

Countries which do not yet have nuclear power, but have developed plans and support for nuclear power plants and do not have existing supplier network.

COUNTRY	REACTORS UNDER CONSTRUCTION		REACTORS PLANNED	REACTORS PROPOSED	TOTAL	
	No.	**MWe gross**	**MWe gross**	**MWe gross**	**No.**	
Belarus	0	0	2400	2400	2	Ostrovets 1&2, construction start late 2013, operation 2019 and 2020
Lithuania	0	0	1350	0	1	Visaginas 1 ABWR by GE Hitachi, construction start 2015(?) operation 2021
Poland	0	0	6000	0	46	Plant supplier selection 2012, first unit operational in 2024, the second in 2029.
Turkey	0	0	4800	5600	8	Intentios to even more, all to be operational until 2030
Saudi Arabia	0	0	0	17000	16	Plans to construct 16 nuclear power reactors over the next 20 years at a cost of more than 60€ billion
UAE	1	1400	4200	14400	13	Plan for 4 NPPs operating by 2020

Countries in which projects are currently on hold but may change (note: Swedish nuclear regulations are under development and applications for new plants may be done after completion in 2014)

COUNTRY	NUCLEAR ELECTRICITY GENERATION	REACTORS OPERABLE	REACTORS PLANNED	REACTORS PROPOSED	TOTAL	
	2011	**MWe net**	**MWe gross**	**MWe gross**	**No.**	
United Kingdom	62.7	10038	6680	12000	13	On hold due to financial problems
Italy	0	0	0	17000	10	The government intended to have 25% of electricity supplied by nuclear power by 2030, but this prospect was rejected at a referendum in June 2011
Netherlands	3.9	485	0	1000	1	Borssele 2 PWRs, construction to start 2015-2016, in operation 2020-2021 (financial problems, on hold 2-5 years), ERH Borssele 1250-2500 (AP1000, EPR or BWR) construction envisaged 2015 operation 2019
Sweden	58.1	9399	0	0		Replacement of existing plants approved, in operation earliest 2025
Switzerland	25.7	3252	0	4000	3	On hold due to public opinion

BUSINESS OPPORTUNITIES AND NEEDED DEVELOPMENT ACTIONS

Several new nuclear power plants are planned to be built in Central & Southern Europe within the next 5 years

Business opportunities	Short term (2-5 years)	Long term (5-15 years)
Northern Europe	Finland – Olkiluoto 4 & Hanhikivi 1 Lithuania – Visaginas 1	Sweden – min. 1 unit
Central/Southern Europe Middle East + other	Belarus – Ostrovets 1&2 Bulgaria – Kozloduy 7 Checz Republic – Temelin 3-4 France – Penly 3 Hungary – Paks 5 Slovakia - Bohunice Turkey – Akkuyu 1-4 UAE – Barakah 1-4 Ukraine - Khmelnitski 3-4 + 2 units Neatherlands – Borssele UK – Hinkley Point C 1-2, Sizewell C 1-2	Poland min. 2 units Turkey – Sinop 1-4 Saudi-Arabia – >10 units Checz Republic – Dukovny 5 Hungary – Paks 6 Slovakia – Kecerovce Ukraine – replacements 9 units UK – Oldbury B, Wylfa B, Moorside 1

Development / investment needs to improve competitiveness	Short term (2-5 years)	Long term (5-15 years)
Topics / actions	Quality systems in place Consortiums established Project funding organized Project references from Northern Europe	Resourcing (staff, manufacturing capacity) International subcontractor network

BUSINESS OPPORTUNITIES IN THE FUTURE NPP PROJECTS

The selected three systems have different extension potential.

System	Location for NPPP	Short term (2-5 years)	Long term (5-15 years)
Piping	Northern Europe	150 MEUR	> 50 MEUR
Cooling water system	Northern Europe	150 MEUR	> 50 MEUR
	Central/Southern Europe Middle East + other	> 300 MEUR	> 500 MEUR
Waste management system	Northern Europe	180 MEUR	> 60 MEUR
	Central/Southern Europe Middle East + other	> 600 MEUR	> 1 200 MEUR

- Piping system has largest potential in countries where the shipment of material is easy.
- The value of cooling water system depends on the location of the unit (e.g. whether direct or indirect cooling, single plant or multiple units which may have common cooling system etc.)
- Waste management system is more emphasized on the concept and not that dependent on the location of the unit, thus it has the largest extension potential.

ANNEX

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