

# FLOATING OFFSHORE SOLAR PANELS

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General Presentation

GTER – 5<sup>th</sup> of May 2015



## THE PARTNERS

- **4C SOLAR INC.**

- Developed the technology
- Holds the patent
- Looks forward the technology commercialization



- **EURL MP**

- Helps in finalizing the technical development
- Represents the interest of 4C SOLAR in Chile



## WHY FLOATING SOLAR PANELS AT SEA?

Considerable results have been attained for solar PV in 2014.

However, the reality of exploiting copes with several critical problems:

- **Temperature drift:** lower efficiency when weather conditions are optimal for energy production. This reduction can reach the 30% with summer radiation conditions.
- **Cleaning of the panel :** dust or birds reduce PV panel efficiency and maintenance is expensive.
- **Mining concession :** it represent a risk for investors.



## WHY FLOATING SOLAR PANELS AT SEA?

**4C SOLAR** technology has the following advantages:

- No water required for cooling and cleaning
- Higher efficiency (+15%) thanks to better cooling
- Reduced maintenance costs
- Reduced erection times and costs
- Ideal for seismic areas
- No land occupation – No mining concession



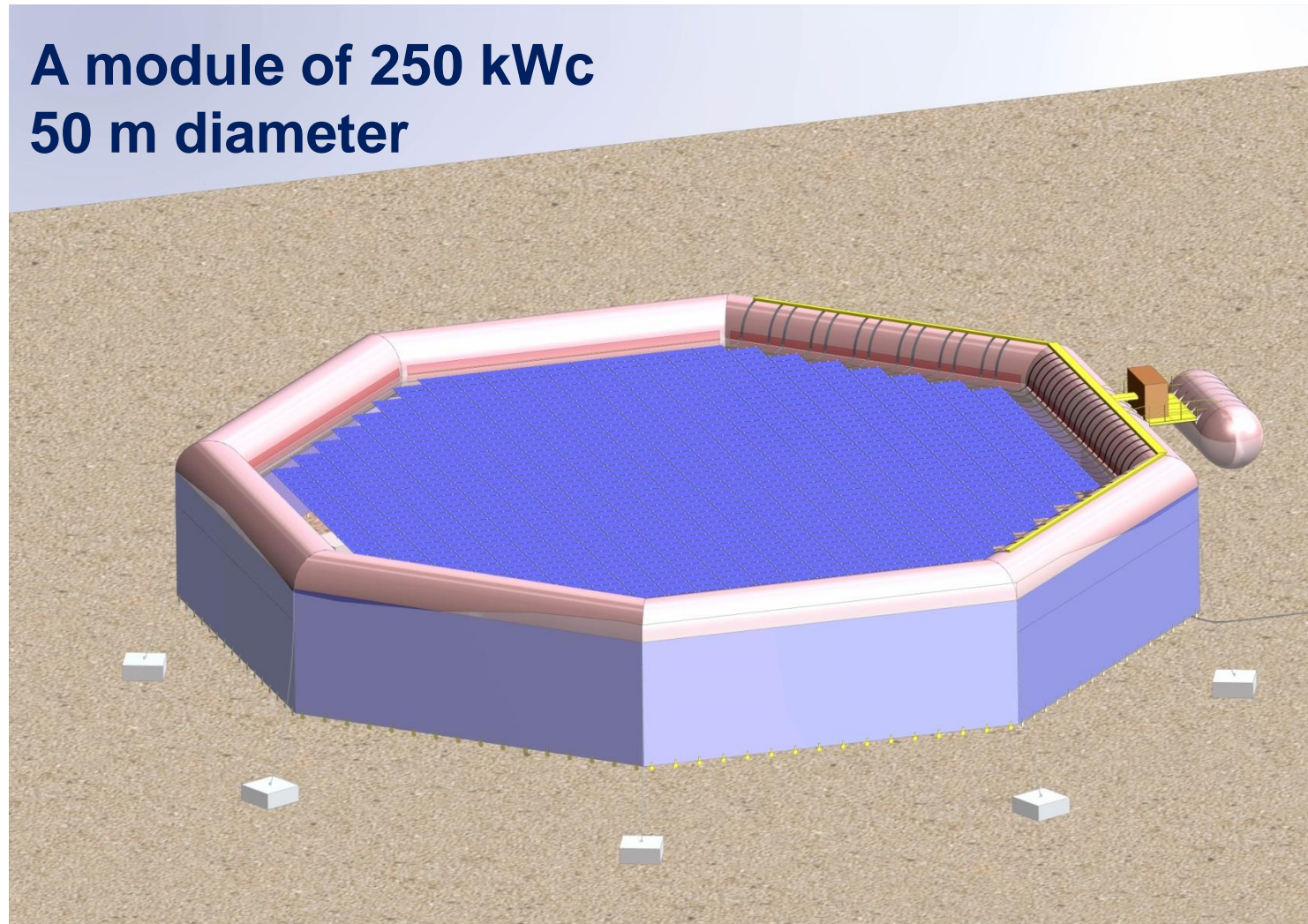




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## 4CSOLAR TECHNICAL SOLUTION

**A module of 250 kWc  
50 m diameter**



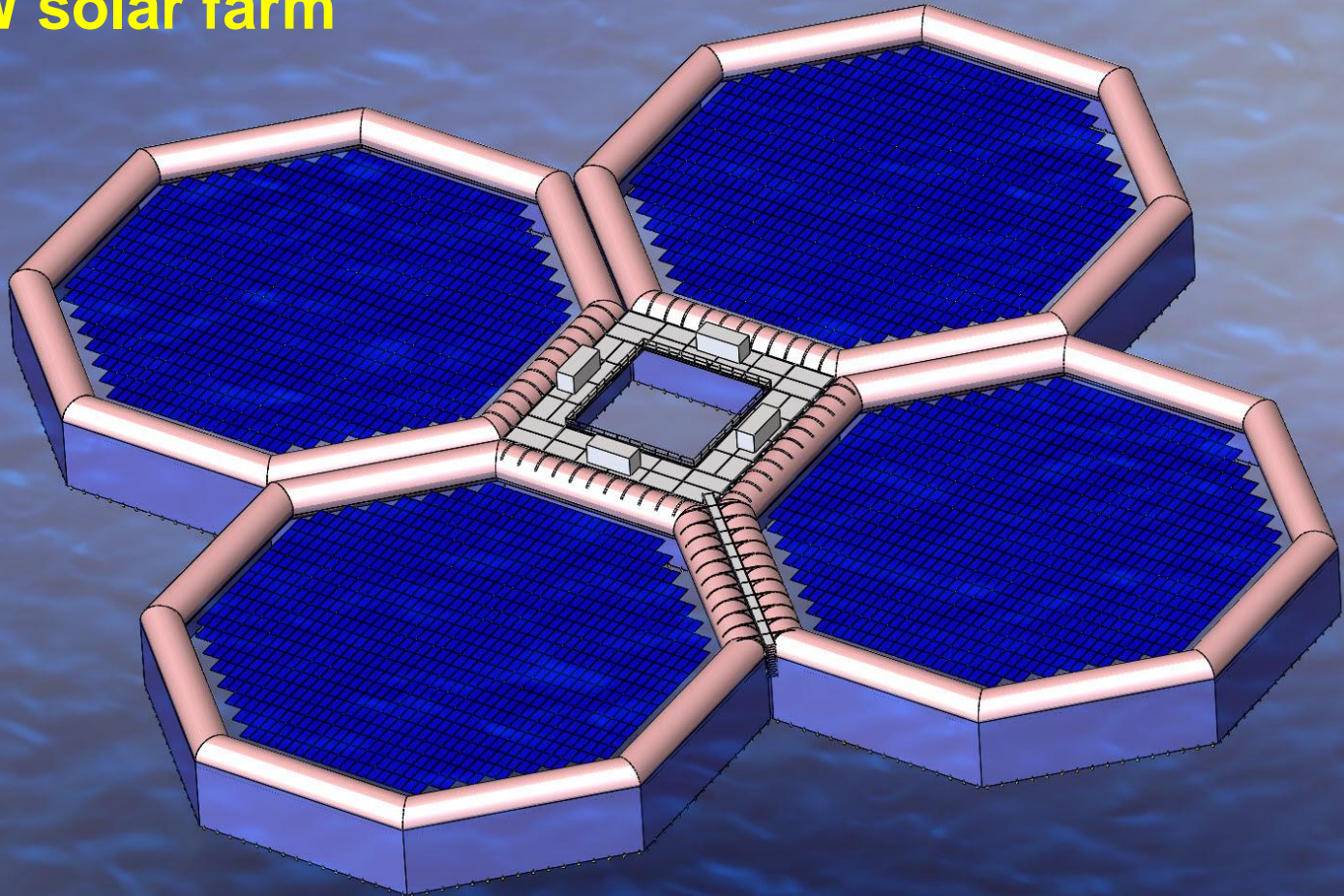




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# A MODULAR APPROACH FOR COST EFFICIENCY

**1MW solar farm**

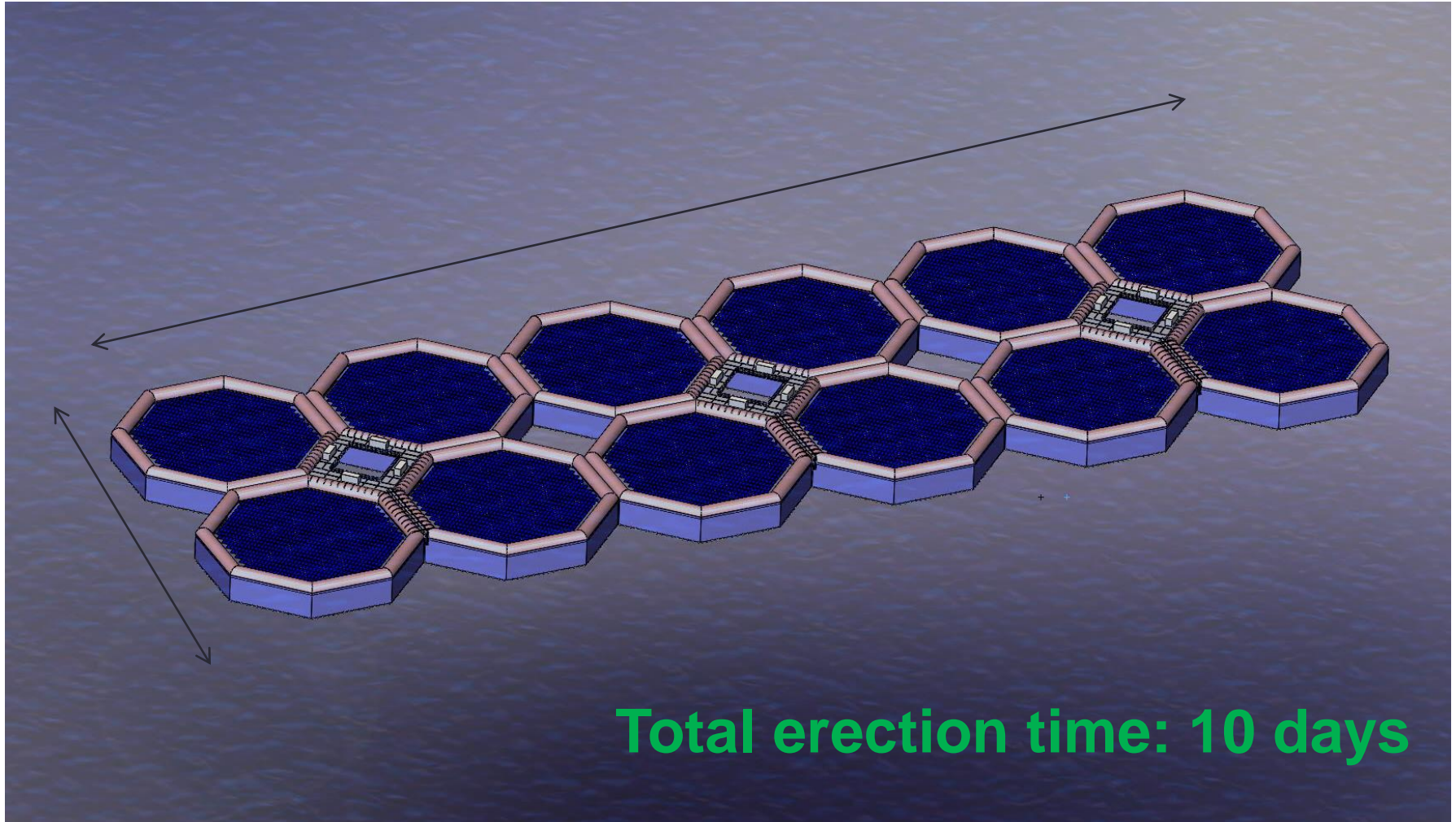






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# EXAMPLE OF 3 MW SOLAR OFFSHORE PLANT

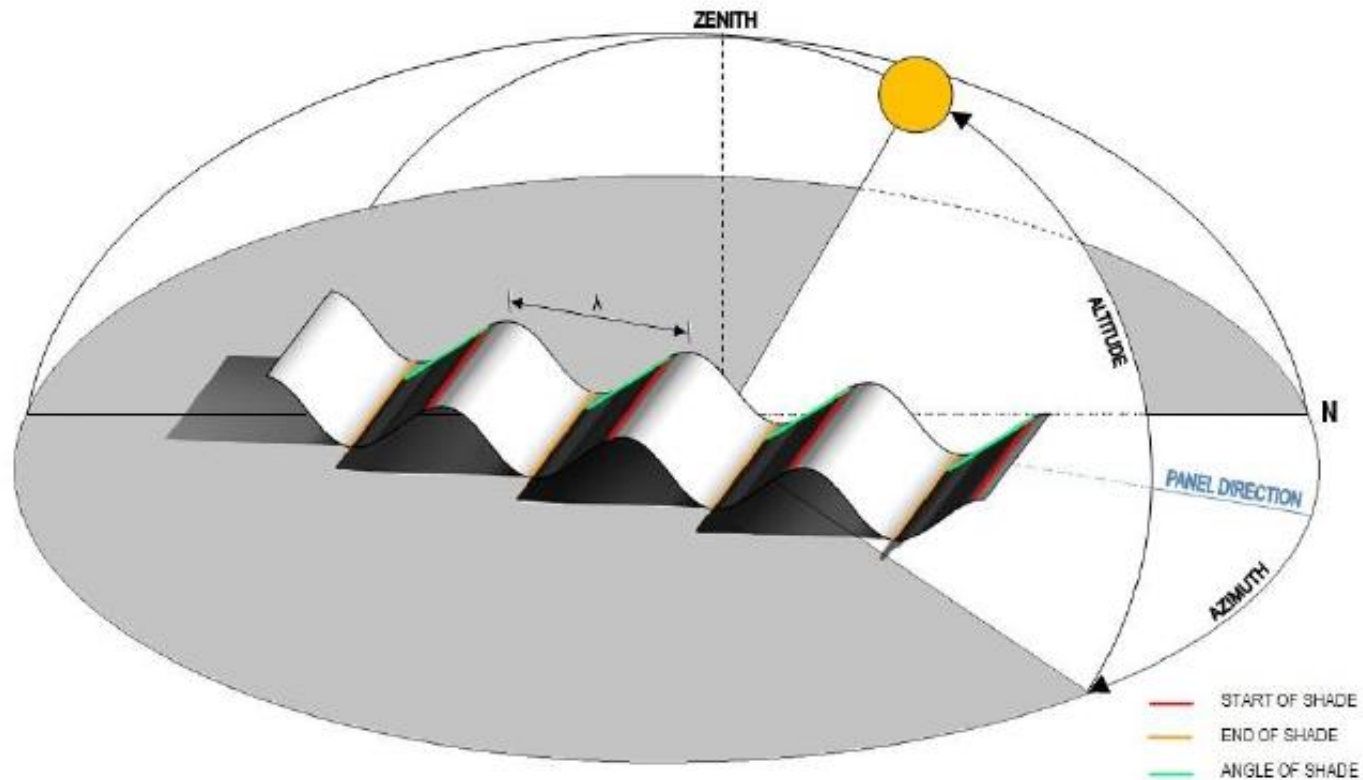


**Total erection time: 10 days**



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## SUNLIGHT AND WAVES



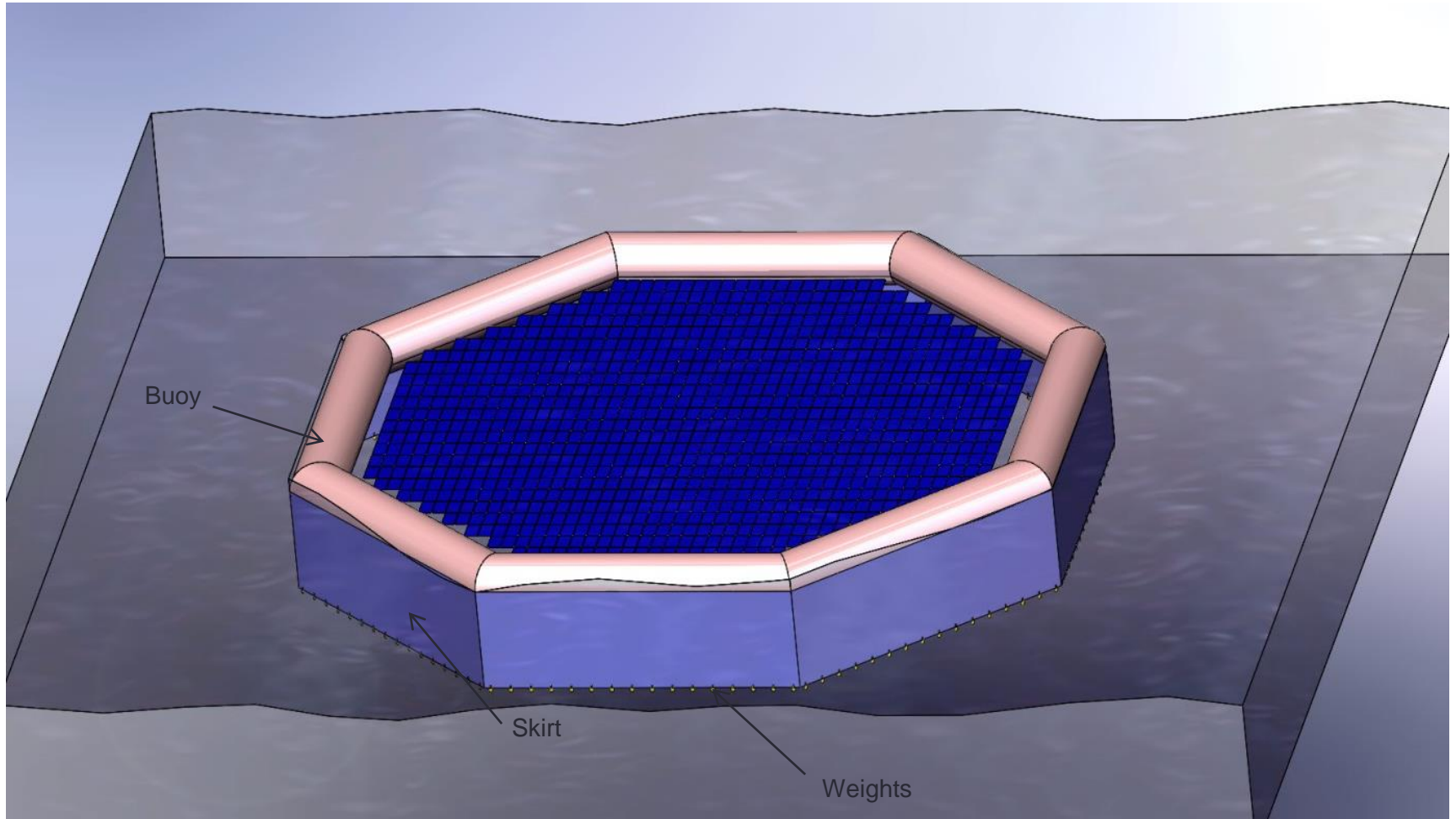
Wave braking system mandatory for offshore solar energy efficiency





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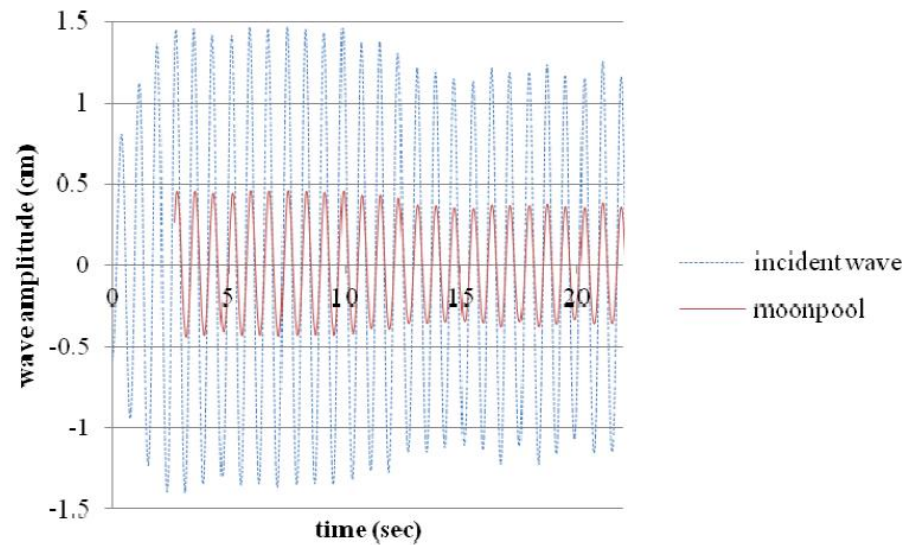
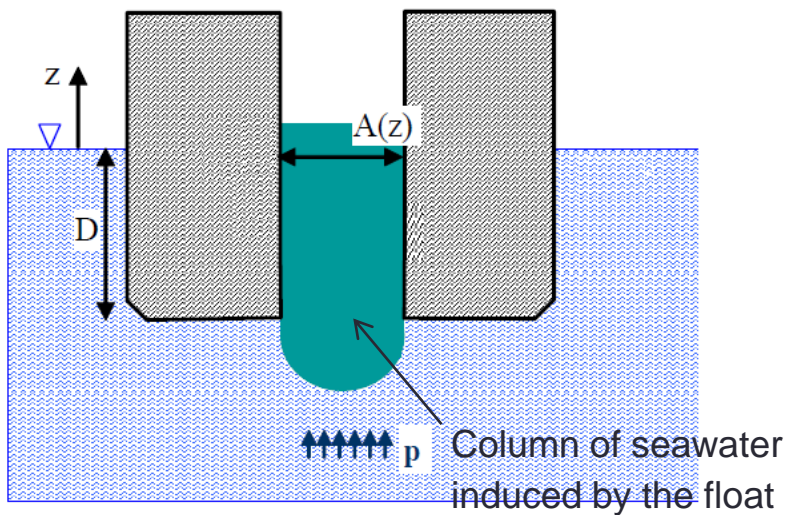
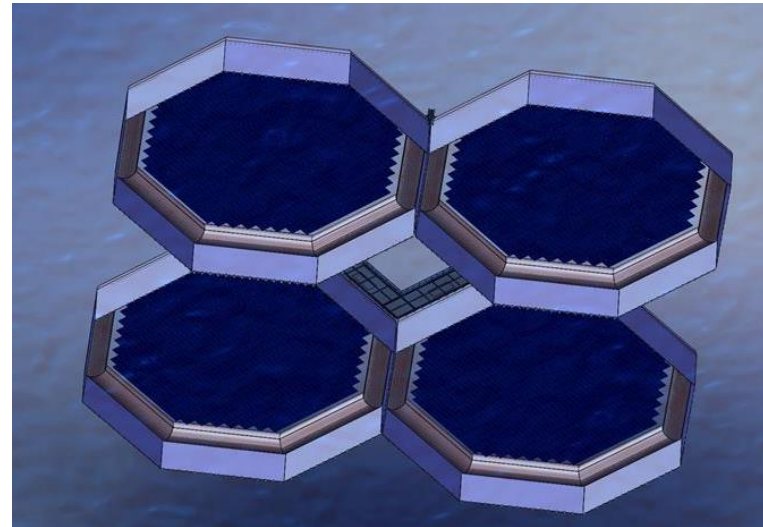
## NO WAVE INSIDE THE BUOY THANKS TO THE MOONPOOL CONCEPT





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## THE MOONPOOL EFFECT

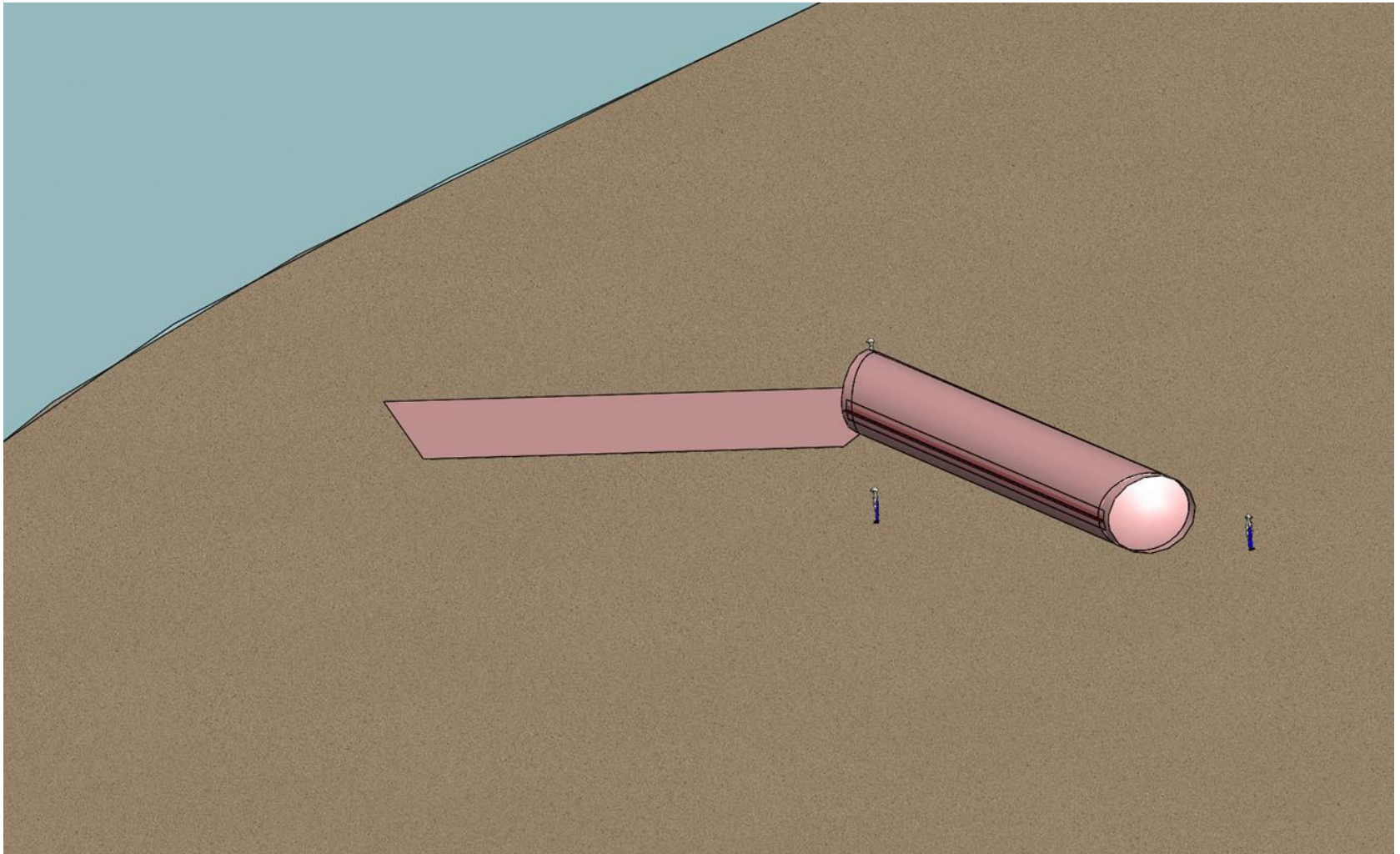






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## ONSHORE ASSEMBLY PROCESS

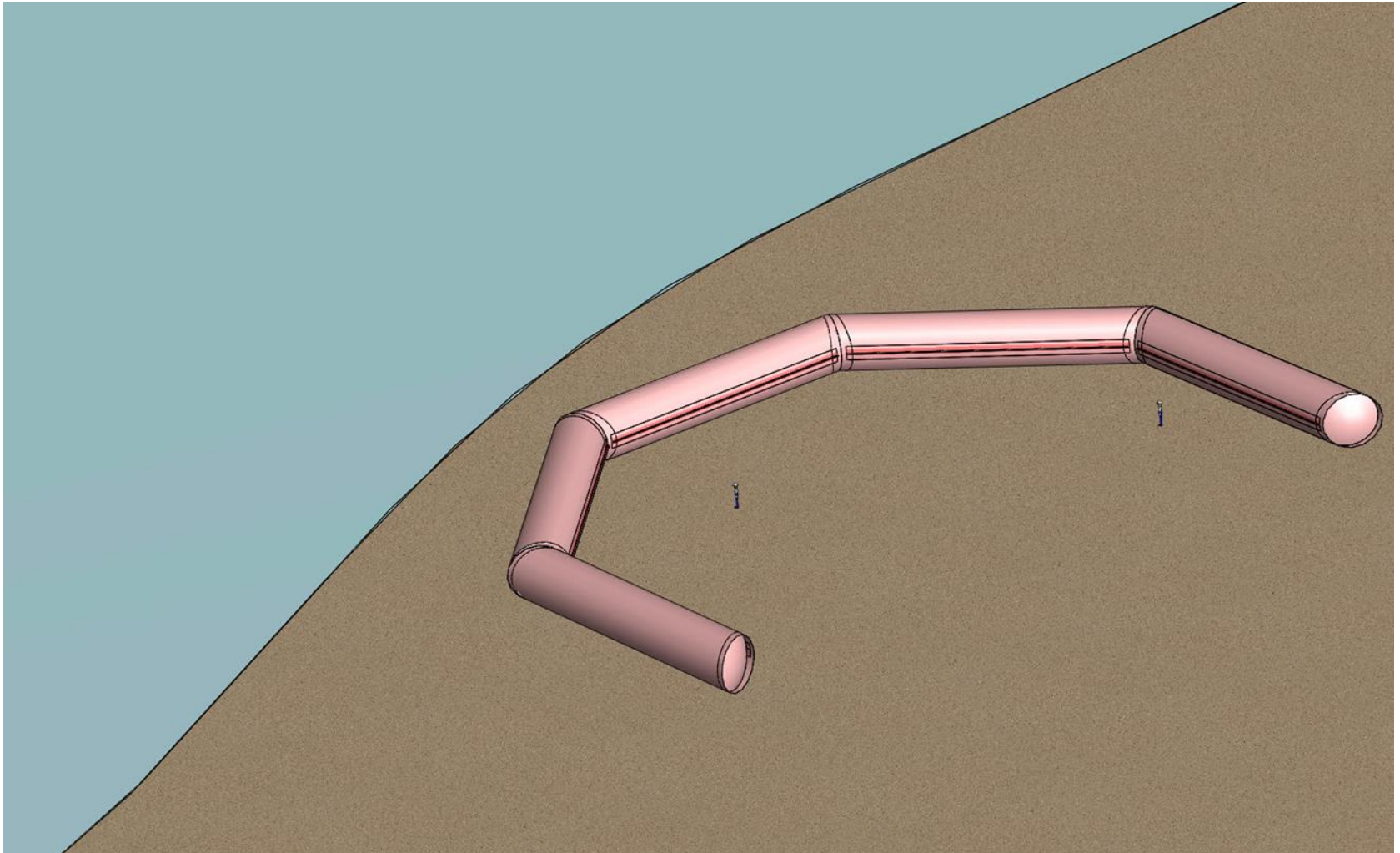






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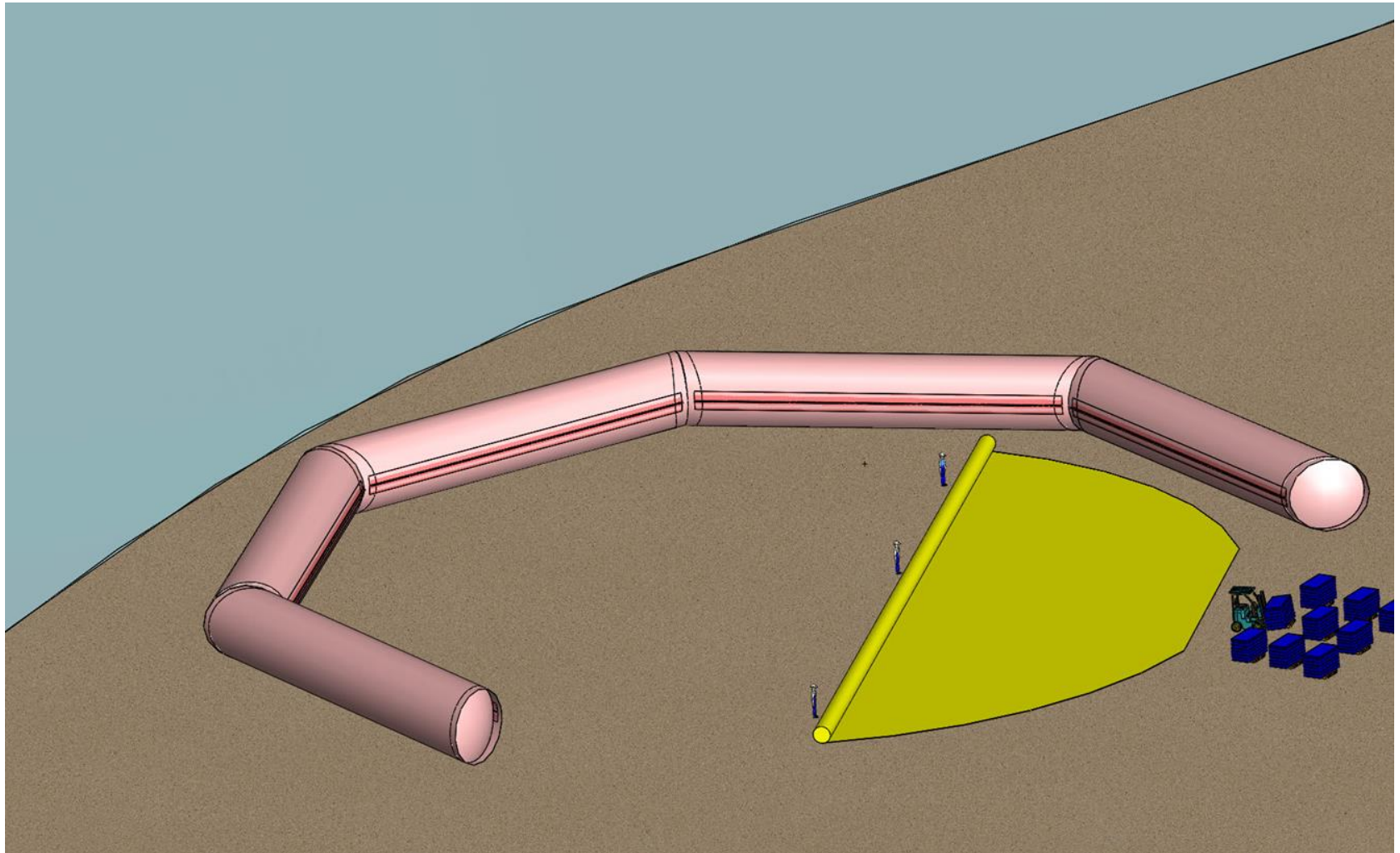
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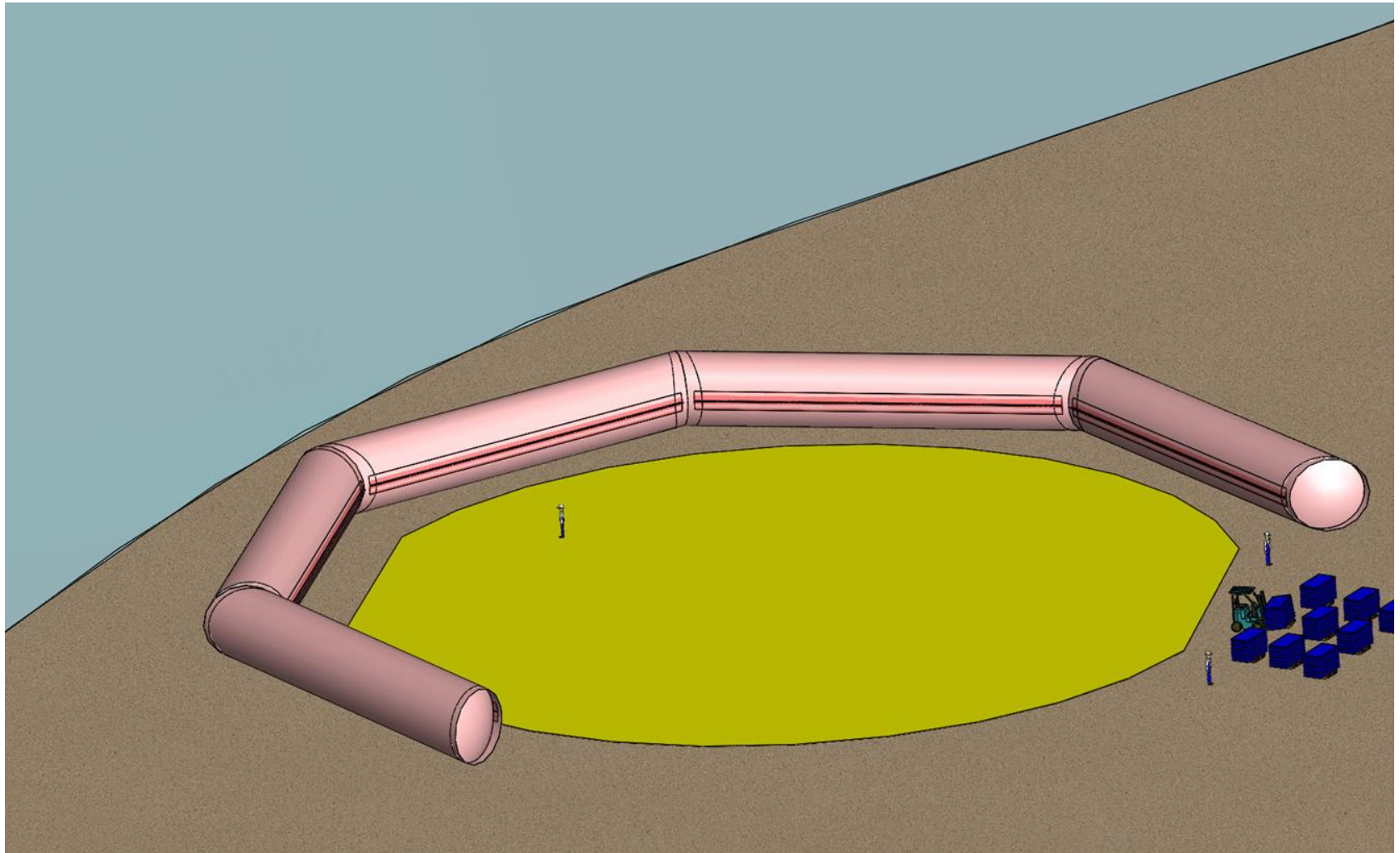
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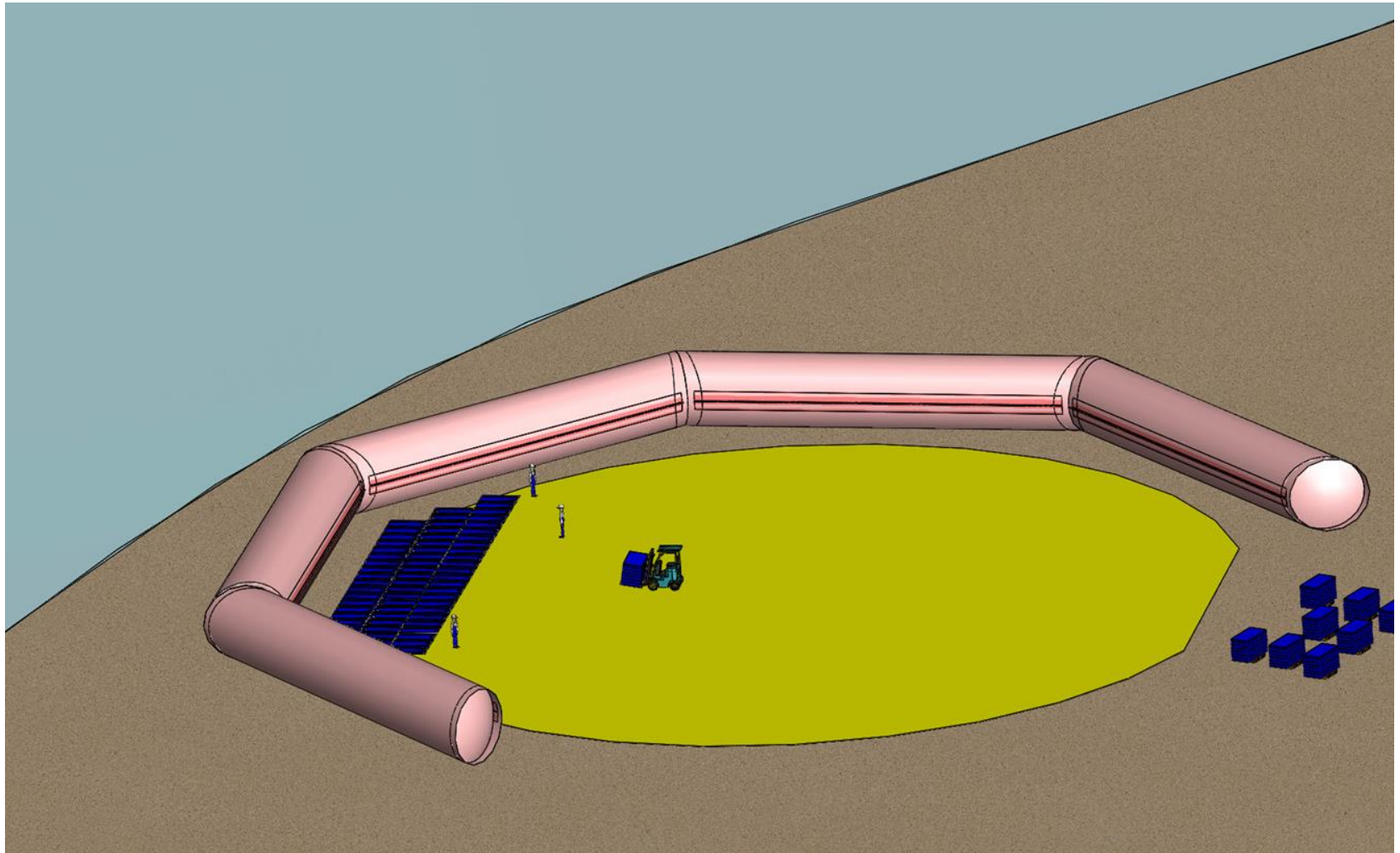






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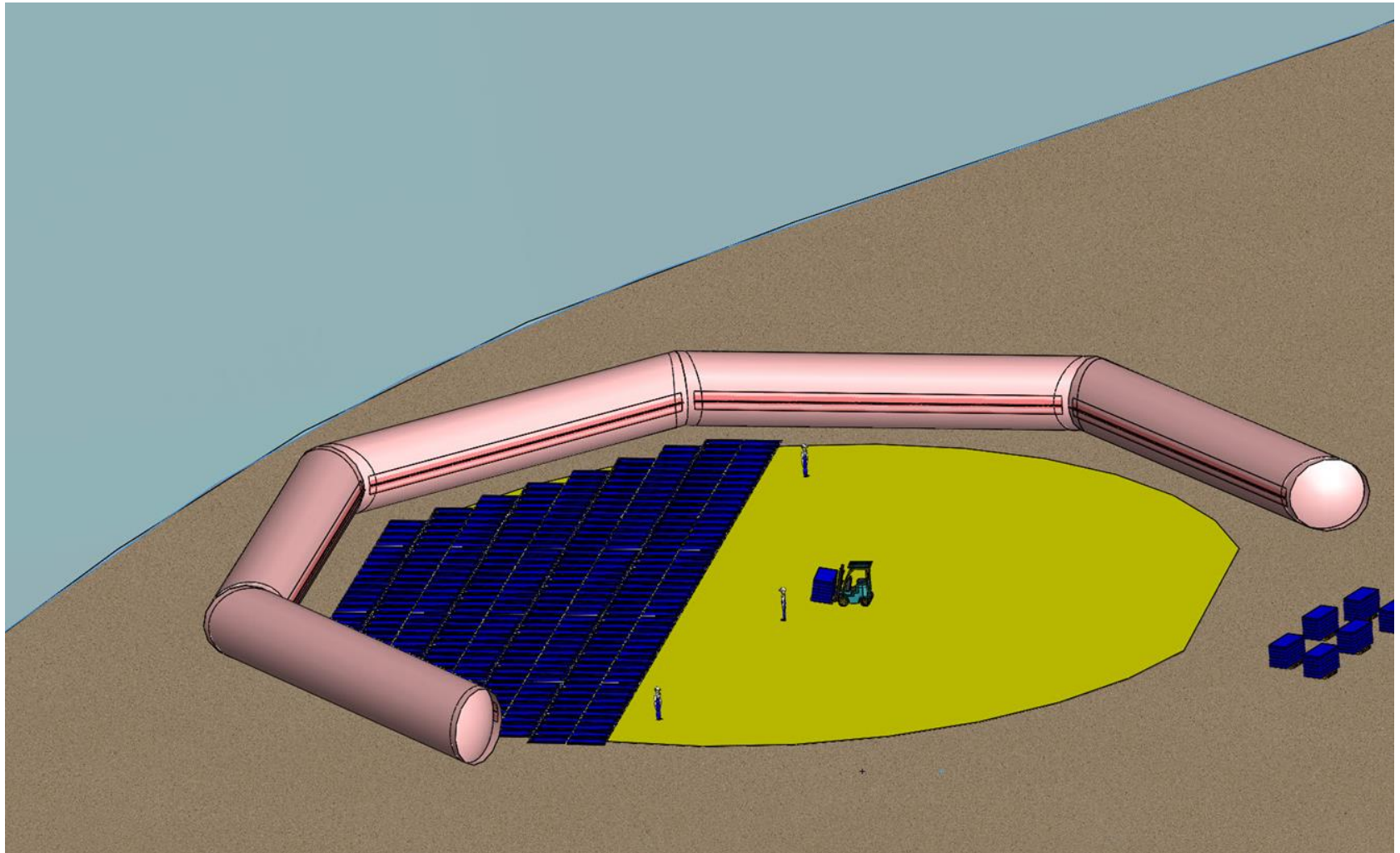
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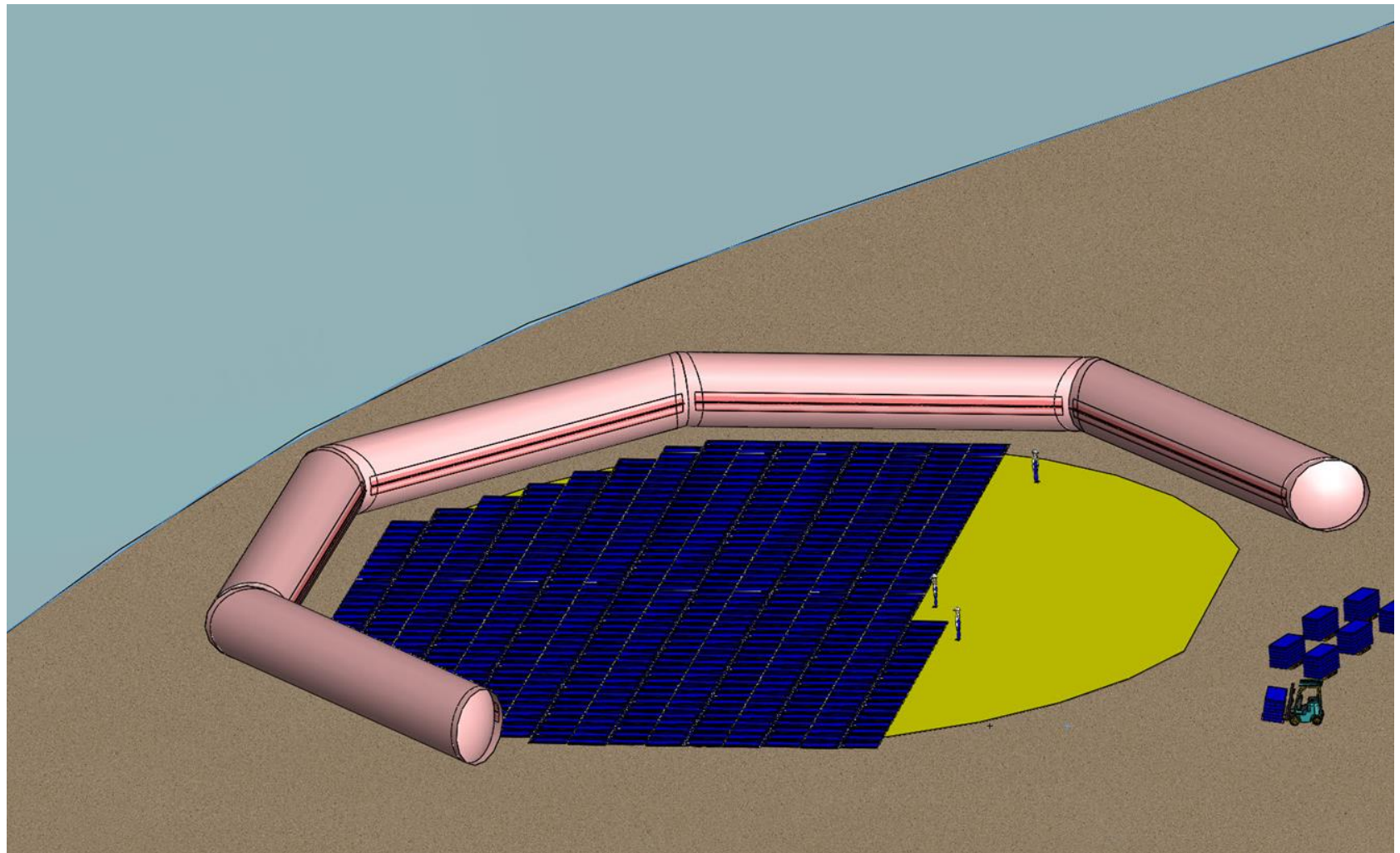
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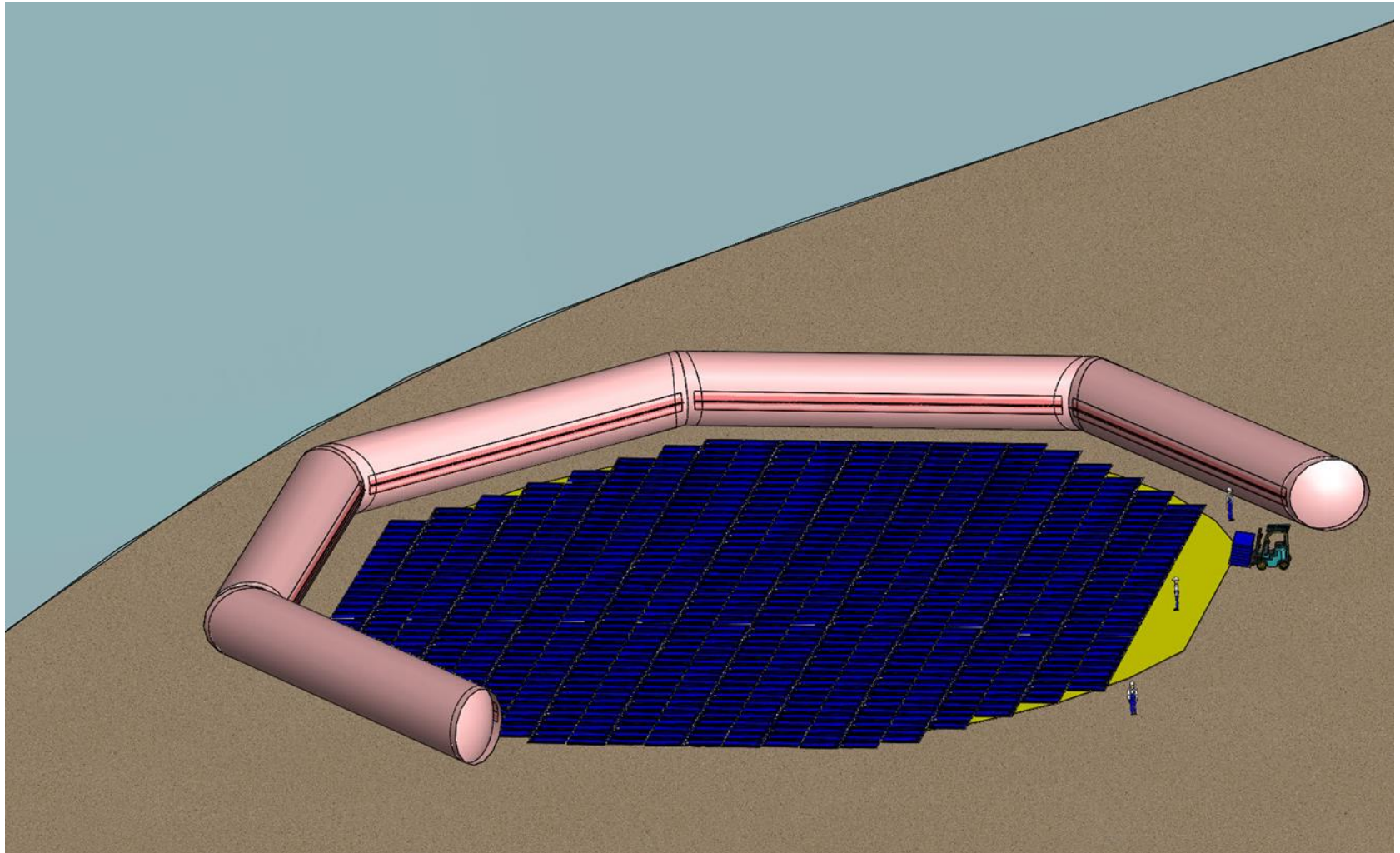






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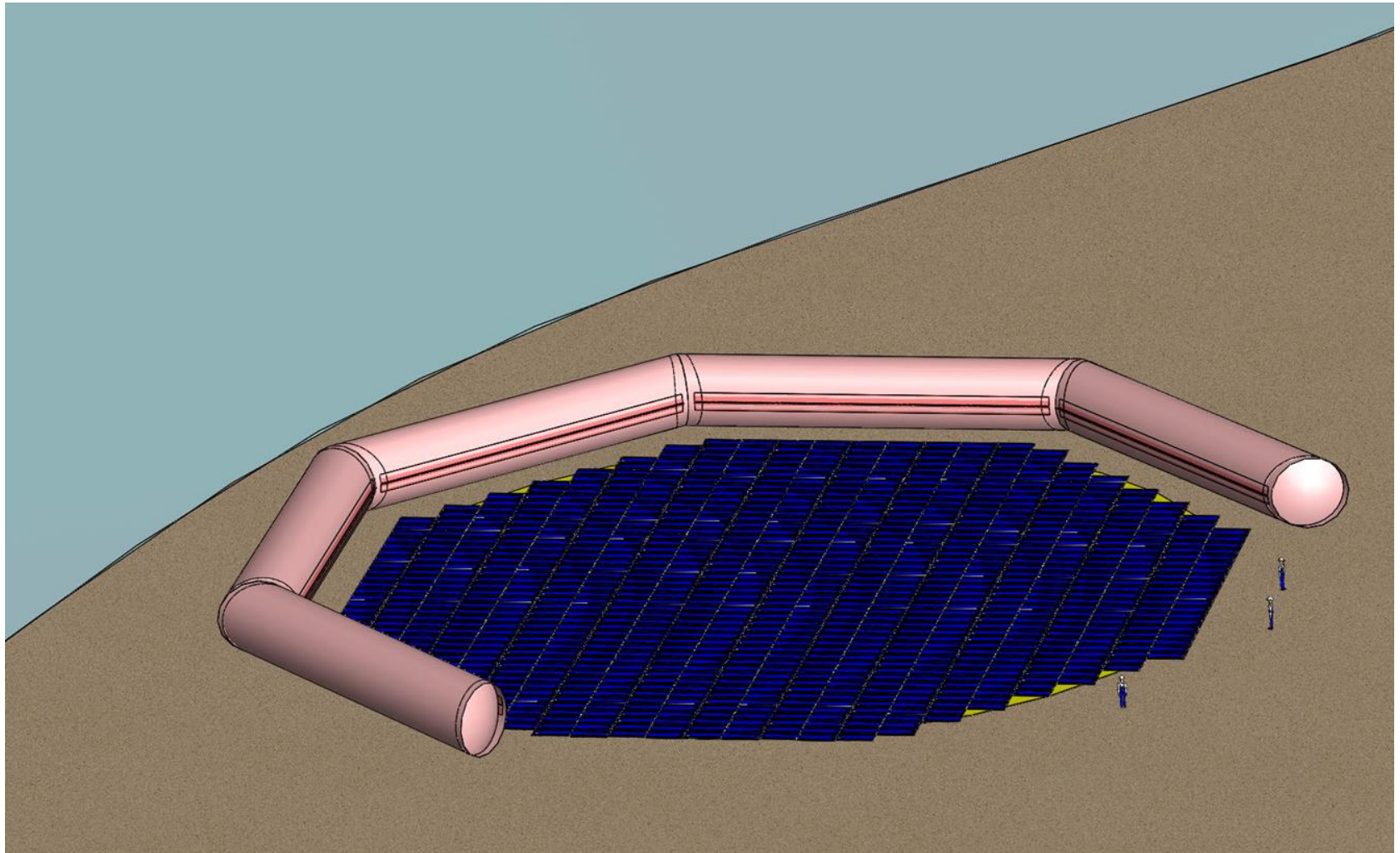
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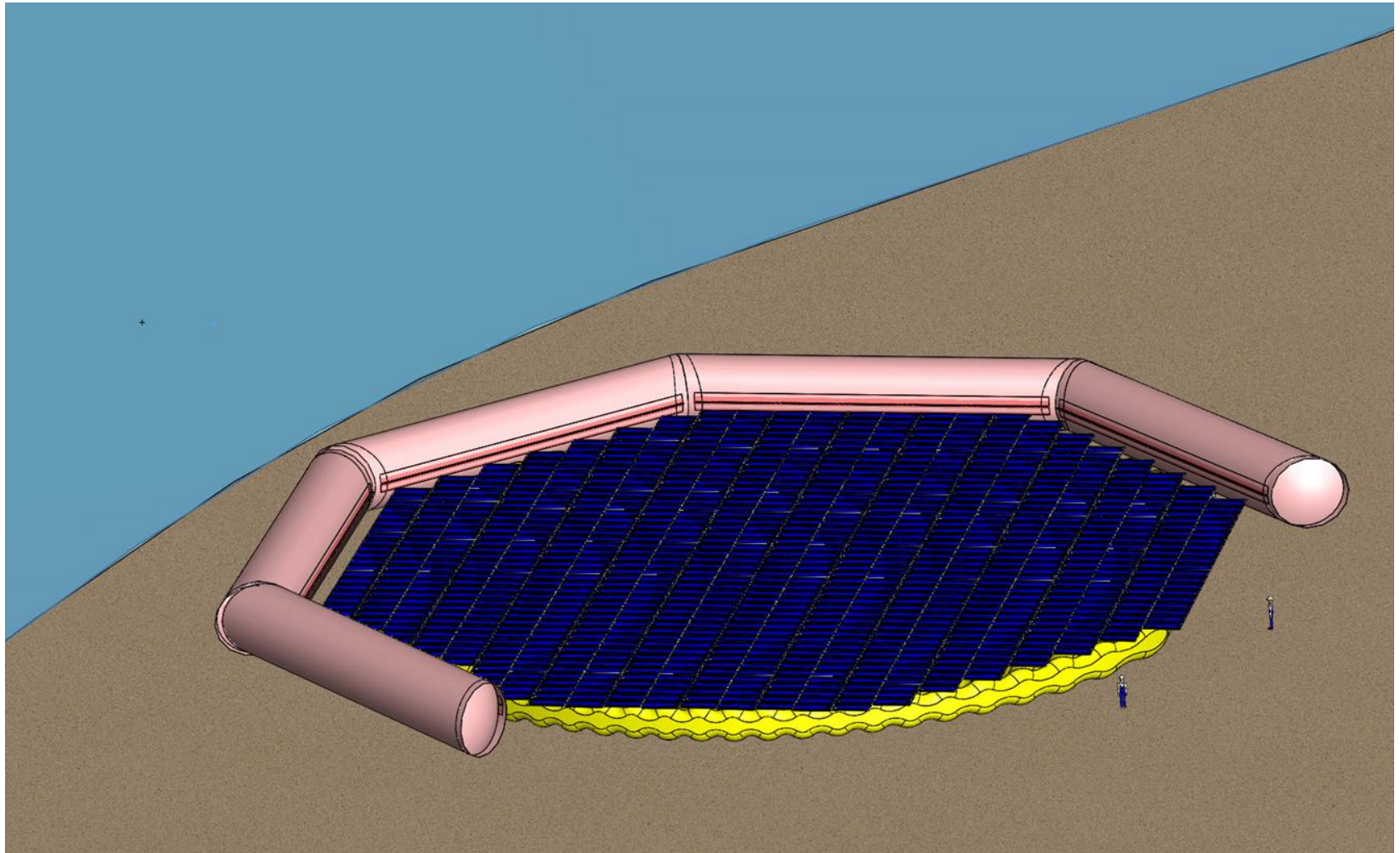






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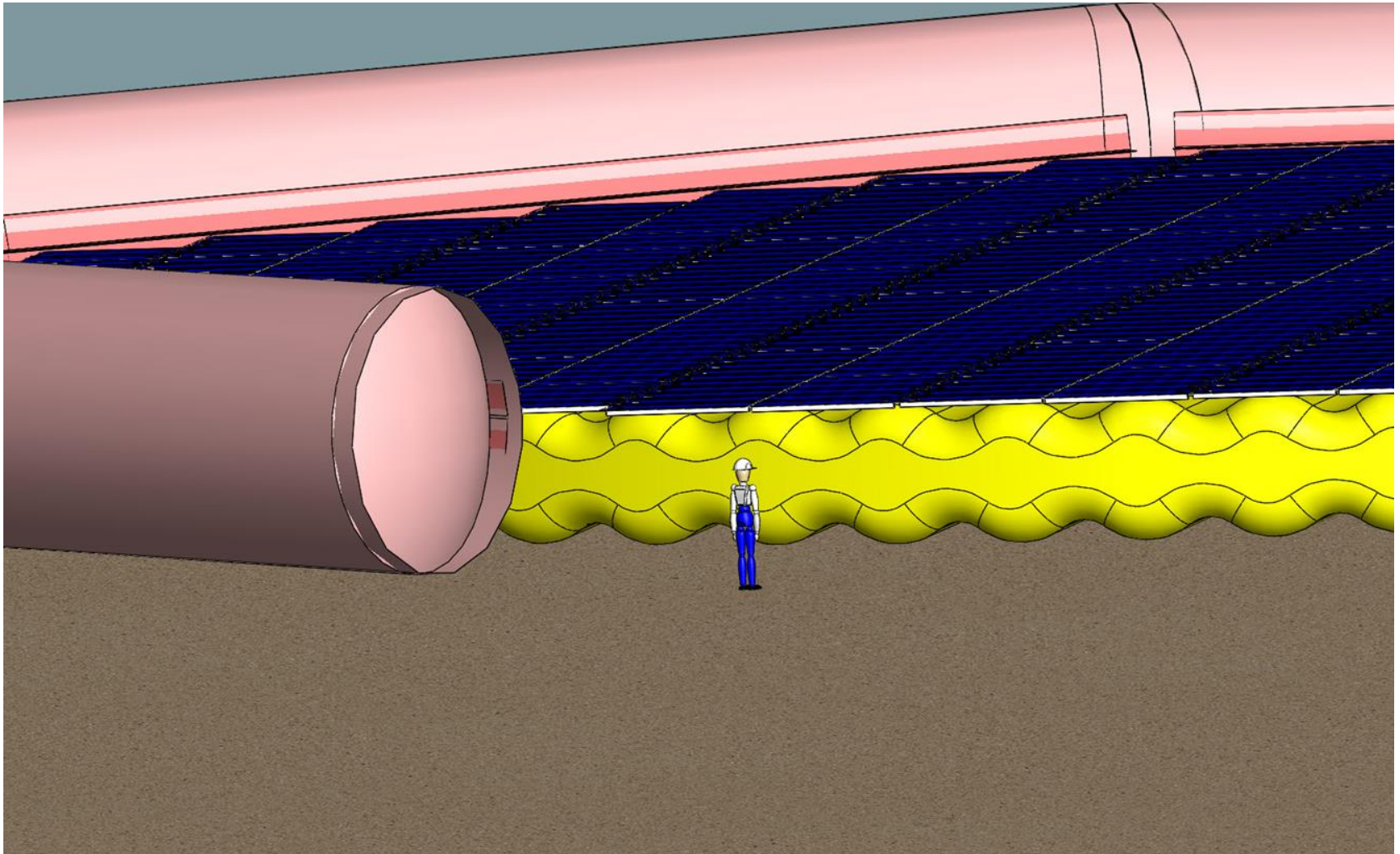






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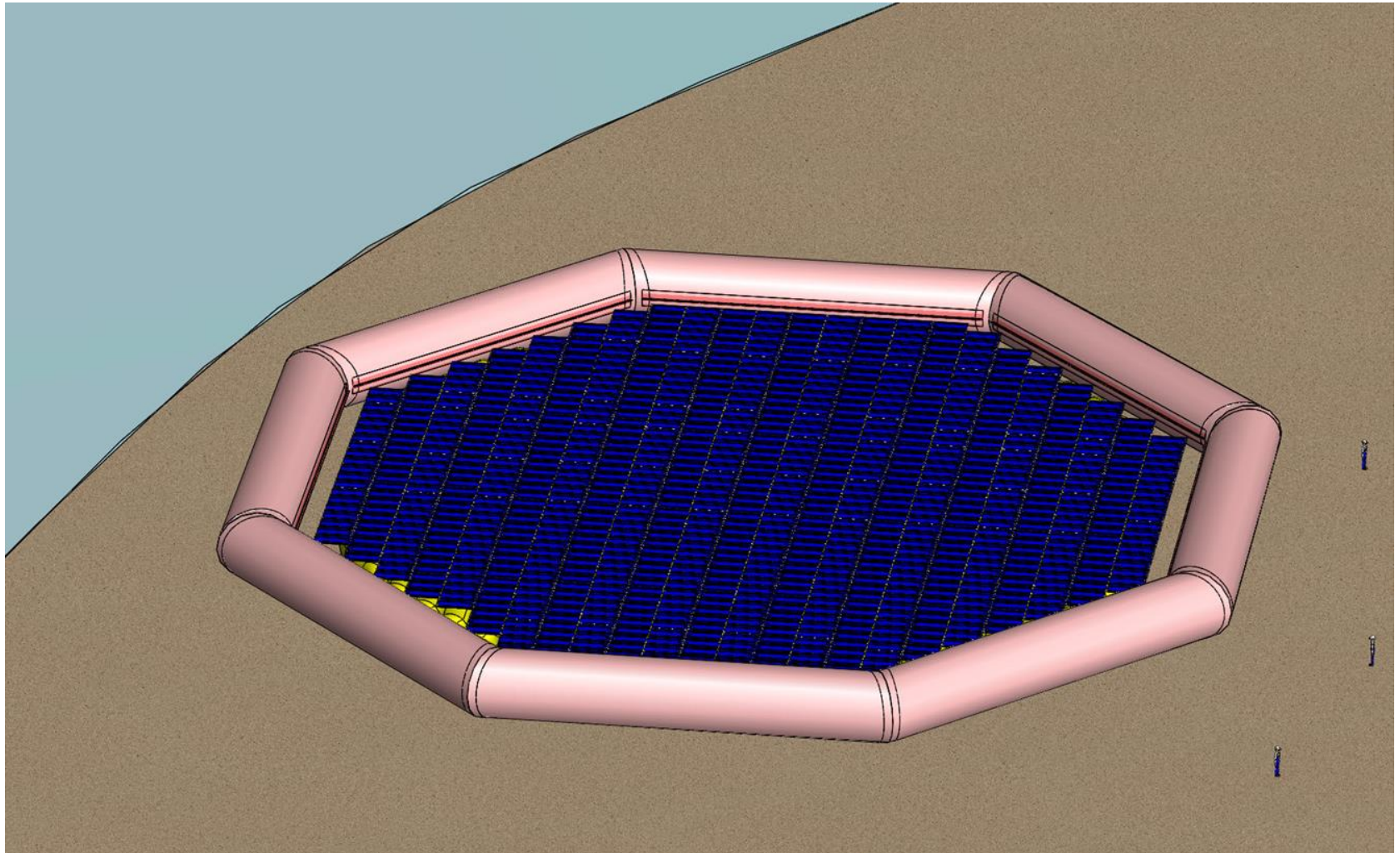
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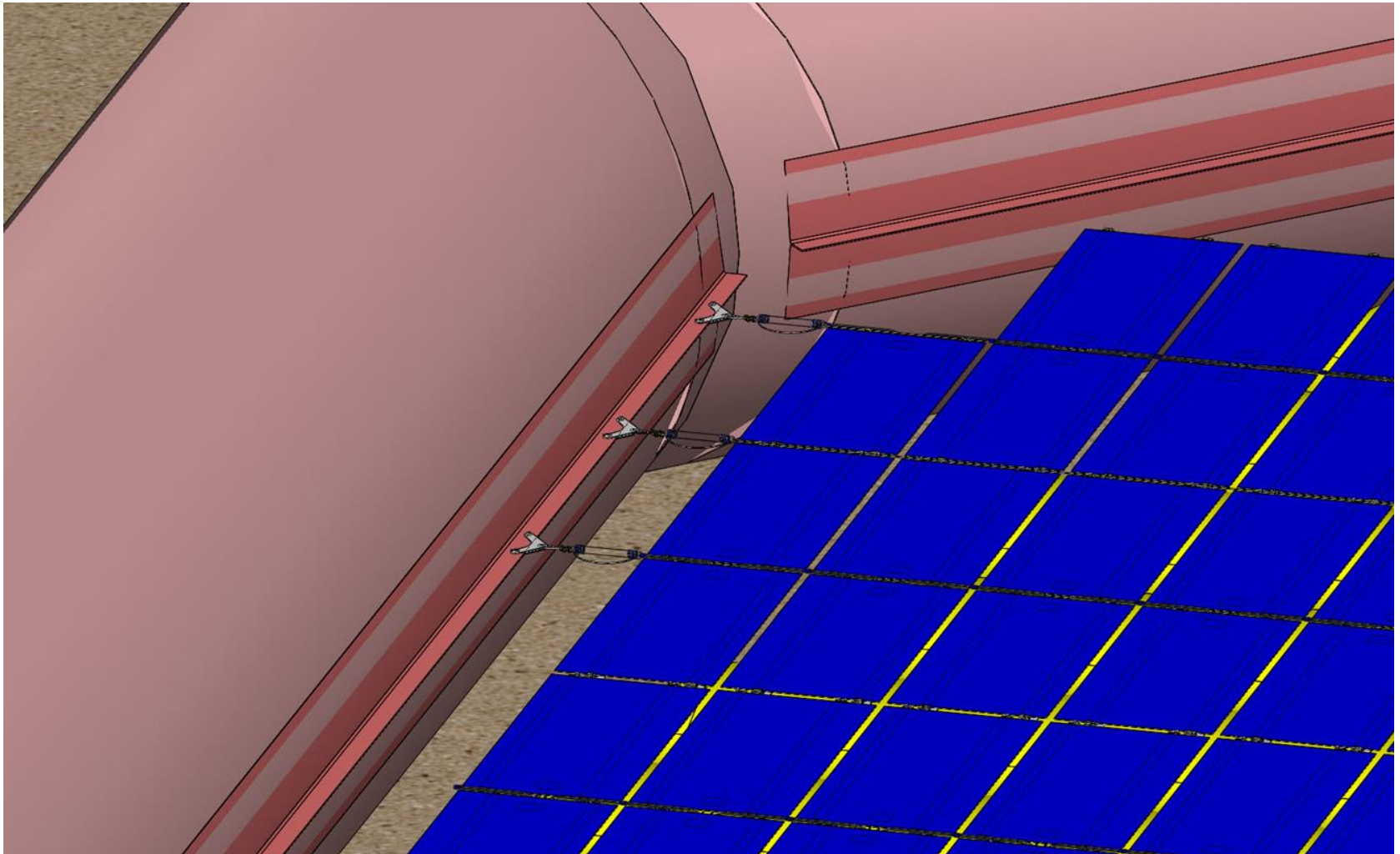






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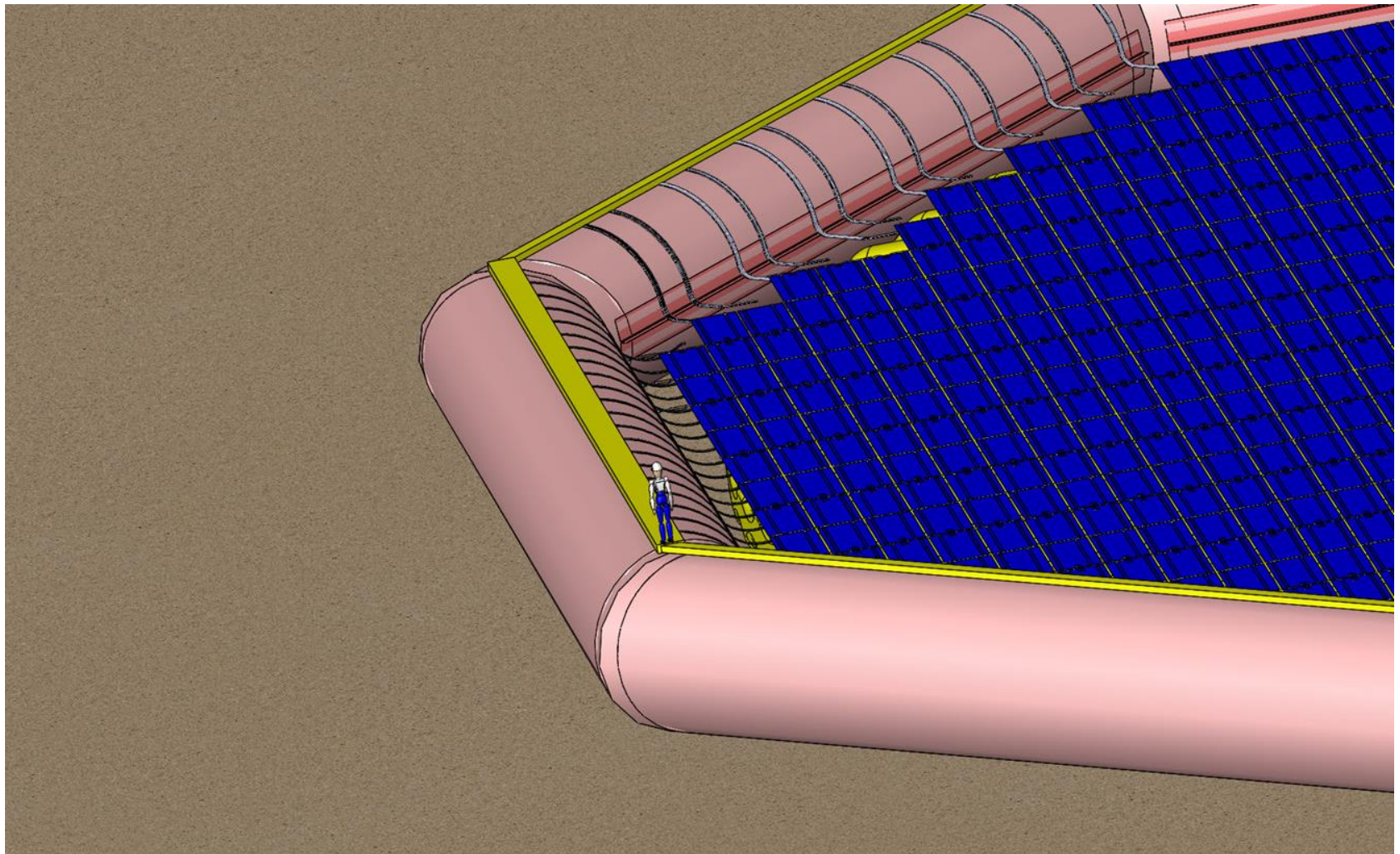






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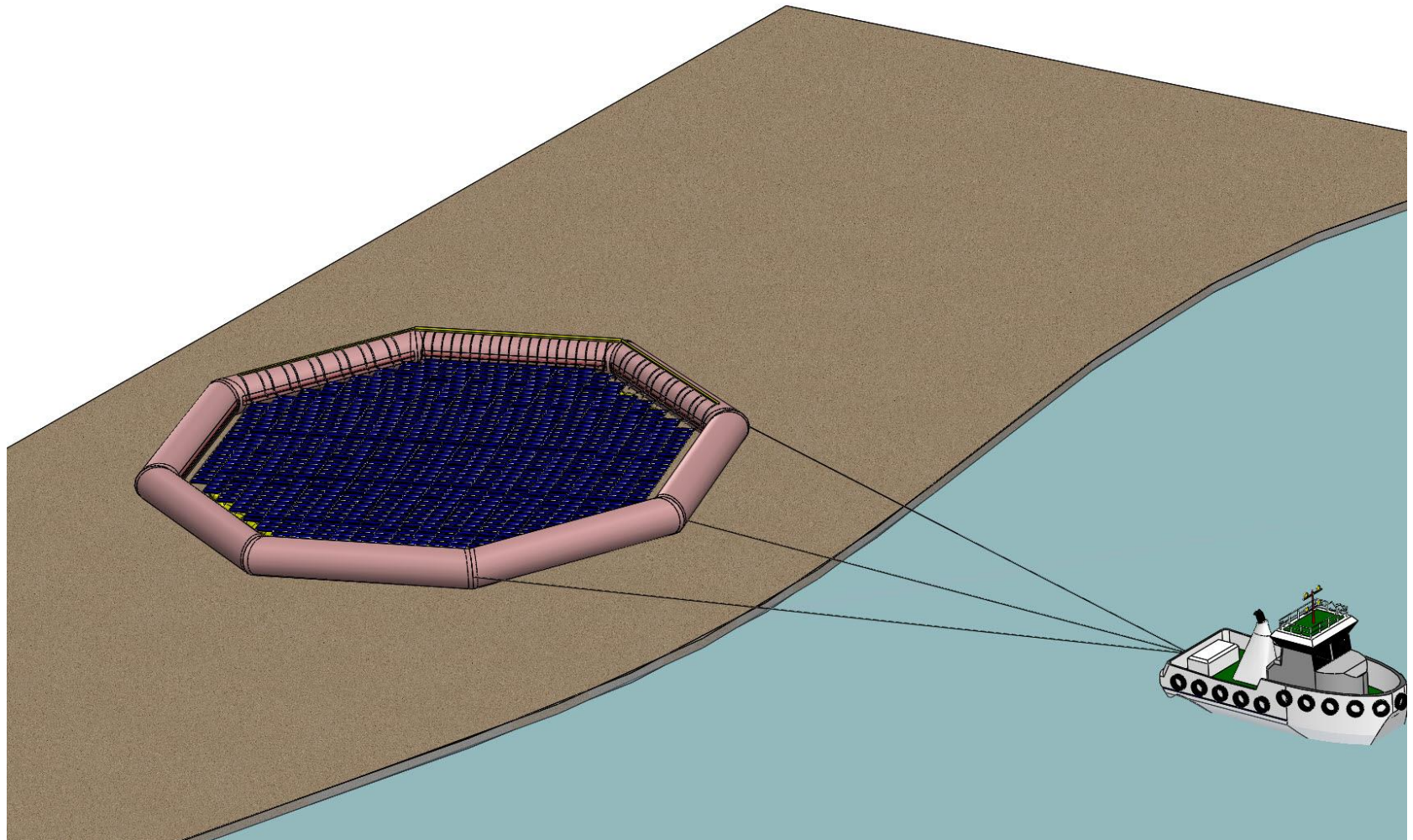
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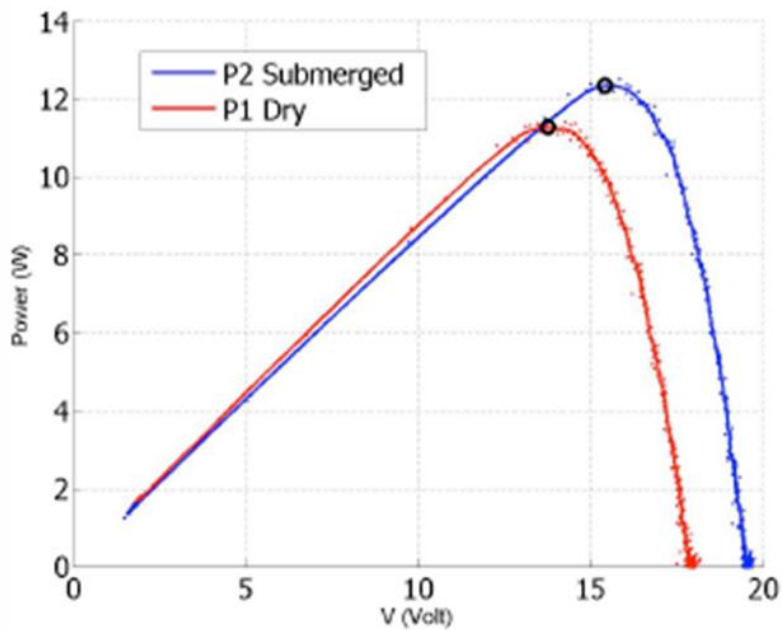
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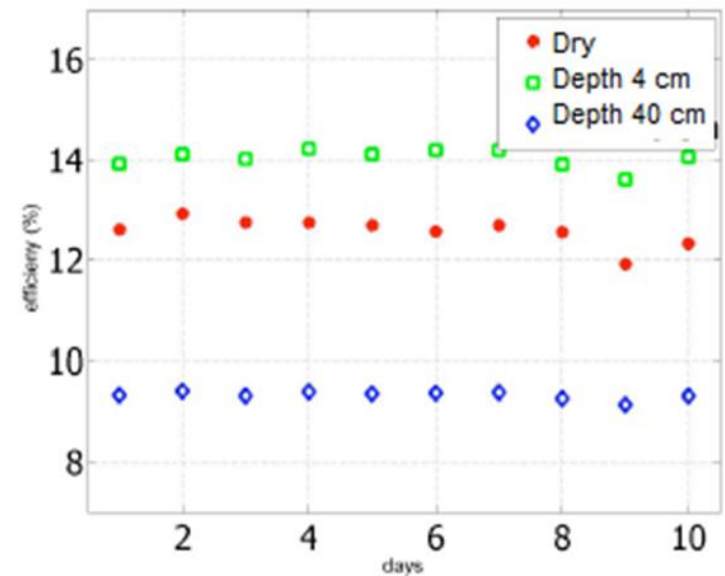


## EXPERIMENTAL RESULTS: +15% EFFICIENCY

I-V Plot depth= 4 cm



Measured relative efficiency



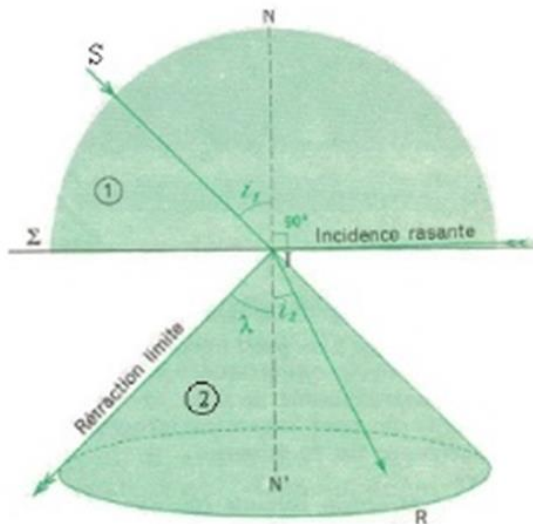
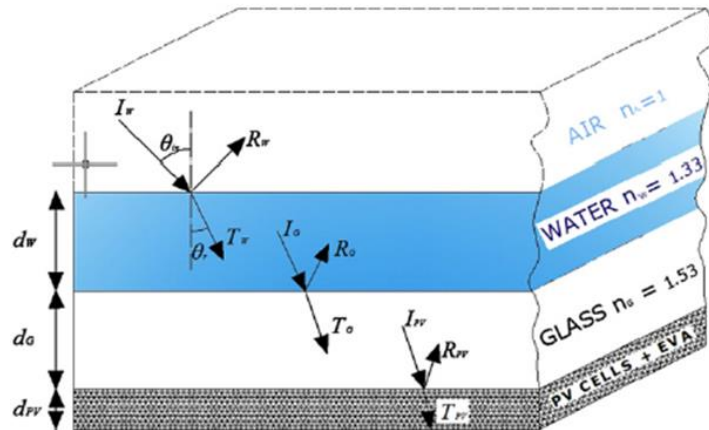
**Average efficiency increase : +15%**



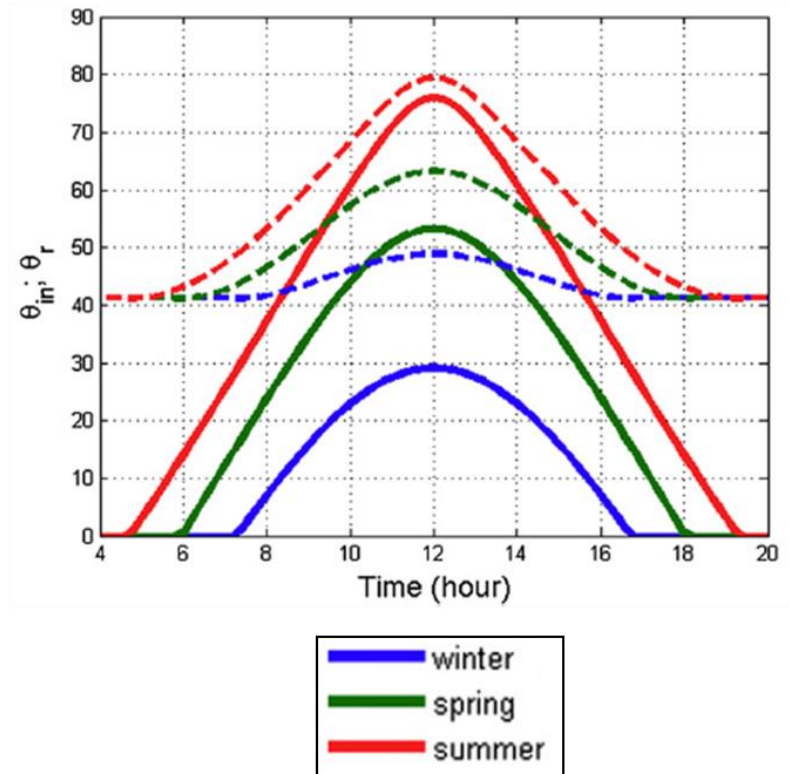


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# REFRACTION AND « FRESNEL EFFECT »



Seawater concentrates sunlight  
in a perpendicular direction  
towards the solar PV panel

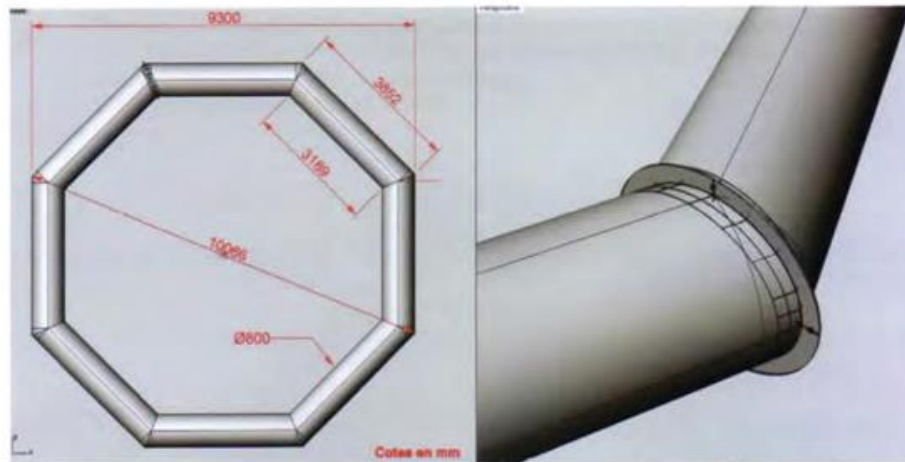
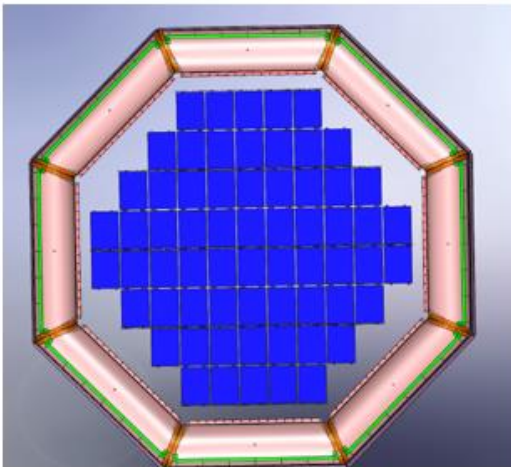


- Power density: **135 W/m<sup>2</sup>** (offshore footprint)
- Hours of sun (@full power): **2'100 hrs/year – 24% load factor**
- CAPEX (incl. grid connection): **1.65 M\$/MW**
- OPEX: 1% of the CAPEX per year
- Interest rate 5%, WACC 10%, Inflation rate 3.5%
- Basic LCoE : **98 \$/MWh**



## WHAT ARE THE NEXT STEPS ?

1. **Test of 10m diameter prototype – 5 kWc – Offgrid – Close to shore**



2. **Installed in harbor of Mejillones**
3. **LABORELEC (GDF-Suez) will survey the tests**
4. **Scale-up in Chile in 2016 ?**