SWGO
The Southern Wide-field Gamma-ray Observatory

Outer Array Perspectives from Brazil

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CBPF
LIP
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO
GOVERNO FEDERAL BRASIL UNIÃO E RECONSTRUÇÃO
FAPERJ Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro
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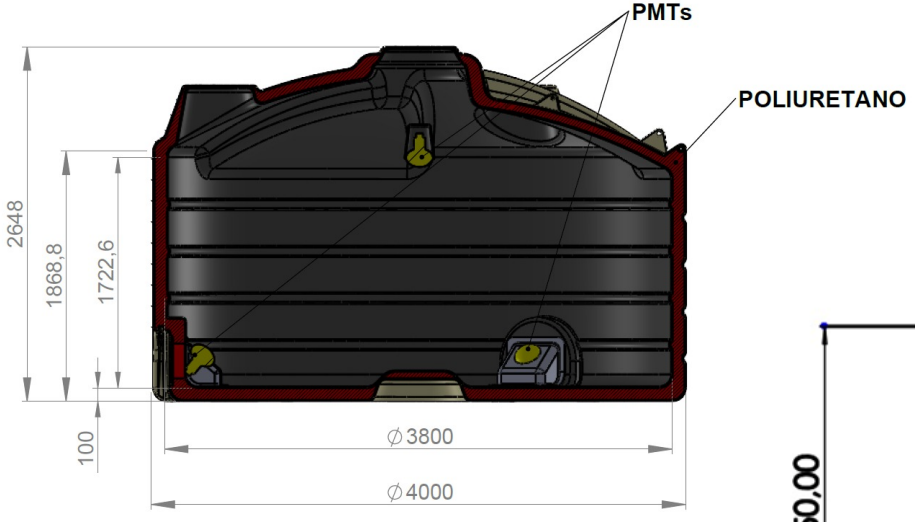
Motivation for the E-tanks

- HAP notes 21-003, 21-008
  - Compact design to minimize water usage
  - Simplification of logistics, installation and maintenance
  - Robustness and reliability of WCD unit
  - Flexibility of array design
    - Array density, unit size and characteristics, thermal insulation

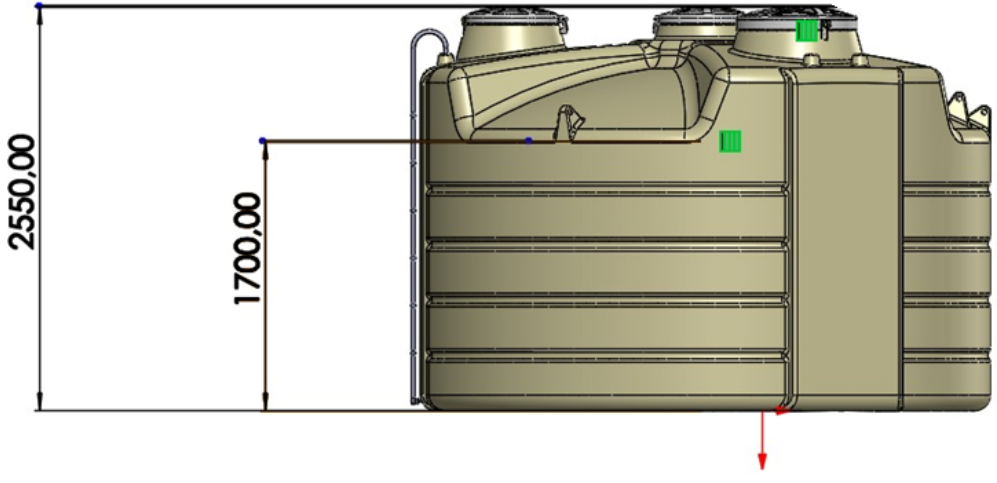
E-tank Development at CBPF

- **Extensive experience drawn from Pierre Auger**
- In cooperation with BR company Rotoplastyc
- HAP notes 23-003, 24-001
- New design, new resin (UV protection), new rotomolding technique
  - UV protection (UV-30 vs. UV-15 in Auger)
  - Rotomolding Patent BR1020210266902
- Recently: new reflective resin in the tank interior under development
  - Reflective properties aiming at substituting the use of a Tyvek liner
  - Samples can be sent to tests on request

Shallow HDPE Tank



- Design of insulated tank
- Later adapted for single-wall



- Flexibility of sizes: limited by transport logistics 3.6 ø x 3.6 *h* (m)

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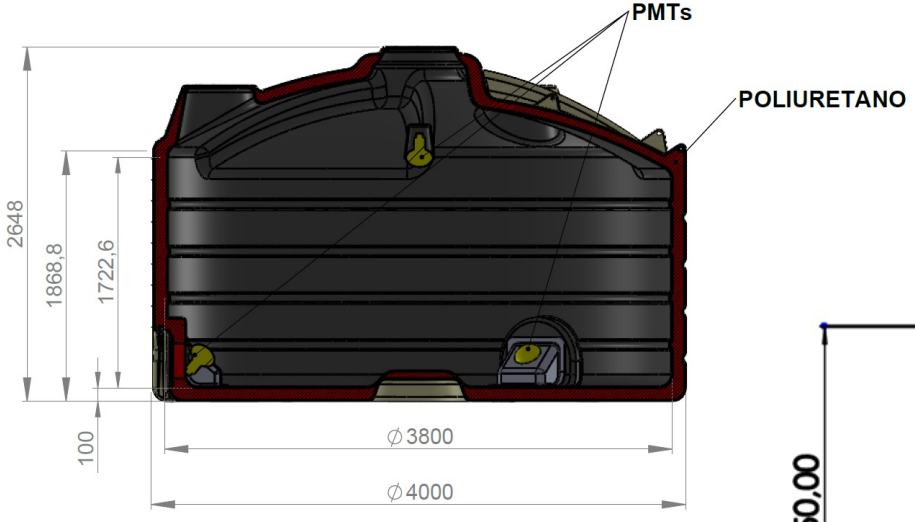
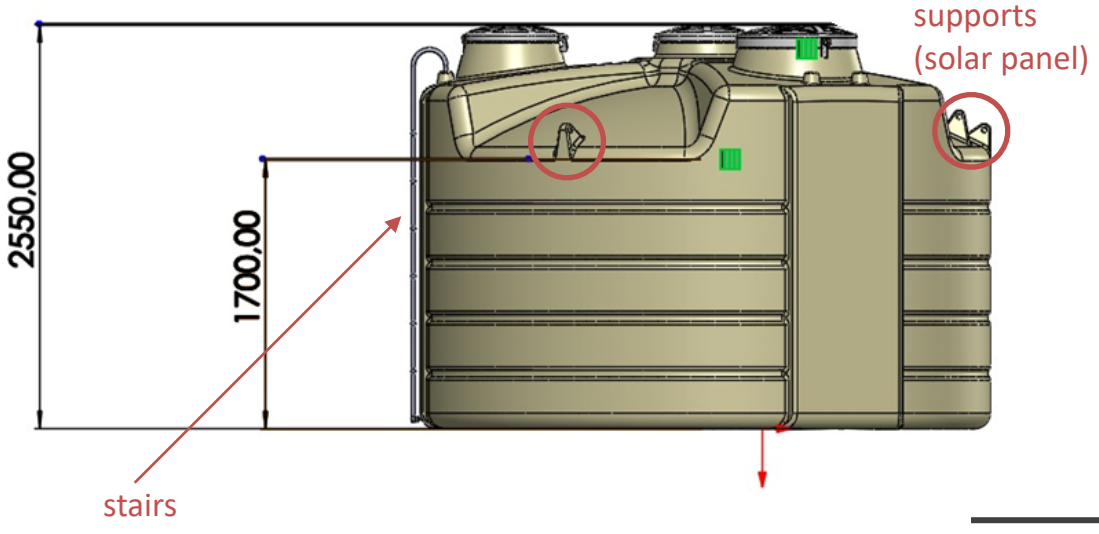


The insulated tank has not yet been produced, to give priority to the single layer design - but is next online in our activities.

Plan to produce over next months to send to the site as 3rd plastic tank

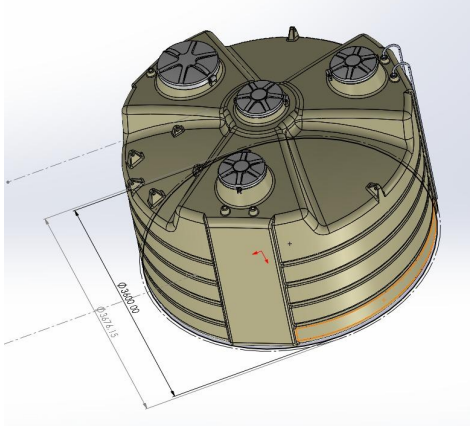


E-tank inventory:

- 1 black tank at CBPF (with hodoscope)
- 1 black tank at Pierre Auger
- 2 tanks (black + reflective) at SPA
- 1 insulated tank in production
- + 1 double layer tank under development
- **CNPq Fund secured for 4 more tanks**

Notes on tank production

- Oven-based rotomolded process essential for quality and altitude production
- A single oven can produce 4 tanks a day
- First 4 prototypes were made on single-attempt indicating robustness and reliability of the technique
- Estimated large-scale costs:
  - HDPE unity: c. 2-3 kUSD
  - + 1-2 kUSD liner+water



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Notes on tank production

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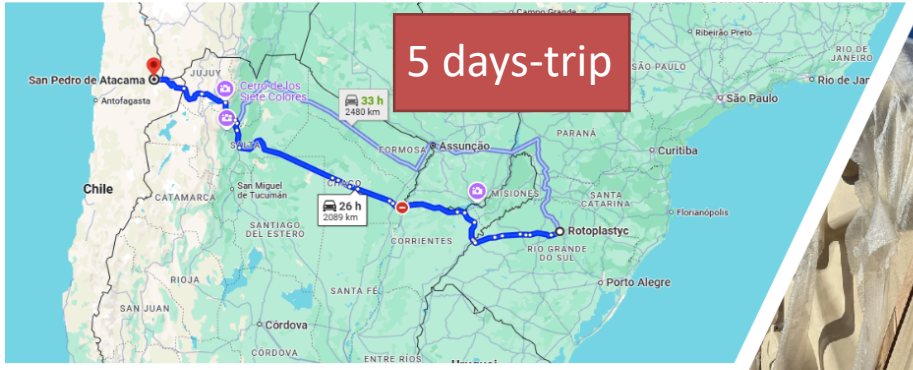
Notes on tank production

Comercial spin-off to agribusiness

E-tanks at San Pedro

- Two tanks currently on storage at RadioSky



Reflective Resin

- Latest R&D Development, to substitute the need for a reflective Tyvek liner
  - Installation of multi-PMT unit at CBPF took < 40 min (3-4 ppl)
  - + time for water filling of the 15 m3 tank of 1+ hour
  - working WCD unit on site in few hours ==> 4 working WCD units per day with handful of workers

Reflective Oxide Nanocoating

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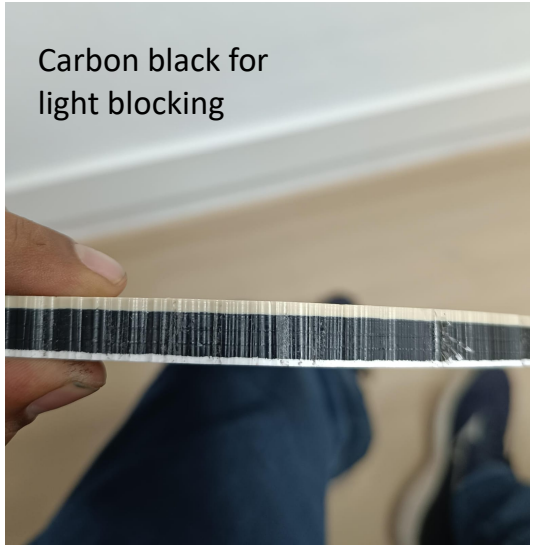
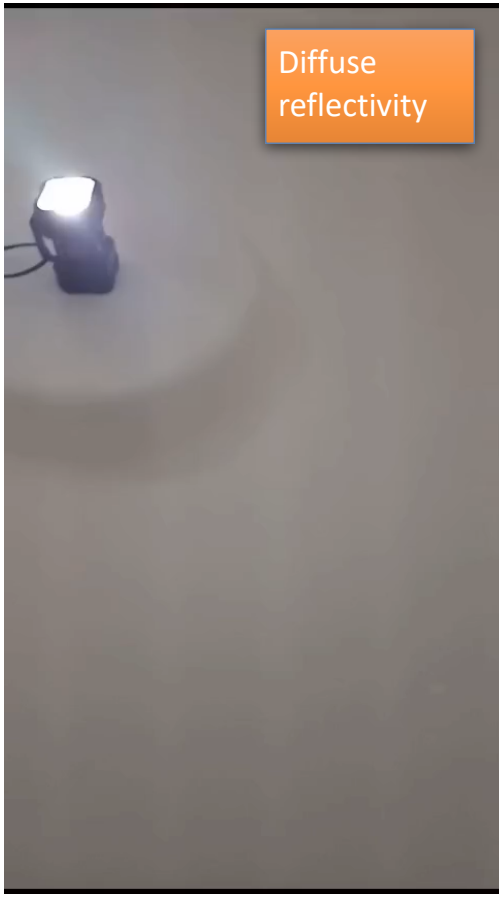
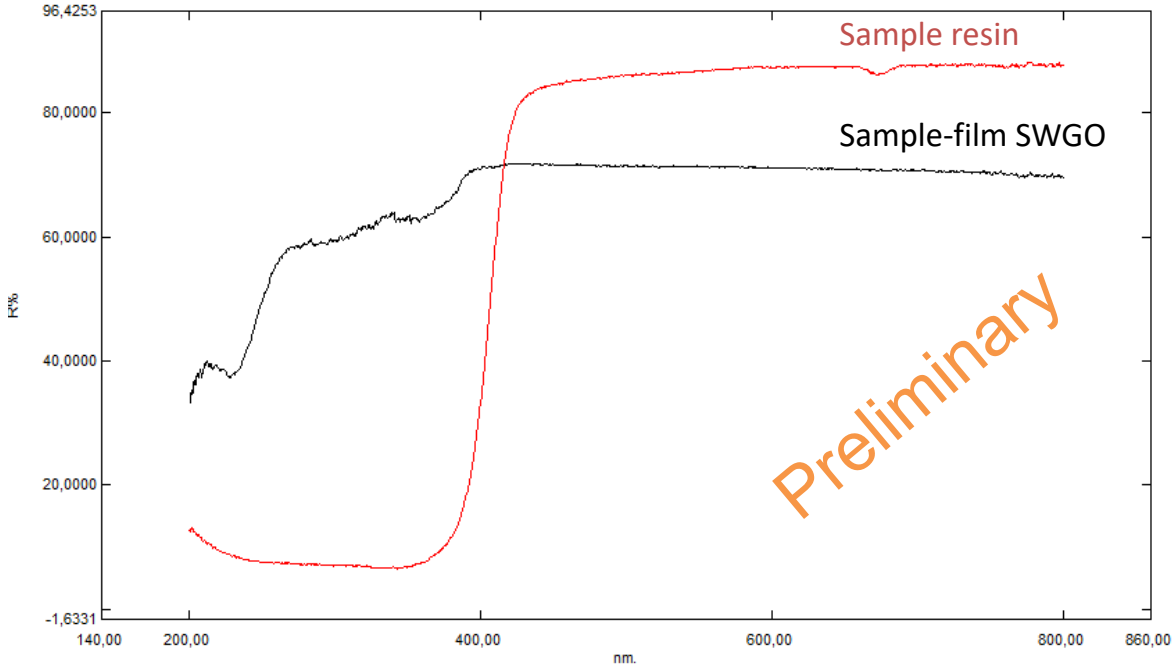




Reflective Oxide Nanocoating

Preliminary:

- Reflectance tests
- Baseline Barium Sulfate
- In visible UV it demonstrates better efficiency than Tyvek film
- We are improving the formula (RON) - hexane-based polyethylene (same as tank)



SWGO film: sample taken by Michael S. to México, similar to Auger film response.

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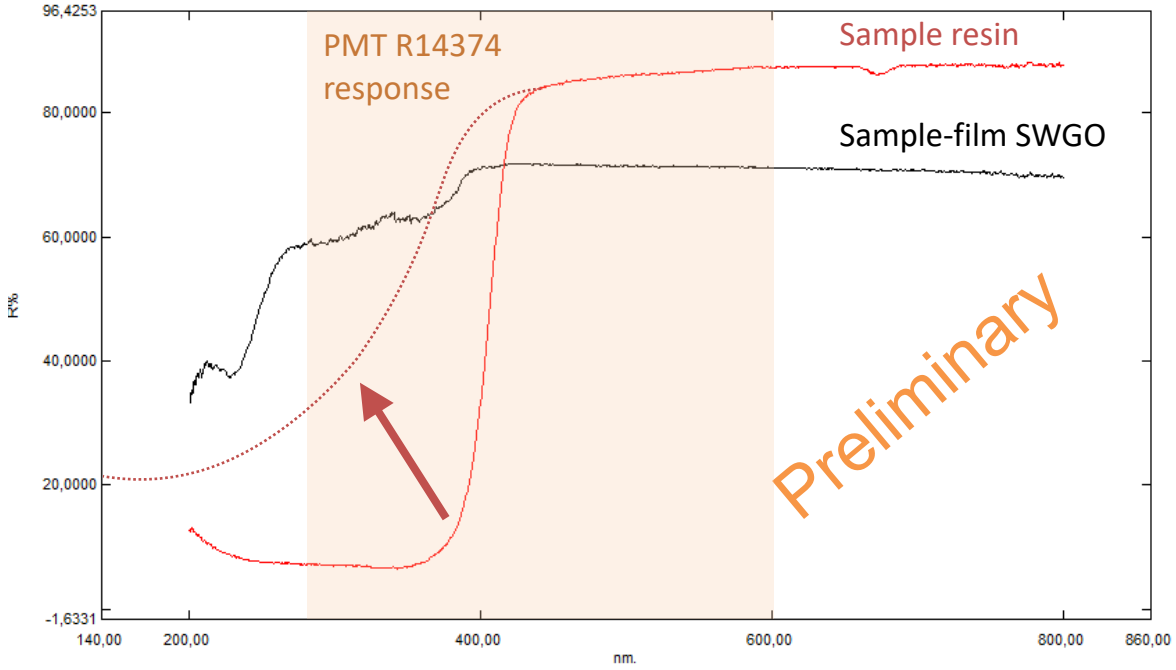

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Further development required below 400 nm, ongoing.

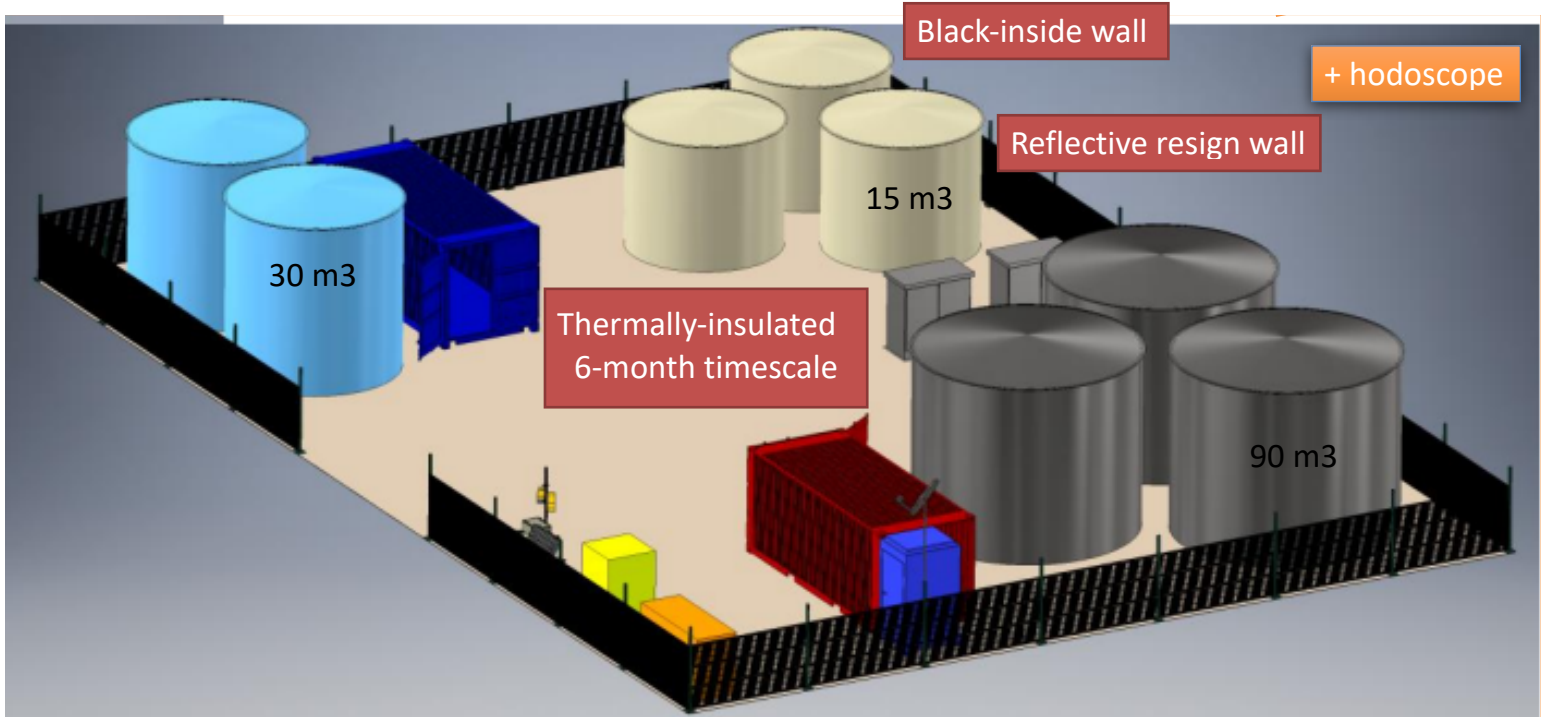
Aimed at being implemented for the insulated tank within next months.

Where are we now?

- HAP notes 23-003, 24-001 describe in detail the production and implementation plan of an E-tank based SWGO array
  - E-tank prototypes are ready to began tests in multiple sites and conditions.
  - CBPF/MCTI invested circa 200 kUSD in the project R&D
  - Integration with multi-PMT module is demonstrated and a complete WCD unit is in operation at CBPF, within an hodoscope
  - The E-tank is the leading outer-array element for SWGO, and tests should direct further optimization.

Coming up in 2026

- **E-tanks will compose the SWGO Pathfinder**
  - We will test various designs: thermal insulation, black or reflective inner wall ==> ready for construction in 2026/27.



Outer array implementation plan

- A single oven can produce 4 tanks a day
- Production model involves fabrication near by the site, at Calama.
- The 4 tanks can be easily transported to the site on two trips, and filled with water with 2 x 30 m^3 tanker truck
- Complete deployment of a water-filled, instrumented tank in circa 4 hours (with 4 ppl)
- We can therefore deploy 4 tanks / day with a crew of 8 ppl :
  - 1000 tanks in one a year
  - A 2000-tanks outer array can be completed in two years.

Production model

- **Rotoplastyc** is a close partner in the R&D phase, including for the development of the rotomolding technique and new reflective resin
- The company is willing to move production of SWGO tanks to Calama
- The project would provide the warehouse + all basic machinery and installations, and contract the production of the tanks.

Production model

- **Scenario:**
  - Calama factory could be established between 2026-27
  - Production & deployment of 1000 outer-array tanks would take place in 2028
  - This gives outer-array activities 2 extra years of optimizations and preparations of various elements

Funding outlook

- We have started discussions with FINEP and MCTI.
- Waiting for a meeting to take place for presenting a formal request of funds.
- Exact values are TBD, but aim to > 4 MUSD (or equivalent to build at least 1,000 tanks + the necessary logistical support for construction)
- If approved, disbursement would start in 2026, planned in 3 installments:
  - 2026-27 : preparations and factory set up
  - 2028 : tank construction and deployment