**Consortium AEN**
Tractebel Brazil, Tractebel Belgium and Empresarios Agrupados

**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

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.)

• 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

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

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.
Topics

A. Presentation of
   i. Eletronuclear facilities in CNAAS
   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

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Presentation
Eletronuclear facilities in the CNAAA site

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

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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

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ANGRA 3 - Project Situation
Current Status & On-going Activities (1/4)

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

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ANGRA 3 - Project Situation
Current Status & On-going Activities (2/4)

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)

Turbine Building from turbine location

Warehouse storing equipment already supplied

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

May 2022

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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

- **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

- **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

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ANGRA 3 - Project Partner
Introduction of Scope of Works (2/2)

**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

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ANGRA 3 - Project Partner
Additional information of Scope of Works (1/5)

ANGRA 3 SCOPE DISTRIBUTION

ENGINEERING & SERVICES ACTIVITIES
ETN --> Acceleration Plan contracts

PROCUREMENT ACTIVITIES
ETN --> FRAMATOME SUPPLIES
ETN --> NATIONAL SUPPLIES

CONSTRUCTION AND ASSEMBLY-INSTALLATION-ERECTION ACTIVITIES
ETN --> Acceleration Plan contracts

COMMISSIONING ACTIVITIES
ETN --> FRAMATOME activities

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ANGRA 3 - Project Partner
Additional information of Scope of Works (2/5)

- 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)

- Procurement Services
  
  **Eletronuclear**
  - Imported supplies (from technology provider)
  - Maintenance of already purchased material

- 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

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

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ANGRA 3 - Project Partner
Additional information of Scope of Works (3/5)

- Construction

**Eletronuclear**
- Construction Works in the critical path for 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

May 2022

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ANGRA 3 - Project Partner
Additional information of Scope of Works (4/5)

- 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.

Images from NUCLEP and ABDAN websites

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## ANGRA 3 - Project Partner

### Additional information of Scope of Works (5/5)

#### Commissioning

<table>
<thead>
<tr>
<th><strong>Eletronuclear</strong></th>
<th><strong>Project Partner</strong></th>
</tr>
</thead>
</table>
| • Direction of the Implementation and direction of the Test Program  
• Provision of the Testing Schedule  
• Provision of specialist personnel for supervision | • 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

<table>
<thead>
<tr>
<th><strong>Eletronuclear</strong></th>
<th><strong>Project Partner</strong></th>
</tr>
</thead>
</table>
| • 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 | • 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 |

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# ANGRA 3 - Tender Information

**Technical Qualification Criteria for Bidders**

| **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 |

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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

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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)

<table>
<thead>
<tr>
<th>Scope</th>
<th>Accum. Physical Progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineering</strong> (Basic and Detailed Design; Framatome Services: 79%)</td>
<td>85.96</td>
</tr>
<tr>
<td><strong>Supplies</strong> (76% of national total cost contracted; 63% delivered; Framatome supplies: 73% delivered)</td>
<td>86.04</td>
</tr>
<tr>
<td><strong>Civil Construction</strong> (Restarted 2022)</td>
<td>67.26</td>
</tr>
<tr>
<td><strong>Electromechanical Erection</strong> (Interrupted 2015; Steel Containment: 54%)</td>
<td>10.77</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>66.23</td>
</tr>
</tbody>
</table>

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## Angra 3: Civil Construction Progress

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

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**Angra 3: Scope division of remaining civil activities: Owner’s Critical Path (PLC) x EPC contractors**  
(Consortium Angra Eurobras NES, Dec./2021)

<table>
<thead>
<tr>
<th>UJB</th>
<th>PLC contractor</th>
<th>EPC contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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.</td>
<td>Completion of all other works, including all remaining 2(^{nd}) stage concreting (closing of openings and block-outs). Finalization of finishing works</td>
</tr>
<tr>
<td>UJA, UBA</td>
<td>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.</td>
<td>Completion of all other works (including 2(^{nd}) phase concreting, finishings, etc.)</td>
</tr>
<tr>
<td>UJE, UJF, ULB, UKA, UPC</td>
<td>Concrete works: finalization of 1(^{st}) stage concrete works only.</td>
<td>Completion of all the rest of the works (including concrete 2(^{nd}) phase, finishing,...). Part of UPC 1(^{st}) stage concrete works shall be included in the 2(^{nd}) phase (EPC) because design is not complete.</td>
</tr>
</tbody>
</table>

**Rest of buildings and infrastructures**: Full scope.

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Angra 3: Status of foreign supply packages (FRAMATOME)
(ELETRONUCLEAR Feb./2022)

• 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.

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# Angra 3: Status of the national supplies

(Consortium Angra Eurobras NES, Dec./2021)

<table>
<thead>
<tr>
<th>LEGAL AGREEMENT</th>
<th>CONTRACT STATUS</th>
<th>STATUS OF SUPPLY</th>
<th>SUPPLY PACKAGE Quantitative (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONTRACTED</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(By ELETRONUCLEAR)</td>
<td>Concluded(^{(1)})</td>
<td>Equipment delivered</td>
<td>18,4</td>
</tr>
<tr>
<td></td>
<td>Ongoing(^{(2)})</td>
<td>Equipment delivered</td>
<td>5,4</td>
</tr>
<tr>
<td></td>
<td>Amendment in progress</td>
<td>Equipment not delivered</td>
<td>1,1</td>
</tr>
<tr>
<td></td>
<td>Past Contracts under renegotiation</td>
<td>Equipment not delivered</td>
<td>14,6</td>
</tr>
<tr>
<td><strong>NOT CONTRACTED</strong></td>
<td>To be contracted by ETN</td>
<td>Equipment not delivered</td>
<td>0,5</td>
</tr>
<tr>
<td></td>
<td>To be contracted by EPC</td>
<td>Equipment not delivered</td>
<td>60,0</td>
</tr>
</tbody>
</table>

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

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Angra 3: Engineering documentation readiness
(Consortium Angra Eurobras NES, Dec./2021)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>READYNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDINGS AND STRUCTURES AT THE PLANT SITE</td>
<td>80.5%</td>
</tr>
<tr>
<td>REACTOR PLANT EQUIPMENT</td>
<td>61.4%</td>
</tr>
<tr>
<td>TURBINE GENERATOR PLANT EQUIPMENT</td>
<td>65.8%</td>
</tr>
<tr>
<td>ELECTRICAL EQUIPMENT</td>
<td>75.0%</td>
</tr>
<tr>
<td>I&amp;C EQUIPMENT</td>
<td>62.3%</td>
</tr>
<tr>
<td>WATER INTAKE AND HEAT REJECTION</td>
<td>45.1%</td>
</tr>
<tr>
<td>MISCELLANEOUS PLANT EQUIPMENT</td>
<td>54.9%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>65.6%</td>
</tr>
</tbody>
</table>

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: Cost estimate (%) for EPC activities

(Consortium Angra Eurobras NES, March/2022)

<table>
<thead>
<tr>
<th>EPC</th>
<th>Activity</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering and Service Activities</td>
<td>Fire Protection System</td>
<td>0,2%</td>
</tr>
<tr>
<td></td>
<td>138kv and 500kv lines</td>
<td>0,1%</td>
</tr>
<tr>
<td>Supply of Equipment and Materials</td>
<td>Remaining National Packages</td>
<td>10,1%</td>
</tr>
<tr>
<td></td>
<td>Bulk Material (Pipes and Supports)</td>
<td>6,1%</td>
</tr>
<tr>
<td>Construction and Erection Activities</td>
<td>Remaining Civil Works</td>
<td>17,4%</td>
</tr>
<tr>
<td></td>
<td>Electromechanical Erection</td>
<td>66,1%</td>
</tr>
<tr>
<td><strong>TOTAL EPC</strong></td>
<td></td>
<td><strong>100,0%</strong></td>
</tr>
</tbody>
</table>
**Angra 3: Cost to complete**

(Consortium Angra Eurobras NES, March/2022)

- **Owner’s (ELETTRONUCLEAR):** 62.8%
- **EPC:** 37.2%

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Thank you!
May 2022