

CONSÓRCIO ANGRA EUROBRAS NES

TRACTEBEL



Market Sounding

May 2022



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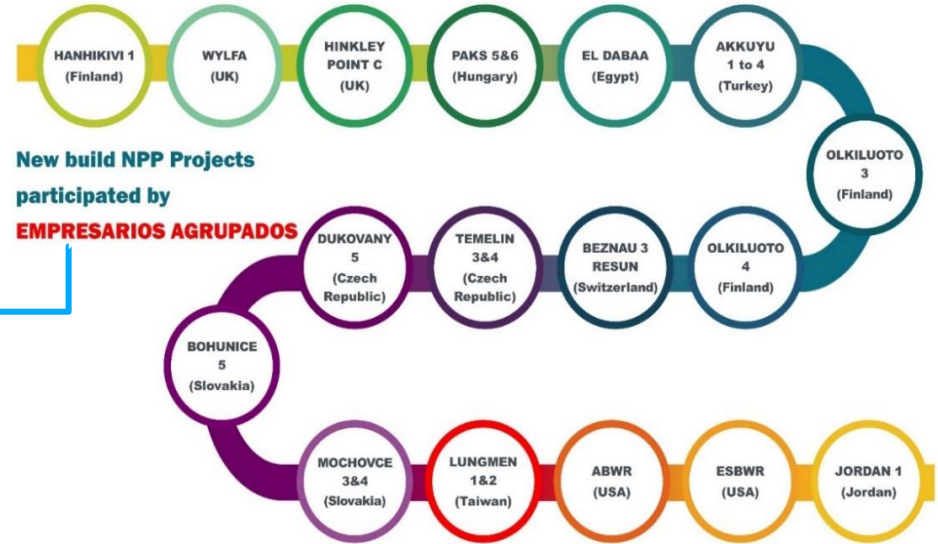
Consortium AEN

Tractebel Brazil, Tractebel Belgium and Empresarios Agrupados

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Tractebel Belgium & Empresarios Agrupados (Spain) are amongst the world top leading engineering companies, able to provide vast array of services for the Nuclear Market.

World class expertise from both companies, in the German Nuclear Safety Standards.
(The standards used in the design of Angra 2 & 3 NPP)



Combined with extensive experience in large projects in Brazil from **Tractebel Brazil**.

Introduction

CONSÓRCIO ANGRA EUROBRAS NES



The Consortium ANGRA EUROBRAS NES (ANGRA EUROPE BRASIL NUCLEAR ENGINEERING SERVICES) or “AEN”, under the leadership of TRACTEBEL ENGINEERING LTDA, is supporting BNDES/Eletronuclear in finalizing Angra 3 Project, performing Service A (together with Services B & C).

“SERVICE A” is responsible for a Technical Operational Evaluation (Present Status & Costs to Complete), Preliminary and Definitive Scopes of EPC, and Advisory Engineering necessary for structuring and implementing the model approved for the feasibility of the Angra 3 Project.

Introduction (cont.)

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- Within the Preliminary Scope of EPC, and later to develop a Project's Definitive Scope of EPC that is consistent with Brazilian regulations and market conditions, AEN is conducting "EPC - A3 - Market Sounding", contacting potential EPC providers to collect preliminary information and screen their comments on the bidding process.
- This material presents a brief description of the Project and the envisaged preliminary EPC scope and requirements. We emphasize that this material has exclusively public information and has an ostensible character.
- We would like to invite your Company to submit your preliminary comments and, if possible, indicating your interest in participating in this Project.
- Comments from bidders' difficulties and suggestions on the EPC process are welcome.

Angra 3 General Features

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Eletrobras Termonuclear – Eletronuclear (ETN), controlled by Centrais Elétricas Brasileiras S.A – Eletrobras, linked to the Ministry of Mines and Energy, is the **OWNER** of Angra 3 Project, as well as the other NPP Units 1 & 2, and other Nuclear Installations situated in CNAAA site (Central Nuclear Almirante Alvaro Alberto), in Angra dos Reis / RJ.

Project Description: Angra 3 was interrupted in its very initial phase and restarted in 2007 as part of the Accelerated Growth Program (PAC), but the construction was suspended in 2015. Restarted in 2022, considering the “Critical Path” of the Project.

FRAMATOME (previously Areva) is the supplier of the nuclear island and responsible for the project’s overall performance.

Reference plant for Angra 3 is Angra 2, all technical updates were incorporated to the project, including those derived from the experience of Fukushima accident. The project, a pre-Konvoi German KWU design, is one of the most successful among the plants currently in operation, with high safety and performance standards (Over 30 years of operation in Germany; 21 years of operation of Angra 2).

General Presentation of EPC Scope of work

Topics

- A. Presentation of
 - i. Eletronuclear facilities in CNAAA
 - ii. Angra 3
- B. Project Organization – Key stakeholders Organization
- C. Project Situation – On-going Activities and Current Status
- D. Project Partner
 - i. Introduction of Scope of Works
 - ii. Key Features
- E. Indicative Tender Information
 - i. Technical Qualification Criteria for Bidders
- F. Overall Schedule - COD February 2028
- G. Project Risk Allocation
- H. Details of Scope of Work

Presentation

Eletronuclear facilities in the CNAAA site

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ANGRA 1

- COD in 1985
- PWR 640 MWe
- Westinghouse technology
- Lifetime 40 years



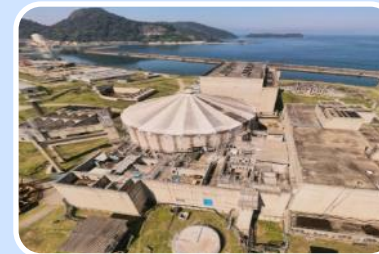
ANGRA 2

- COD in 2001
- PWR 1360 MWe
- KWU – Pre-Konvoi
- Lifetime 40 years



Dry Storage Facility

- Commissioned in 2020



ANGRA 3

- COD projection Feb. 2028
- Reference Plant: ANGRA 2
- Lifetime 40 years

Presentation

ANGRA 3

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- **Key Features of the ANGRA 3 NPP:**

Location: Angra dos Reis (Rio de Janeiro)

PWR Reactor – KWU → FRAMATOME ANP

Power Generation: Siemens Turbine 1405 MWe

Construction Suspended in 2015. Resumed in 2022

Commercial Operation Date – February 2028

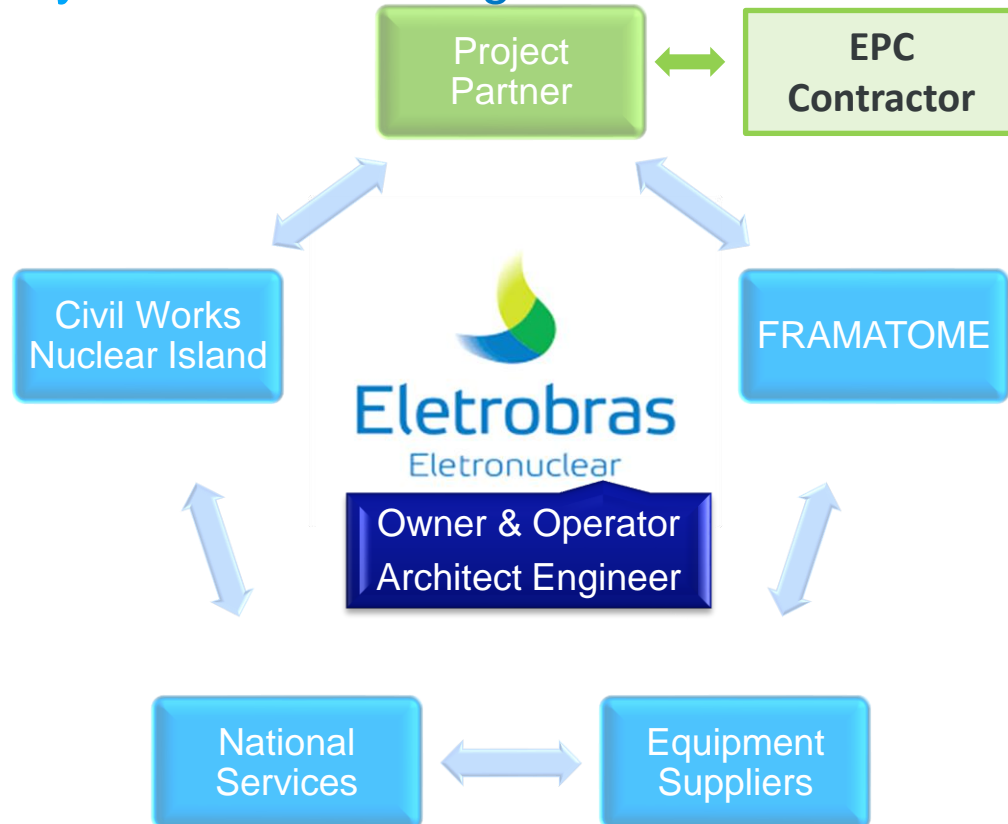
Eletronuclear acting as **Architect Engineer**

Angra 3 Enterprise - **Multi-package** organization



ANGRA 3 - Project Organization

Key Stakeholders Organization

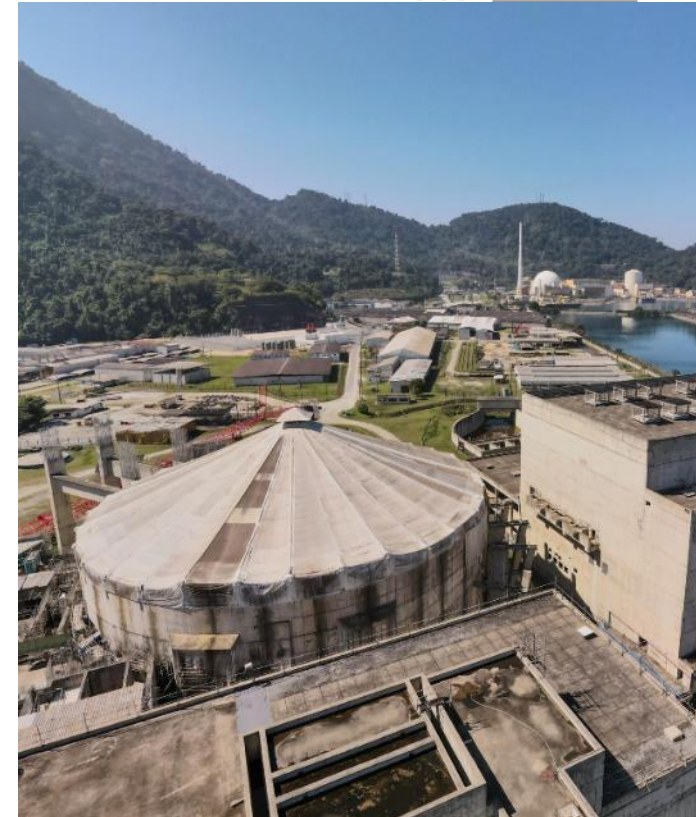


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ANGRA 3 - Project Situation

Current Status & On-going Activities (1/4)

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Angra 3 – Work done by ETN

Civil Assets – Buildings & Structures

- Exhaustive maintenance and preservation works on all the **civil assets** since suspension of construction

Equipment and supplies

- **Main equipment** (Reactor Pressure Vessel, Steam Generators, Pressurizer, Condensers, High Pressure Turbine, Generator Set,...) stored and preserved in NUCLEP premises
- **Other equipment** stored in warehouses located in the CNAAA site and preserved by ETN teams
- **Containment** structures preserved in the site area

ANGRA 3 – On-going Activities by ETN

Project Resumption – Contracted activities

- **Civil Works** for buildings in the critical path
- Erection and commissioning of **Polar Crane, Semi-gantry** crane
- Assembly of **Containment** sphere

On-going activities managed by ETN

- Refurbishment of special lifting devices (Manitowoc crane).
- Contracts renegotiation with several suppliers (incl. Pool lining erection, supply of heat exchangers,...).

ETN incoming activities

- Contracting of **Engineering** Services for Design finalization, Owner Engineer and Inspection and Supervision of works.
- **General Inspection** program for all already supplied equipment
- **Simulator** design, purchase and construction

ANGRA 3 - Project Situation

Current Status & On-going Activities (2/4)

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Angra 3 – Current situation Nuclear Island



Site Area between Angra 3 and Angra 2



ANGRA 3 - Project Situation

Current Status & On-going Activities (3/4)

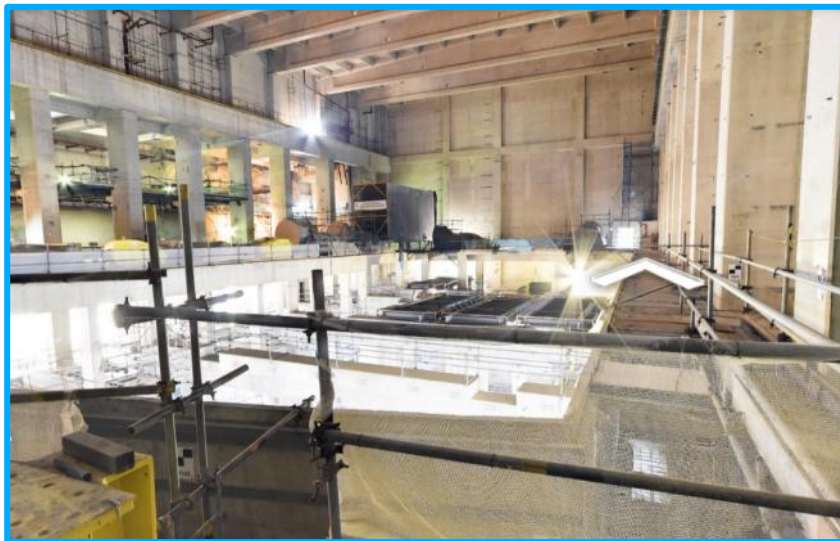
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Turbine Building from turbine location

Warehouse storing equipment already supplied



ANGRA 3 - Project Situation

Current Status & On-going Activities (4/4)

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Civil Works maintenance



Equipment reception & maintenance operations



ANGRA 3 - Project Partner

Introduction of Scope of Works (1/2)

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Management in all levels his Scope

- **Engineering Services**
 - Finish or develop Detail Design as per DORs
 - Develop pending engineering necessary to execute his scope of Work
 - Prepare, and keep up-to-date, all the As-Built
 - Inspect, Review and Report all Electromechanical Design
- **Commissioning Activities**
 - Perform Construction and Installation Tests
 - Support with workmanship, materials and equipment for:
 - Preoperational Tests
 - Start-Up Tests and Trial Operation
 - Performance Tests
- **Quality Control**
 - Prepare a comprehensive Quality Assurance Plan
 - Solve requested Corrections
- **Procurement Services**
 - Acquire and Supply remaining Equipment and Bulk Material (National Supplies)
 - Maintain and preserve them
 - Supply Spare Parts and Consumables
- **Construction & Assembly Work**
 - Execute the remaining Construction Work
 - Place Major Components
 - All Electromechanical Erection and Installation
 - Execute Temporary Works

ANGRA 3 - Project Partner

Introduction of Scope of Works (2/2)

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Engineering Services

- Around 65% Engineering Completeness. Owner to complete it except:
- Detailed Design Lines 138 kV & 500 kV and Substation
- Detailed Design Fire Protection System inside buildings
- Detailed Design Package Plants

Procurement Services

- Purchase of equipment (Partial) National Scope
- Purchase of almost all Bulk Material and Spare Parts and Consumables
- Already purchased National equipment, the risk of deficiencies is minor due to Owner's maintenance and the type of equipment concerned (mostly static).

Construction & Assembly Work

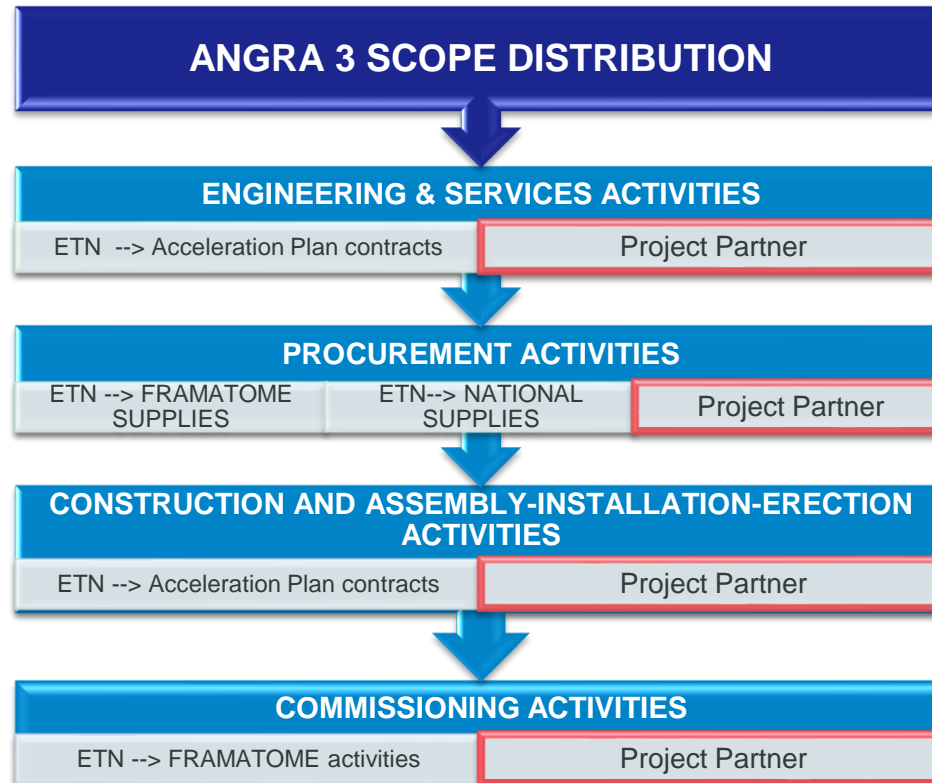
- Civil Construction (Buildings + Infrastructure + Marine Works)
- Electro-mechanical erection including Heavy Equipment (i.e: Steam Turbine, Generator Unit)
- General Inspection made by the Owner before installation of the Imported stored electrical and mechanical equipment replacing the missing, damaged and aged parts and reconstituting cannibalization.

Commissioning Activities

- Perform Construction and Installation Tests
- Provision of personnel for the rest of test

ANGRA 3 - Project Partner

Additional information of Scope of Works (1/5)



ANGRA 3 - Project Partner

Additional information of Scope of Works (2/5)

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• Engineering Services

Eletronuclear

- Provision of all Detailed Design studies
- Including 3D Model for mechanical systems
- As-built documentation (except detail design executed by Project Partner)

Project Partner

- Detailed Design Lines 138kV & 500 kV and Substation
- Detailed Design Fire Protection System inside buildings
- Detailed Design Package Plants
- Redlines markups for As-built



• Procurement Services

Eletronuclear

- Imported supplies (from technology provider)
- Maintenance of already purchased material

Project Partner

- Equipment (partial) within National Scope - remaining equipment not supplied by technology provider
- Bulk Material, Spare parts and Consumables

ANGRA 3 - Project Partner

Additional information of Scope of Works (3/5)

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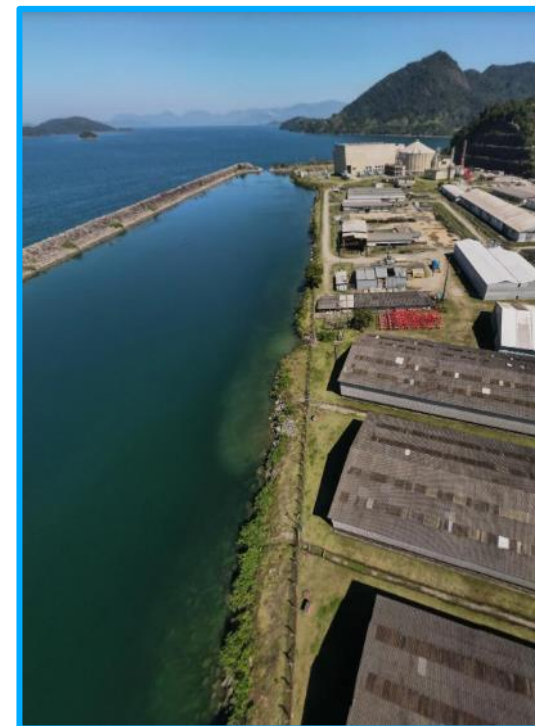
• Construction

Eletronuclear

- Construction Works in the critical path for on Nuclear Island buildings (Acceleration Plan)
- Provision of some temporary services
- Provision of areas for temporary facilities
- Construction supervision

Project Partner

- Construction site organization
- Repair Works on existing civil assets
- Finalization of all buildings and structures. Including:
 - Turbine table construction
 - Discharge Channel
 - Vent stack
- Site Infrastructure
 - Landscaping and site platform grading
 - Roads and parking areas
 - Sanitary Installation and yard drainage
- Marine Works
 - Shoreline
 - Jetty



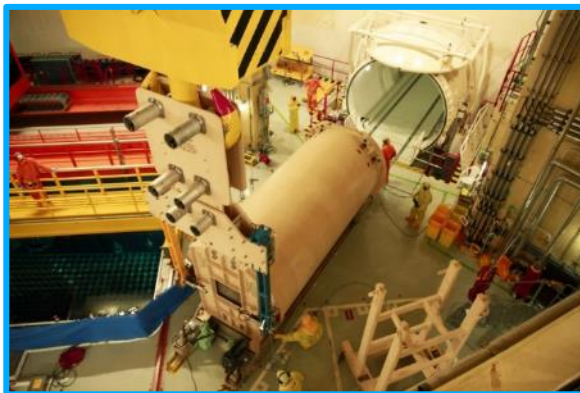
ANGRA 3 - Project Partner

Additional information of Scope of Works (4/5)

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Images from NUCLEP and ABDAN websites

• Erection and Assembly works

Eletronuclear

- Provision of the Manitowoc Crane
- Installation or erection of captive/civil dependant equipment, and others such as:
 - Polar Crane
 - Semi-gantry crane
 - Fuel Pool Liners
 - Moisture Separator Re-heaters
- General Inspection of equipment before installation of the Imported stored electrical and mechanical equipment replacing the missing, damaged and aged parts and reconstituting cannibalization

Project Partner

- Erection and installation of Heavy Equipment, such as:
 - Reactor Pressure Vessel
 - Steam Generators and the rest of primary equipment
 - Steam Turbine
 - Generator Unit
- Erection of all electro-mechanical equipment.

ANGRA 3 - Project Partner

Additional information of Scope of Works (5/5)

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Commissioning

Eletronuclear

- Direction of the Implementation and direction of the Test Program
- Provision of the Testing Schedule
- Provision of specialist personnel for supervision

Project Partner

- Perform Construction and Installation Tests
- Support with workmanship, materials and equipment for:
 - Preoperational tests
 - Start-up test and Trial Operation
 - Performance Test

QA/QC & Interface management

Eletronuclear

- Manages interfaces between Project Partner and ETN (including the rest of ETN contractor's)
- Provides the Overall Project Quality Management
- Provision of the General Project Schedule

Project Partner

- Management of interfaces and integration. Resolution of interfaces requirements with all disciplines and contractors
- Execute activities following its Quality Assurance Plan based on CNEN NN 1.16 standard



Image from ELETRONUCLEAR website

ANGRA 3 - Tender Information

Technical Qualification Criteria for Bidders

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Project References

- Nuclear Projects
- Large Scale Power Generation Plant

Construction Experience

- Construction of complex superstructures
- Marine Works and earthworks

Mechanical Erection & Installation experience

- Installation of heavy equipment and components
- Erection of Mechanical, electrical & installations equipment and materials

Inspection / Testing & Commissioning

- Execution of large inspection programs in new built projects
- Commissioning of Power Plants or other Industrial facilities

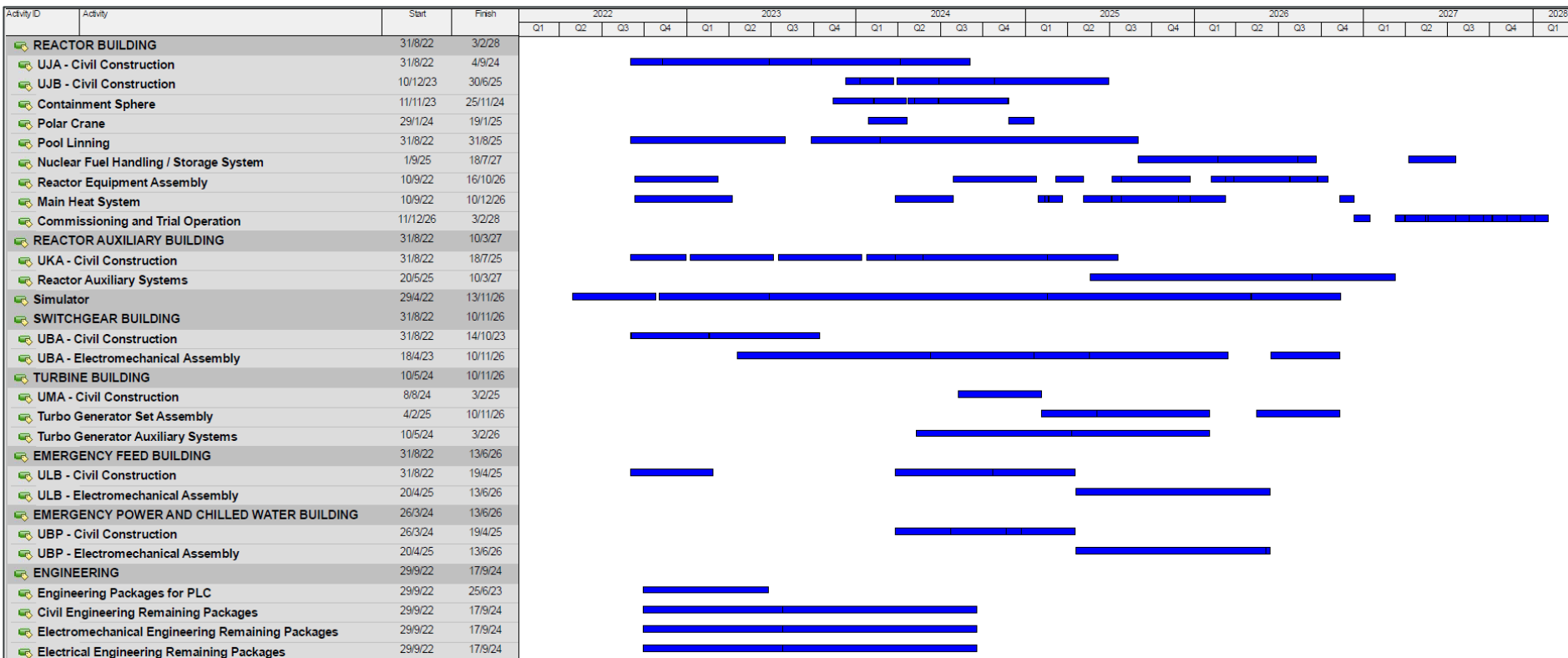
Site visit

- Acknowledgement of Angra 3 site conditions

ANGRA 3 - Overall Schedule

COD – Feb. 2028

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Product 8 Service A Material for Market Sounding - The presented information is still under study and is intended exclusively to support the initial conversations in the market sounding process, and therefore, under no circumstances, can be understood as final.

ANGRA 3 - Project Risk Allocation

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Delay in contract finalization which leads to a delay in start and finish dates.

Unwillingness of new contractors to renegotiate previous contracts for the supply of critical equipment

Scope changed by licensing agency requirements

Occurrence of HSE issues due to high occupation of the site for the owner, contractors and subcontractors

Process Safety and Environmental topics are not transferred to the new execution stage of the project

Delivery of long lead items

Onsite coordination and interfacing with other contractors

Insufficient transportation facilities and insufficient on-site storage space

Changes in the order of assembly due to the mismatch between project availability, evolution of civil works, evolution of electromechanical assembly and the goods and materials supplied available for assembly

Interfaces between the different structures and scopes of work

Insufficient resources available for monitoring the quality requirements



Details of the Scope of Work

- Estimative quantities (in percentages) for the completion process of finalizing Angra 3 Project, (information from ELETRONUCLEAR & EPC scope for Angra 3 Project).



Angra 3: Overall Project Progress

(ELETRONUCLEAR report, Feb./2022)

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Scope	Accum. Physical Progress (%)
Engineering (Basic and Detailed Design; Framatome Services: 79%)	85,96
Supplies (76% of national total cost contracted; 63% delivered; Framatome supplies: 73% delivered)	86,04
Civil Construction (Restarted 2022)	67,26
Electromechanical Erection (Interrupted 2015; Steel Containment: 54%)	10,77
Total	66,23

Angra 3: Civil Construction Progress

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Building / Structure		Reported progress (%)		
		Concrete	Steel Structures	Finishing work
Reactor building (Interior)	UJA	50.2	13.5	0.0
Reactor building (Annulus)	UJB	81.9	71.3	60.5
Main Steam and Feedwater Valve Compartment	UJE	34.0	0.0	0.0
Structure for equipment lock enclosure	UJF	73.3	0.0	0.0
Reactor auxiliary building	UKA	84.7	44.4	23.8
Turbine Building	UMA	90.8	65.7	41.0
Electrical Building	UBA	99.7	35.7	56.4
Emergency Power and chilled water supply building	UBP	43.0	0.0	0.0
Emergency feed Building	ULB	87.0	3.9	0.0
Condensate polishing building	ULD	93.4	0.0	0.0
Staff facilities and office building	UYA	44.0	0.0	0.0
Vent Stack	UKH	29.2	0.0	0.0
Main cooling water intake structure	UPC	38.6	0.0	0.0

Angra 3: Scope division of remaining civil activities: Owner's Critical Path (PLC) x EPC

contractors (Consortium Angra Eurobras NES, Dec./2021)

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	PLC contractor	EPC contractor
UJB	Concrete works: finalization of 1 st stage concrete works in the building, including partial 2 nd stage concreting (closing of block-outs and 2 nd stage concrete...). Erection of steel structures. Finishing works, not including the final painting of floors nor the second coat of paint on some walls and in traffic areas.	Completion of all other works, including all remaining 2nd stage concreting (closing of openings and block-outs). Finalization of finishing works
UJA, UBA	Concrete works: finalization of 1 st stage concrete works. No 2 nd stage concreting activities. Erection of steel structures. Finishing works, not including the final painting of floors nor second coat of paint on some walls and in traffic areas.	Completion of all other works (including 2nd phase concreting, finishings, etc.)
UJE, UJF, ULB, UKA, UPC	Concrete works: finalization of 1 st stage concrete works only.	Completion of all the rest of the works (including concrete 2nd phase, finishing,...). Part of UPC 1st stage concrete works shall be included in the 2nd phase (EPC) because design is not complete.
Rest of buildings and infrastructures		Full scope.



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Angra 3: Status of foreign supply packages (FRAMATOME)

(ELETRONUCLEAR Feb./2022)

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- 77,2% physical progress

- Main supplies

- Before the restart (Already delivered):

Reactor Pressure Vessel; Steam Generators; Pressurizer; Primary Piping;
Reactor Cooling Pumps; Feedwater Pumps; High and Low Turbine; Electric Generator.

- After resumption (already in the current contract):

Various piping and piping materials; Brackets; Flanges; Main Cooling Water Pumps; Turbo Group Auxiliaries Generator; I&C Cables; LOCA resistant Power Cables; Electric Generator Auxiliaries; Various tanks.



INTERNAL

Angra 3: Status of the national supplies

(Consortium Angra Eurobras NES, Dec./2021)

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LEGAL AGREEMENT	CONTRACT STATUS	STATUS OF SUPPLY	SUPPLY PACKAGE Quantitative (%)
CONTRACTED (By ELETRONUCLEAR)	Concluded ⁽¹⁾	Equipment delivered	18,4
	Ongoing ⁽²⁾	Equipment delivered	5,4
	Amendment in progress	Equipment not delivered	1,1
	Past Contracts under renegotiation	Equipment not delivered	14,6
NOT CONTRACTED	To be contracted by ETN	Equipment not delivered	0,5
	To be contracted by EPC	Equipment not delivered	60,0



- (1) Contracts fully paid and equipment delivered
- (2) Contracts that include an erection supervision clause from the supplier

Angra 3: Engineering documentation readiness

(Consortium Angra Eurobras NES, Dec./2021)

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ITEM	READYNESS
BUILDINGS AND STRUCTURES AT THE PLANT SITE	80.5%
REACTOR PLANT EQUIPMENT	61.4%
TURBINE GENERATOR PLANT EQUIPMENT	65.8%
ELECTRICAL EQUIPMENT	75.0%
I&C EQUIPMENT	62.3%
WATER INTAKE AND HEAT REJECTION	45.1%
MISCELLANEOUS PLANT EQUIPMENT	54.9%
TOTAL	65.6%

Angra 3: Cost estimate (%) for EPC activities

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(Consortium Angra Eurobras NES, March/2022)

EPC	Activity	%
Engineering and Service Activities	Fire Protection System	0,2%
	138kv and 500kv lines	0,1%
Supply of Equipment and Materials	Remaining National Packages	10,1%
	Bulk Material (Pipes and Supports)	6,1%
Construction and Erection Activities	Remaining Civil Works	17,4%
	Electromechanical Erection	66,1%
TOTAL EPC		100,0%

Angra 3: Cost to complete

(Consortium Angra Eurobras NES, March/2022)

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- **Owner's (ELETRONUCLEAR): 62,8%**
- **EPC: 37,2%**

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Thank you!

May 2022



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