Role of the owner-operator in optimizing the cost of electricity generated by a nuclear power plant. Based on the experience of Rosenergoatom



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Project's financial indicators (LCOE) are achievable through project time and cost management



Management of project schedule and costs is the role of the owner, performed by the Rosenergoatom (REA) Concern

Status quo

The overall performance of a new NPP project depends on individual performance of each of Rosatom's divisions in reducing their share of LCOE







Decisions affecting the cost and schedule of NPP construction are taken throughout the project life cycle

Decisions affecting the cost and schedule of NPP construction									
	Estimating the project								
	FEED	Investment case	Engineering documentation	Contracting	Detailed design	Procurement of works	Procurement o equipment and materials	f Construction and commissioning	
Documents affecting time and costs	 Cost estimation Baseline construction schedule 	 Feasibility study Project master plan 	 Cost estimation Baseline constru level 3 	ction schedule	 Total estimation Revised construction so level 3 		Actual schedule	and costs	
Action owners	 Engineering company 	 Engineering company 	 Engineering com 	ipany	 General Contrac 	tor	 General Contra 	ctor	
Decisions affecting the costs	 Engineering decisions at the FEED phase: power generation technology, safety, construction technology, operation 	 Site decision 	 Engineering decisions outside the FEED phase: auxiliary buildings and infrastructure, construction technology Assumptions about baseline prices and indices 	 Selecting the type of contractor contract Selecting general contractor Defining the scope and price of contract 	 Engineering decisions at the implementation phase Changes in construction documentation Review of baseline prices and indices 	 Selection of contractors Calculation of work cost conversion factors 	 Selecting equipment modifications Selecting equipment vendors Using optimization levers 	 Estimating the actual scope of performed work Monitoring productive time and productivity of workforce and machines 	
Decisions affecting the schedule	 Engineering decisions at the FEED phase: power generation technology, construction technology 	• -	 Engineering decisions outside the FEED phase: construction technology 	 Selecting general contractor Defining contract terms Planning the schedule 	 Managing the deadlines of detailed design documentation 	 Managing the deadlines of work procurement Selecting the approach to work sourcing 	 Managing procurement deadlines Supplier due diligence Monitoring production schedule Initiation of supplies Manufacturing quality management 	 Network schedule management Estimating the actual scope of performed work Monitoring productive time and productivity of workforce and machines 	

REA has had a limited impact on costs and schedules of NPP projects in recent years



A strong Owner organization builds up key functions, 73 of them according to one analysis

Work streams	Function groups	Sharing of owner responsibilities
Overall project	Investment case	
	Investment planning	2. ЭТАП 2: КОМПЛЕКСНОЕ УСИЛЕНИЕ ФУНКЦИИ УПРАВЛЕНИЯ КАПСТРОЕМ В КРЗА. Усиление службы заказчика-застройщика потребует выполнение
	Contract management	КРЭА ряда важных функций (1/3) Виспартное вым у Распацования у состоят в с
	Cost management	Propring program of many set and provide the set of the set
	Long-term planning	Productinguidence * * Productinguidence *
	Licensing	Pagatona grandomenus carbanal fanganesis raggguase Pagatona carbanal carbanal fanganesis raggguase Pagatona carbanal carbanaa carbanaa carbanal carbanal carbanal carbanal carbanaaa carban
Engineering	Management of design documentation	$\begin{array}{c c c c c c c c c c c c c c c c c c c $
management	Management of detailed design documentation	
Procurement	Procurement of long-lead items	
management	Procurement standard equipment	McKinsey & Company 12
Management of construction and	Management of sub-contractors	Conscience of the second and the sec
commissioning	Detailed planning and control	Kongon, cotingene rgalen faarseneder in inngjage Kongon, cotingene rgalen faarseneder in inngjage Kongon, cotingene rgalen faarseneder in inngjage Kongon, cotingene
	Sub-contractor performance management	
	Construction control and safety monitoring	

SELECTIVE

REA implements improvement initiatives which focus on economic performance of NPP projects



ILLUSTRATION: FEED

1. The main goal of the VVER-TOI project's FEED is to ensure the project's excellence in key technical and economic indicators

Parameters	HITACHI ABWR 1350 MW	@ AP-1000 1170 MW	CHNP APR-1400 1400 MW	<pre>B HITACHI ESBWR 1550 MW</pre>	AREVA EPR 1600 MW		Advanced technology
Efficiency, gross percent	35.5-37.2	32.9-35.3	35.0-36.5	33.0-35.6	35.0-37.0	3X.X	>35
Availability, percent	>87	>90	90	>87	>90	XX	>85
Construction of the first power unit from first concrete to start-up, months	43	36	48	35	54	X0	<40
Probability of reactor core melting	1.6*(10) ⁻⁷	5*(10) ⁻⁷	2.3*(10) ⁻⁶	3.2*(10) ⁻⁸	6.1*(10) ⁻⁷	X.9*(10) ⁻⁷	<x.x*(10)<sup>-7</x.x*(10)<sup>
Specific area of unalterable part, m ² /MW	47.4	49.8	57.9	46.5	57.4	4X.8	_
Specific CAPEX in USA (NC) (estimated by B&R including contingencies), USD/kWh, net	4484	4121	4590	3244	4244	3XXX	<3000
Cost of electricity, USD/kWh	0.0240	0.0230	0.0259	0.0211	0.0253	0.0XX	<0.0200

Source: AEP; VNIIAES

ILLUSTRATION: RELATED PROJECT

2. After revision of the project, optimization potential was identified along three initiatives EXAMPLE: AKKUYU PROJECT

Rubles sanitized

Pageline estimate Toom approximant P Discussed estimization activity

enses E	ffect	Optimization example
aration X	XX -28%	Optimization of the lay-out and reduction of construction site by 32% as well as reduction of excavation by 56%
^{ly} x	XX -24%	Optimization of study costs by 24% based on the benchmarking with best practices
	XX 70	Optimization of the cost of long-lead items by 9% thanks to itemized benchmarking
pment	XX X	Optimization of the cost of typical NPP equipment by 6%
struction	XX X -42%	Reduction of the cost of 60 buildings (~76% of construction costs) also by reviewing the physical scope and prices for materials and manpower
ect agement	XX XX XX	Optimization of project management costs by 38% based on best practices
er enses	X -8%	Reduction of other expenses by 8% by reducing the calculation base
	enses E aration X y X pment struction agement er enses	SensesEffectarationxyxyxx24%pmentxxxx24%pmentxxxx7%struction ullationxxect agementxxexpensesxxxx-38%

ILLUSTRATION: RELATED PROJECT

2. Optimization of NPP layout helps achieve saving in site preparation and construction costs



1 Not exhaustive

ILLUSTRATION: RELATED PROJECT

Rubles

2. Lower price for materials sourced in the area of NPP construction

EXAMPLE: AKKUYU PROJECT

-XX

Percent of cost saving



1 Reduction of the cost of work and materials does not include a 12% increase of the physical scope due to higher seismic requirements

3. REA strengthens the role of the owner in the management of key events during construction and commissioning phases



3. The management hierarchy enhances the efficiency of owner interaction with EPC contractor, sub-contractors and suppliers

EXAMPLE: PROJECT NOVOVORONEZH NPP-2

NV NPP-2 meetings hierarchy	Chairman	Frequency	Participants	Targets of the team		
Management meeting September 4	• CEO	 Biweekly 	 Senior management of REA, NV NPP, AEP, OEK, ATE, and VNIIAES and major sub-contractors 	 Preparation Review of the status of the critical path Review of problems and finding debottlenecking calutions of problems of problems and finding debottlenecking 		
Site meetings Monthly meeting	 Deputy CEO for capex 	Monthly	 Supervisors of NV NPP (shop managers), managers of AEP in 	 Solutions, elimination of obstacles (often artificial) Preliminary discussion with REA and AEP to coordinate available options 		
Weekly meetings	 Project manager station manager 	V • Weekly	NV, OEK, ATE and sub- contractors in NV	 Preparing draft orders Assistance Detailed presentation of the work status (events/buildings/contractors) 		
Topical meetings	 Shop managers of NV NPP-2¹ GC (Moscow AEP) project directors 	 1-2 times a week 	 Leaders and action owners from contractors 	 Ensuring transparency of efforts in priority areas Execution of orders Recording key actions in minutes Control of the target effect of meeting decisions 		
Daily shop-level meetings	 Shop managers of NV NPP-2 	 4-5 times a week 	 Workers from contractors (e.g. supervisors) 			

1 If necessary, the meeting can be lead by project manager / station manager

ILLUSTRATION: CONSTRUCTION AND COMMISSIONING

3. Staff training and development is a special focus area

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EXAMPLE: PROJECT NOVOVORONEZH NPP-2

Novovoronezh NPP-2



Pavlov Alexey Engineer, Electrical Shop



Nikishov Alexander *Engineer,* Construction Supervision



Molodtsov Anton *Engineer,* Reactor Shop

Beloyarsk NPP



Razva Anton *Engineer,* Thermal C&I



Pugach Alexander *Foreman,* Safety



Samodelkin Pavel Engineer, Construction Supervision

Enhancing owner organization





Sudarev Evgeniy *Reactor Operator*, Reactor Shop



Makeev Evgeniy *Engineer,* Thermal C&I



Yanin Alexey Deputy Head, Construction

Leningrad NPP-2



Arbuzov Nikolay *Foreman*, Thermal C&I



Mukhin Oleg Engineer, Reactor Shop



Zaitsev Maxim Engineer, Thermal Shop



Naumov Andrey Deputy Head of Project Management, Construction



Fertov Anatoliy *Engineer,* Construction Supervision



Kovalenko Andrey *Engineer,* Construction Supervision



Sadyrov Marat *Engineer,* Construction Supervision

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ILLUSTRATION: NPP OPERATION

4. OPEX reduction should be ensured in all controlled sources

Billion RUB				2010			2012	XX	Proportion in total costs Percent	Controlled expenses
				ZUIU			Billion			
	Structure					Percent	RUB	Percent		
		[Wages		X,X	X.5	X,8	3 X,7		
	Operating expenses		Insurance		X,X	X ,6	X,8	3 X,4	I Personnel and	XG
		┢╌╴	Social benefits]	X,X	X,9	Х,:	3 X,9	benefits	
			Other personnel expenses]	X,1	X,6	Х,	X ,6		
			Maintenance services]	X,7	X,9	X,2	2 X,4	.]	
			Purchasing electricity in the wholesale market ³]	X,0	X.5	X, ⁻	X,2	II Maintenance⁴	X.5
		H	Spare parts				Х,3	3 X,9		
		H	Feedstock and materials ²		X,9	X,0	X,8	3 X,1	III Feedstock and mate	rials 🔨
			Purchased electricity				X.	5 X,7		
		H	Property insurance		Х,З	X,6	Х,9) X,2		
			Property tax]	X,2	X,6	Χ,	7 X,9	IV Assets	X,1
Expenses	1	H	Services (excl. maintenance)		X,0	X.5	X,8	3 X,7		
2010 2013			SNF/radioactive waste handling		Х,З	X,7	Х,	X ,7		
			Payments to power market services		X,9	X,0	X,8	3 X,2		
			Other operating expenses		X,0	X,0	X,8	3 X.5		
	Nuclear fuel]		X,9	X.5	Х,	7 X,1		
	Depreciation]		X,3	X,7	X.!	5 X.5	•	
	Income tax]		X,4	X,7	X,9) X ,4	•	
		_	NPP development			X,1	X,8	3 X,4	•	
	Provisions		NPP decommissioning		X,8 - X,6	X,3	X,2	2 X.5	• •	
			Physical security]	X,8	X ,9	X,9	X,6	•	
		 	Safety		X,4	X,2	Χ,	7 X,1	•	
		<u> </u>	Radioactive waste disposal				X,9) X,1		
	Nonoperating					X,1	X,2	2 X ,4		

1 Data for 2013 2 Excluding nuclear fuel and spare parts

3 For contractual obligations

4 Electricity is reflected only in the margin and cost of production (0.5 bn)

4. Maintenance can be reduced thanks to detailed planning and initiatives with equipment vendors



ILLUSTRATION: NPP OPERATION - PERSONNEL

4. Personnel costs may be reduced by sharing best practices between Rosatom plants



1 Accounting, Finance, Human Resources, Production, Procurement, Transportation

2 Safety and Reliability, Engineering Support, Production and Quality, Radiation Protection

3 Including AER branches

4 Operation of the main equipment (turbine, reactor, chemical plant, ventilation, plant support systems)