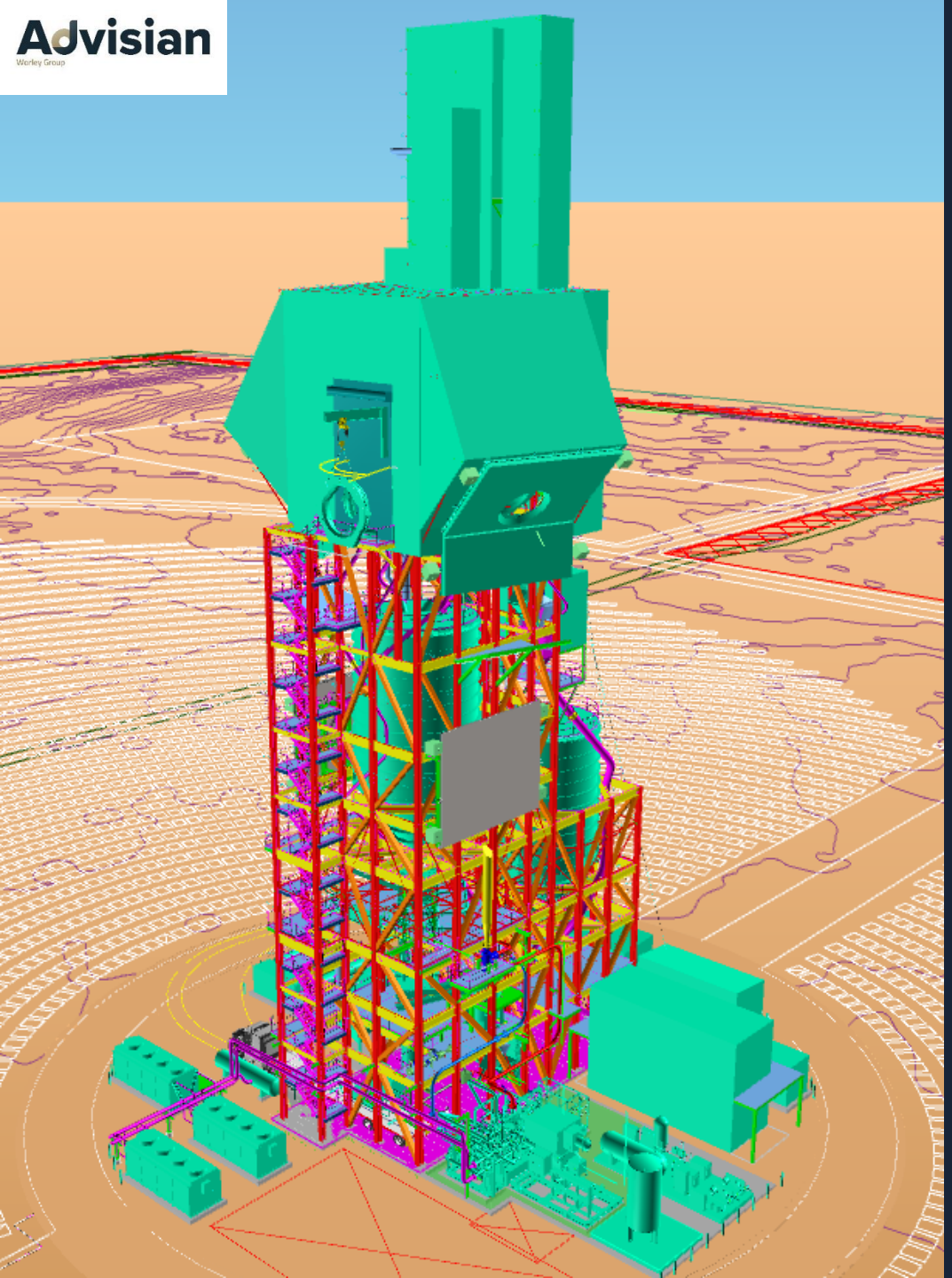

Integrated Thermal Energy STorage and Brayton Cycle Equipment Demonstration

Project Design Basis

- Masih Jorat
- Matthew Carlson
- Amanda Gold
- Capella Engineering Team

8th International Supercritical CO_2 Power Cycles • February 27 – 29, 2024 • San Antonio, TX, USA

Acknowledgements/Disclaimers

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Forward-Looking Statements

This presentation includes "forward-looking statements" for purposes of the safe harbor provisions under the United States Private Securities Litigation Reform Act of 1995. Statements that are not historical in nature, including the words "may," "will," "anticipate," "intend," "expect" and other similar expressions are intended to identify forward-looking statements. These forward-looking statements include, but are not limited to, statements regarding benefits and efficiencies of a hybrid concentrated solar solution and achievement of such efficiencies and goals. Forward-looking statements are predictions, projections and other statements about future events that are based on current expectations and assumptions and, as a result, are subject to risks and uncertainties. Many factors could cause actual future events to differ materially from the forward-looking statements in this press release, including but not limited to: i) our financial and business performance, including risk of uncertainty in our financial projections and business metrics and any underlying assumptions thereunder; (ii) the delisting of our common stock on the New York Stock Exchange; (iii) changes in our business and strategy, future operations, financial position, estimated revenues and losses, projected costs, prospects and plans; (iv) our ability to execute our business model, including market acceptance of our planned products and services and achieving sufficient production volumes at acceptable quality levels and prices; (v) our ability to access sources of capital to finance operations, growth and future capital requirements; (vi) our ability to maintain and enhance our products and brand, and to attract and retain customers; (vii) our ability to scale in a cost effective manner; (viii) changes in applicable laws or regulations; (ix) developments and projections relating to our competitors and industry; (x) unexpected adjustments and cancellations related to our backlog; and (xi) our ability to protect our intellectual property. You should carefully consider the foregoing factors and the other risks and uncertainties disclosed in the "Risk Factors" section in Part I, Item 1A in our Annual Report on Form 10-K for the year ended December 31, 2022, as supplemented in our Quarterly Report on Form 10-Q for the quarters ended March 31, 2023 and September 30, 2023, and other documents filed by the Company from time to time with the SEC. These filings identify and address other important risks and uncertainties that could cause actual events and results to differ materially from those contained in the forward-looking statements. Forward-looking statements speak only as of the date they are made. Readers are cautioned not to put undue reliance on forward-looking statements, and the Company assumes no obligation and does not intend to update or revise these forward-looking statements, whether as a result of new information, future events, or otherwise.

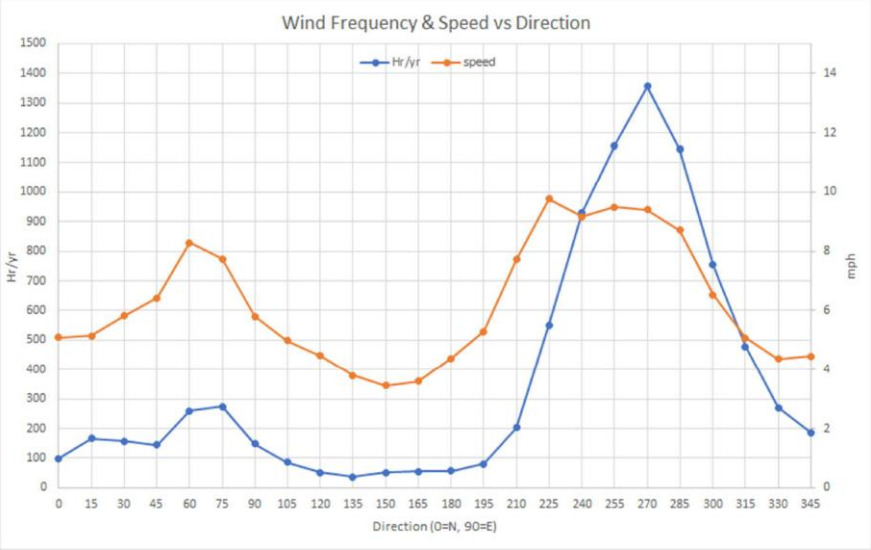
Heliogen

Project Location/Site

Hour of Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
12:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
3:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 AM	0	0	0	0	2	23	10	0	0	0	0	0	3
5:30 AM	0	0	4	125	363	443	300	193	47	2	0	0	123
6:30 AM	0	28	218	524	633	689	579	587	463	269	72	7	339
7:30 AM	217	306	531	719	737	794	722	720	699	637	448	301	569
8:30 AM	566	531	704	806	818	864	805	828	804	734	689	616	730
9:30 AM	696	716	833	867	889	919	853	894	849	860	803	732	826
10:30 AM	744	794	886	874	911	949	882	913	901	902	810	785	862
11:30 AM	770	800	872	824	911	956	909	887	930	918	857	723	863
12:30 PM	781	758	849	817	899	943	911	872	917	900	815	655	843
1:30 PM	749	740	802	798	863	927	864	870	887	857	731	606	808
2:30 PM	663	667	685	707	795	903	809	844	811	765	613	578	737
3:30 PM	524	626	613	682	707	840	737	798	690	633	532	447	652
4:30 PM	234	495	486	548	586	757	662	737	580	382	187	156	484
5:30 PM	5	118	235	305	476	637	531	535	252	20	0	0	259
6:30 PM	0	0	3	28	128	337	250	109	6	0	0	0	72
7:30 PM	0	0	0	0	0	10	6	0	0	0	0	0	1
8:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
9:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²/day	5.9	6.6	7.7	8.6	9.7	11.0	9.8	9.8	8.8	7.9	6.6	5.6	8.17
kWh/m²/mo	184	184	239	259	301	330	305	303	265	244	197	174	249
												Total Annual DNI (kWh/m²/yr)	2,985

Total Annual DNI:

2,985 kW/m2/year



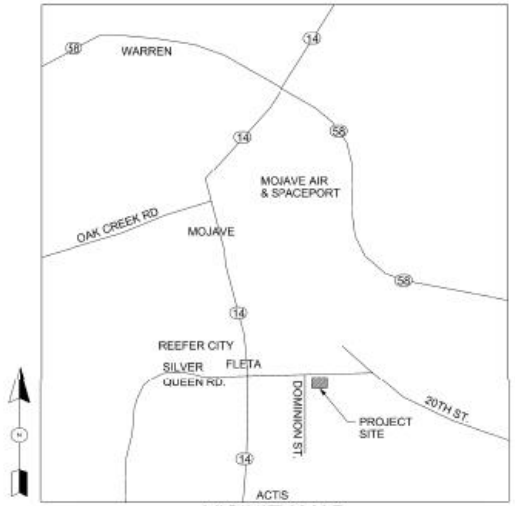
Average wind speed: ~ 9 mph at grade
(Average of 30 mph and up to ~100 mph at the receiver deck)

HELIOGEN CAPELLA SOLAR ENERGY PROJECT

LOCATED AT

301 SILVER QUEEN ROAD
MOJAVE, CA 93501
COUNTY OF KERN

SITE COORDINATES: LAT. N 34.9923°, LONG. W 118.1287°



VICINITY MAP
NOT TO SCALE

SITE PLAN
NOT TO SCALE

- **Nearby locations**
  - Edwards Air Force Base
  - Mojave Air & Spaceport
  - Reefer City
  - Highways 14/58

Heliogen

Plant Configuration

RECEIVER UNITS 1 AND 2

Heat Transfer Material:	CARBO HSP 16/30
Receiver Category:	Particle, Direct
Aimpoint Height (m):	47.3
Receiver Manufacturer:	Heliogen
Receiver Configuration:	Centrifugal Cavity
Number of Receivers:	2
Aperture Diameter (m):	2.6

THERMAL ENERGY STORAGE

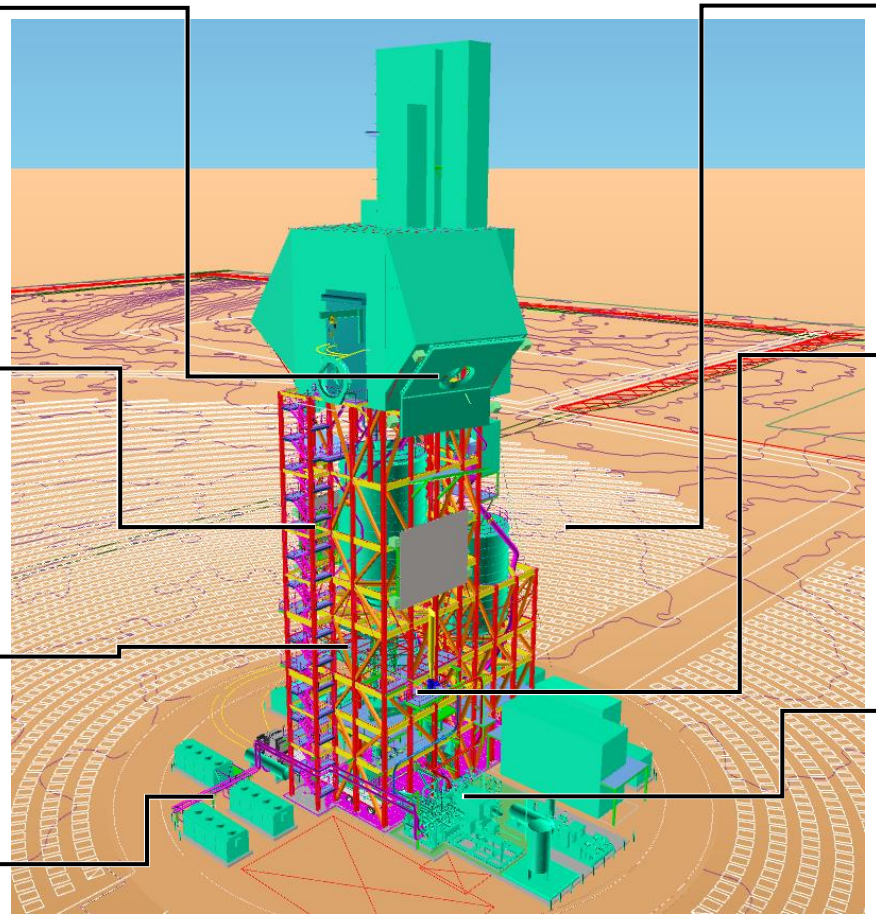
Storage Type:	2-tank Direct
Storage Capacity:	4 hours (60.2 MWh)
Storage Mechanism:	Sensible, 470 to 670 °C
Particle Elevation:	Skip Hoists
Stored Particle Weight:	920 mt

PHX SCO2 MANIFOLD UNIT 1

Manifold Design:	Heliogen
Manifold Fabrication:	Worley
Material of Construction:	Inconel 740H

COOLER UNITS 1-3

Cooling Type:	Hybrid (**Adiabatic**)
Cooler Manufacturer:	EvapCo
Number of Coolers:	3 units, 4 fans each



HELIOSTAT FIELD

Solar Field Aperture Area (m^2):	Up to 43,008
# of Heliostats:	Up to 22,400
Heliostat Aperture Area (m^2):	1.92
Heliostat Manufacturer:	Heliogen
Heliostat Model:	GenV
Heliostat Control Method:	Closed-loop (SOHOT)
Control System Provider:	Heliogen

PRIMARY HEAT EXCHANGER (PHX) UNIT 1

Nominal Thermal Duty (MWh):	13.4
Heat Exchanger Manufacturer:	VPE/Solex
Heat Exchanger Arrangement:	Counterflow Moving packed bed
Heat Exchanger Construction:	Diffusion bonded Parallel plate
Materials of Construction:	Stainless Steel

POWER BLOCK UNIT 1

Nominal Power Cycle Capacity:	5 MWe
Power Block Manufacturer:	HPS
Power Cycle Working Fluid:	sCO_2
Power Cycle:	RCBC
Turbine Inlet Temperature (°C):	600
Turbomachinery Architecture:	Integrally Geared

Heliogen

Innovations Leading to Competitive Dispatchable Power

	What we are doing	Why we are doing it
Particle Receiver	Directly irradiating our particles	Our sunlight is heating particles instead of tubes; no need for costly alloys.
	Rotating our particles in a drum	Control of rotational speed to optimize particle temperature.
Moving Packed Bed Heat Exchanger	Diffusion-bonding our parallel plates	Small channels reduce the size, weight, and cost without sacrificing performance.
	Gravity-driving our particle flow	Fewer moving parts means cheaper construction and reliable operation.
Supercritical CO_2 Power Block	Choosing the right size for deployability	A 5 MW turbine of this cycle can fit in standard globally transportable skids
	Choosing a high efficiency cycle for our size	A 5 MW sCO_2 cycle has comparable efficiency to steam cycles 10x larger.

Modular design accelerates cost reduction through learnings, faster fabrication and deployment

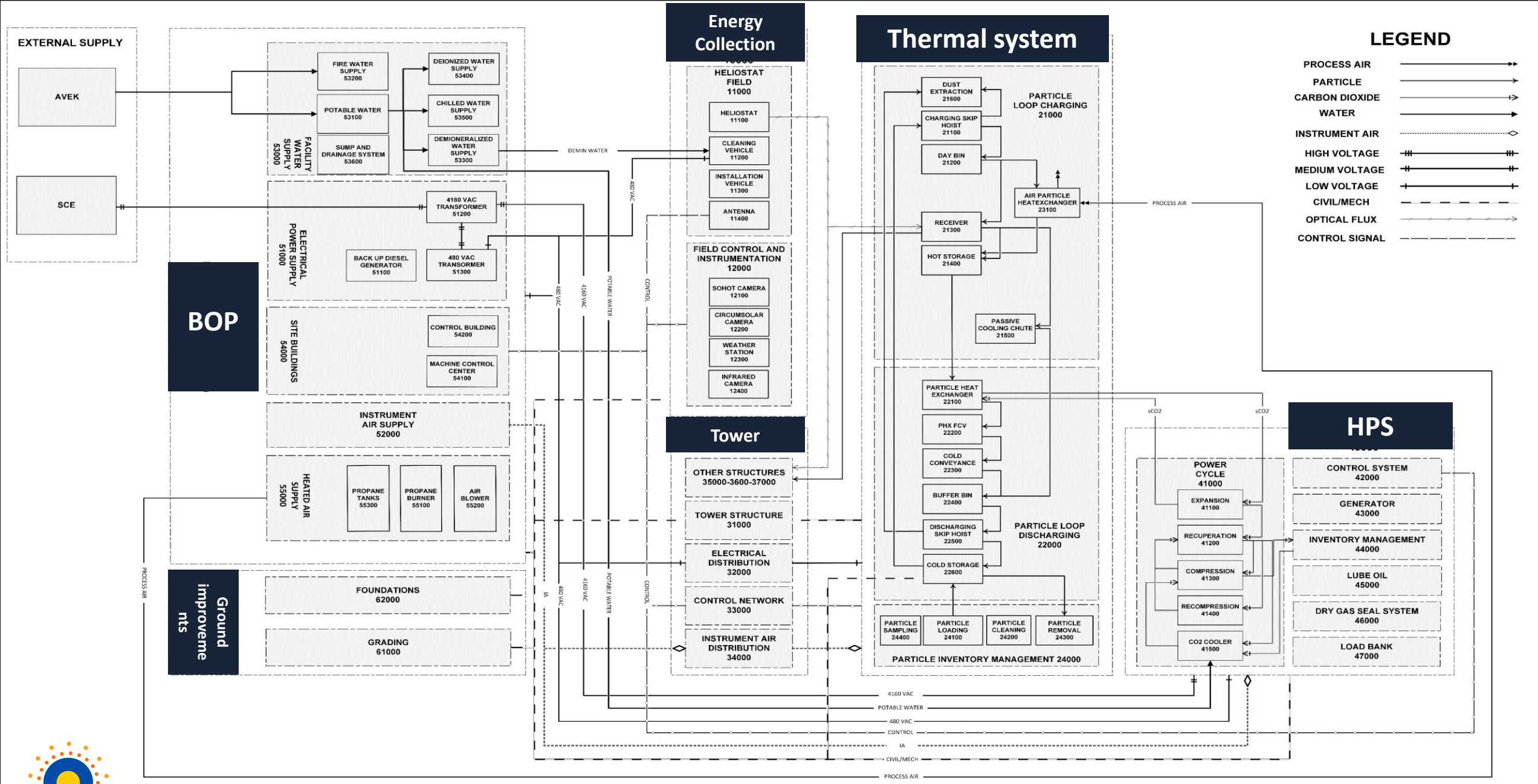
Heliogen

Minimum Design Criteria

Charging System	Discharging / Other Systems
Operating Lifetime 25 years	**Operating Lifetime** 25 years
Operating Frequency Approx. 300 days/year	**Operating Frequency** Approx. 340 days/year
Start/stop Cycles 18,750 (approx. 2.5/day)	**Start/stop Cycles** 8,500 (approx. 1/day)
Operating Hours 100,000 (100 @ 750 °C) (up to 14 hr/day)	**Operating Hours** 60,000 (4 to 8 hr/day)

NOTE: Actual design life expected to exceed minimum design criteria

Heliogen



Block Flow Diagram

Heliogen

PRODUCED BY:
Heliogen
130 W UNION ST, PASADENA, CA 91103
TEL: (626) 720-4530

REVISIONS		
REV	DATE	DESCRIPTIONS
E	06/07/2023	FINAL ISSUE

DOCUMENT #			
DRAWN BY	REVIEWED BY	APPROVED BY	DATE
MJ	MC	MC	04/20/2023
PROJECT	CAPELLA SOLAR ENERGY PROJECT		
DOCUMENT	BLOCK FLOW DIAGRAM SHEET 1		

Process Specification

Heliogen

RECEIVER UNITS 1 AND 2

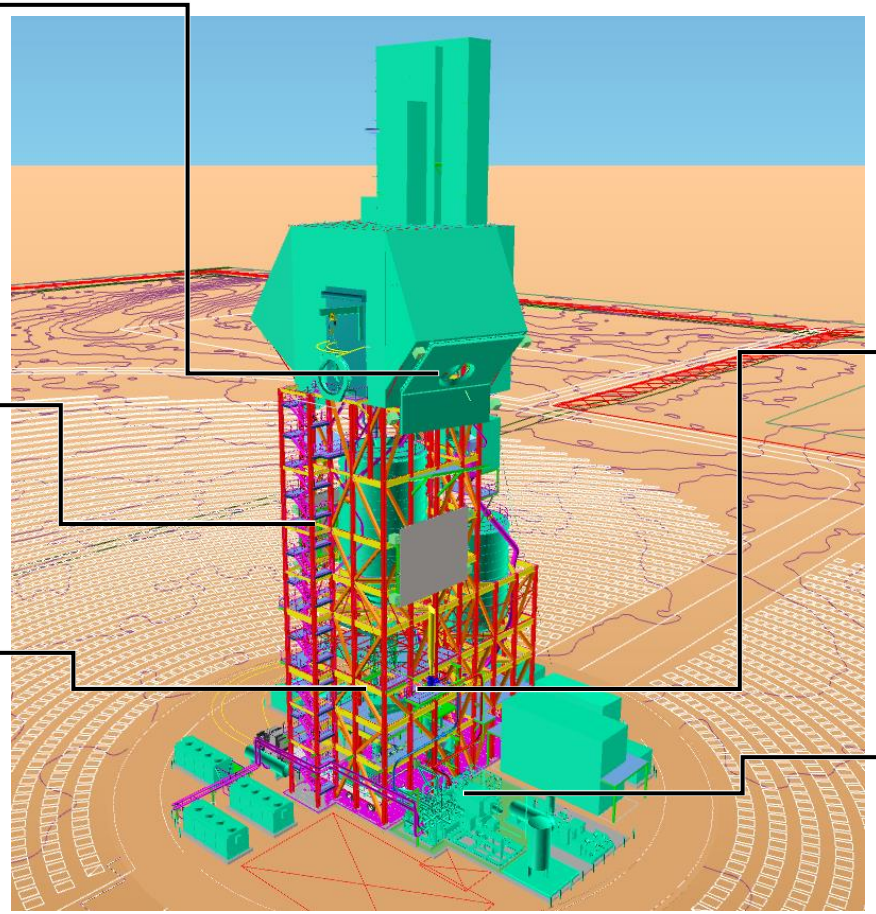
Receiver Output Power:	6.9 to 9.2 MW
Receiver Particle Flow:	31.1 to 41.3 kg/s
Receiver RPM :	30
Receivers Inlet Temp.:	450-470C
Receiver Outlet Temp:	675-755C
Receiver Turndown:	1:10

THERMAL ENERGY STORAGE

Storage Inlet Flowrate:	63-83 kg/s
Storage Capacity:	4 hours (60.2 MWh)
Storage Mechanism:	Sensible, 470 to 670 °C

Charging Skip Hoist

Capacity:	60-85 kg/s
Temperature:	Up to 500C
Number of Skips:	1 with Counterweight



PRIMARY HEAT EXCHANGER (PHX) UNIT 1

Nominal Thermal Duty:	13.4 MWh
PHX Particle Flow:	61.4-63 kg/s
PHX Inlet Particle Temp:	670-675 C
PHX Outlet Particle Temp:	470C
PHX Inlet sCO2 Temp :	440C
PHX Inlet sCO2 Temp	600C
PHX sCO2 Pressure:	200-220 bar
PHX sCO2 Flowrate:	~67 kg/s

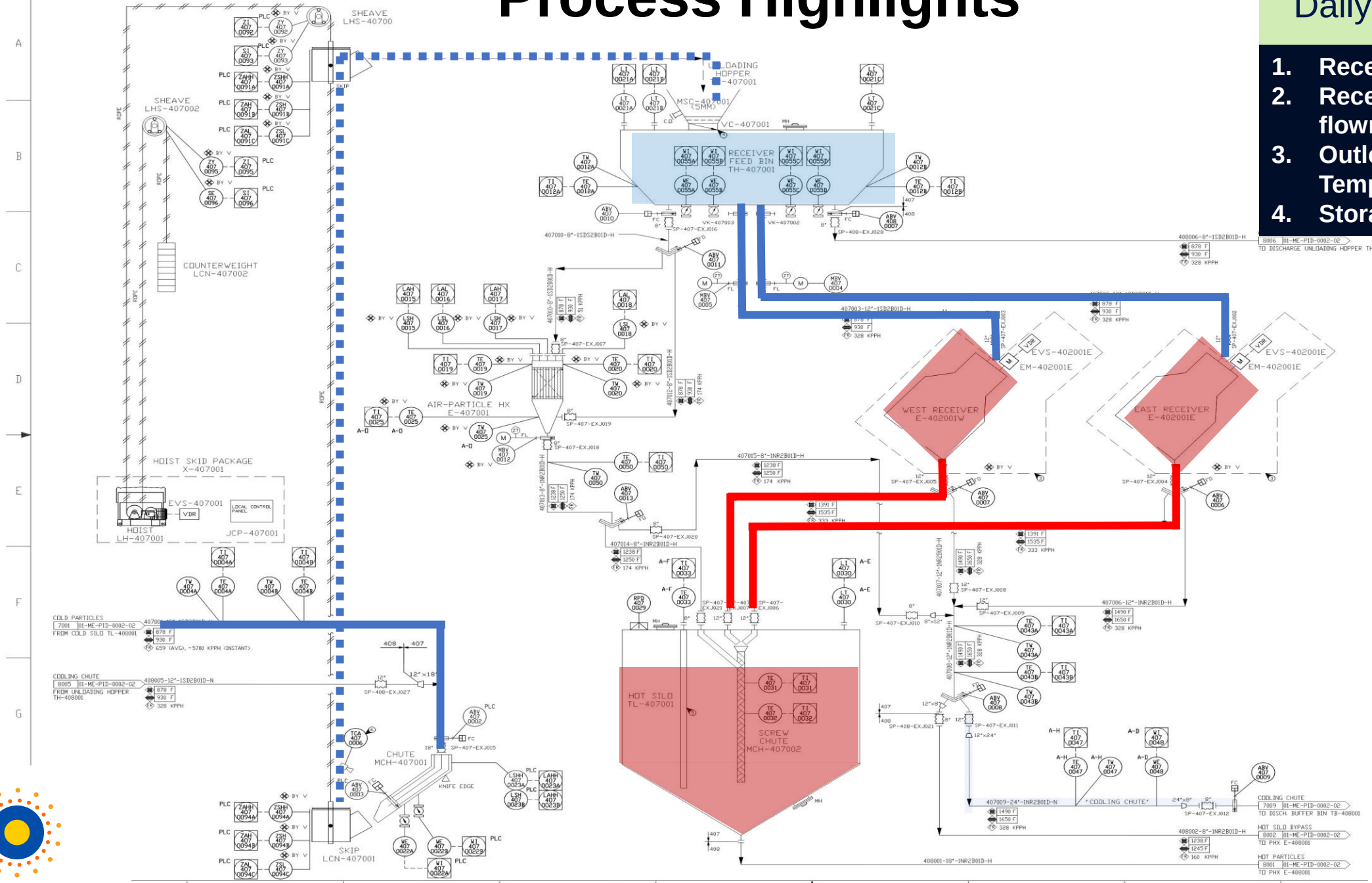
POWER BLOCK UNIT 1

Nominal Power Cycle Capacity:	5 MWe
Power Cycle Working Fluid:	sCO_2
Power Cycle:	RCBC
Power Cycle Turndown:	40%
Turbine Inlet Temperature (°C):	600
Turbomachinery Architecture:	Integrally Geared

Process Highlights

Daily Charging 657

1. Receiver full load
2. Receivers at nominal flowrate of 31 kg/s
3. Outlet Receiver Temperature at 675 C
4. Storage filled to 4hr



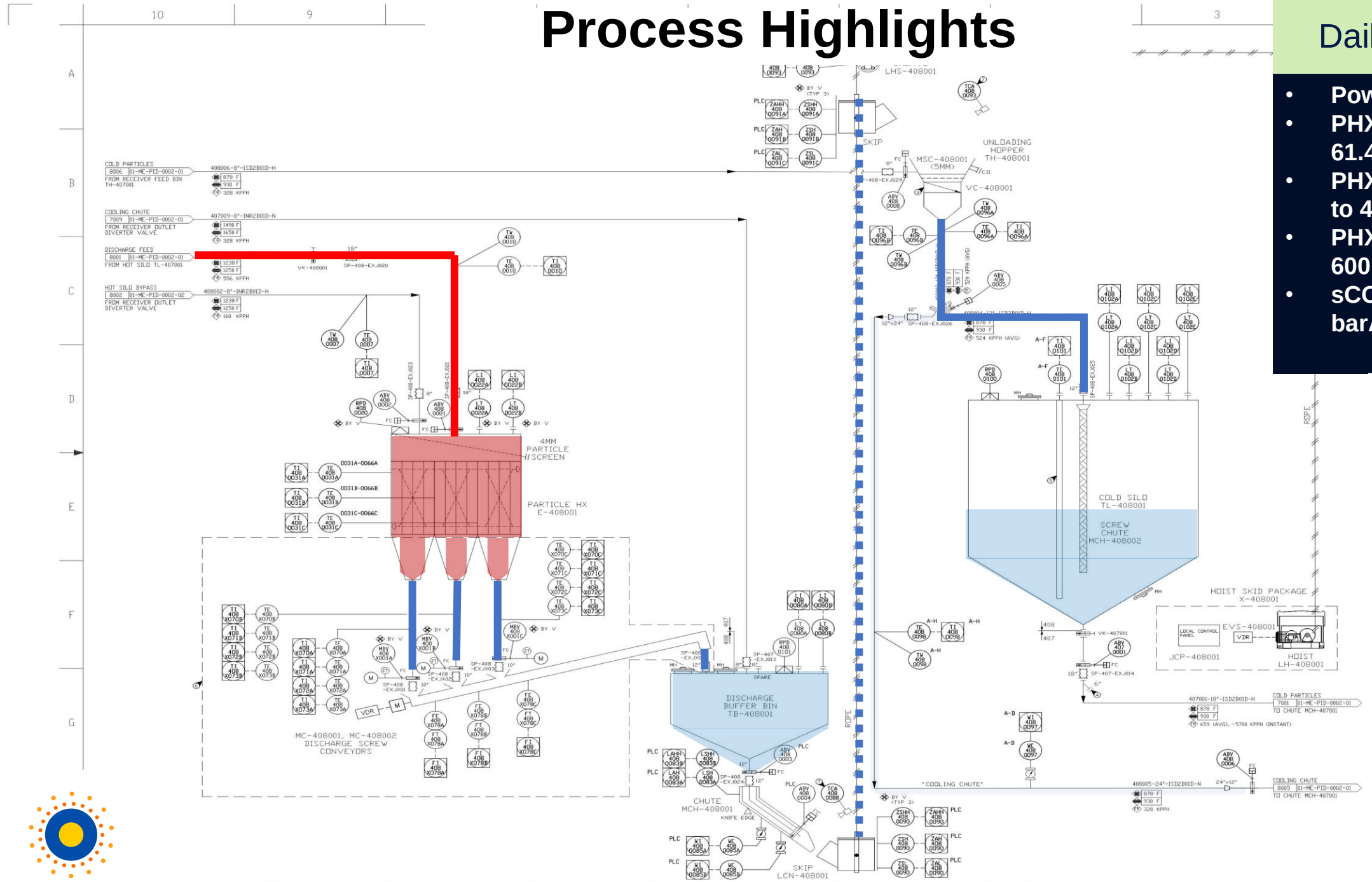
Heliogen

Advisian
Worley Group

Process Highlights

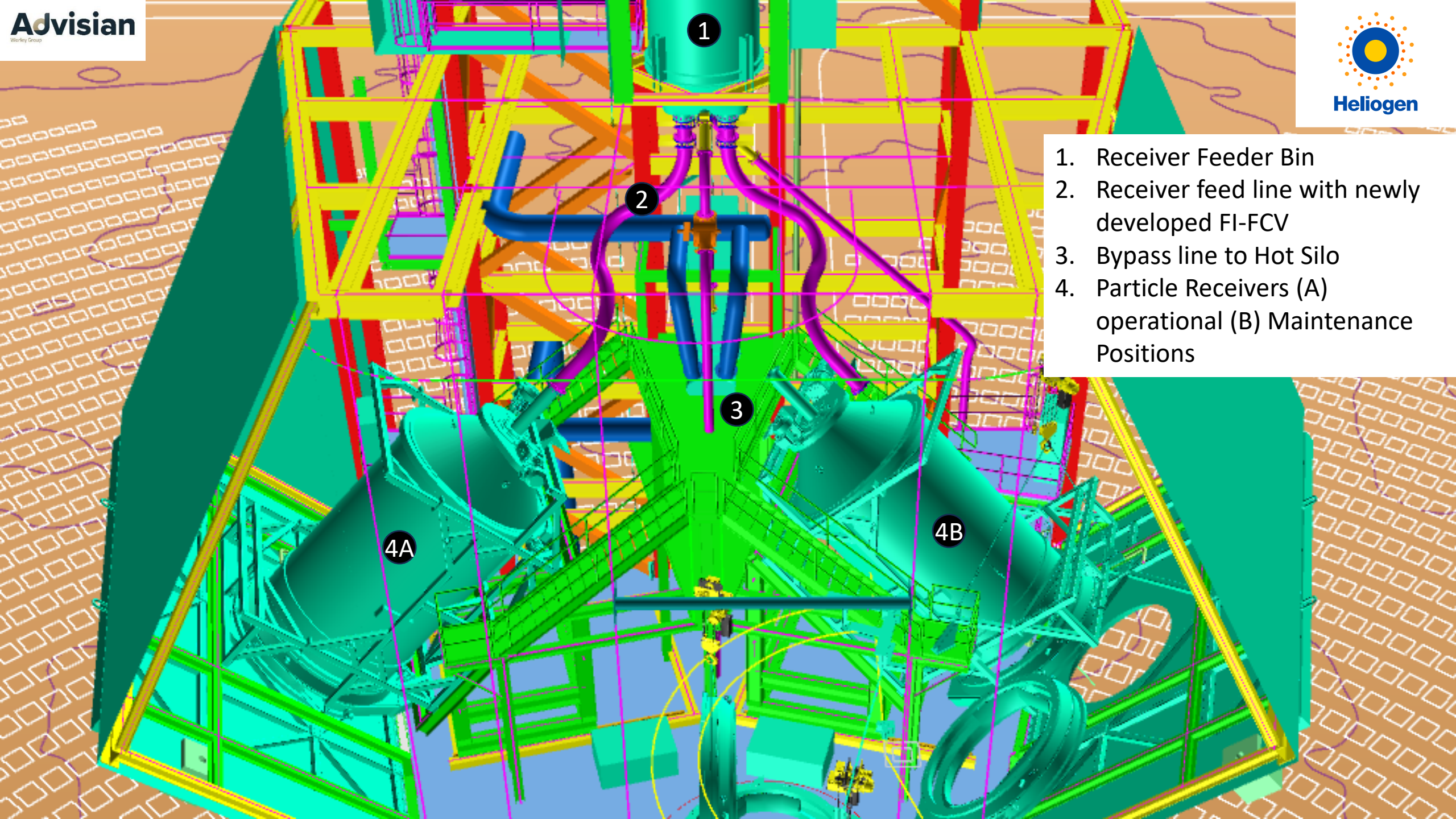
Daily Discharging

- Power Block full load
- PHX flowrate at nominal 61.4 kg/s
- PHX particle dT of 670 C to 470 C
- PHX sCO2 dT of 440 C to 600 C
- sCO2 pressure ~220 barA



Heliogen

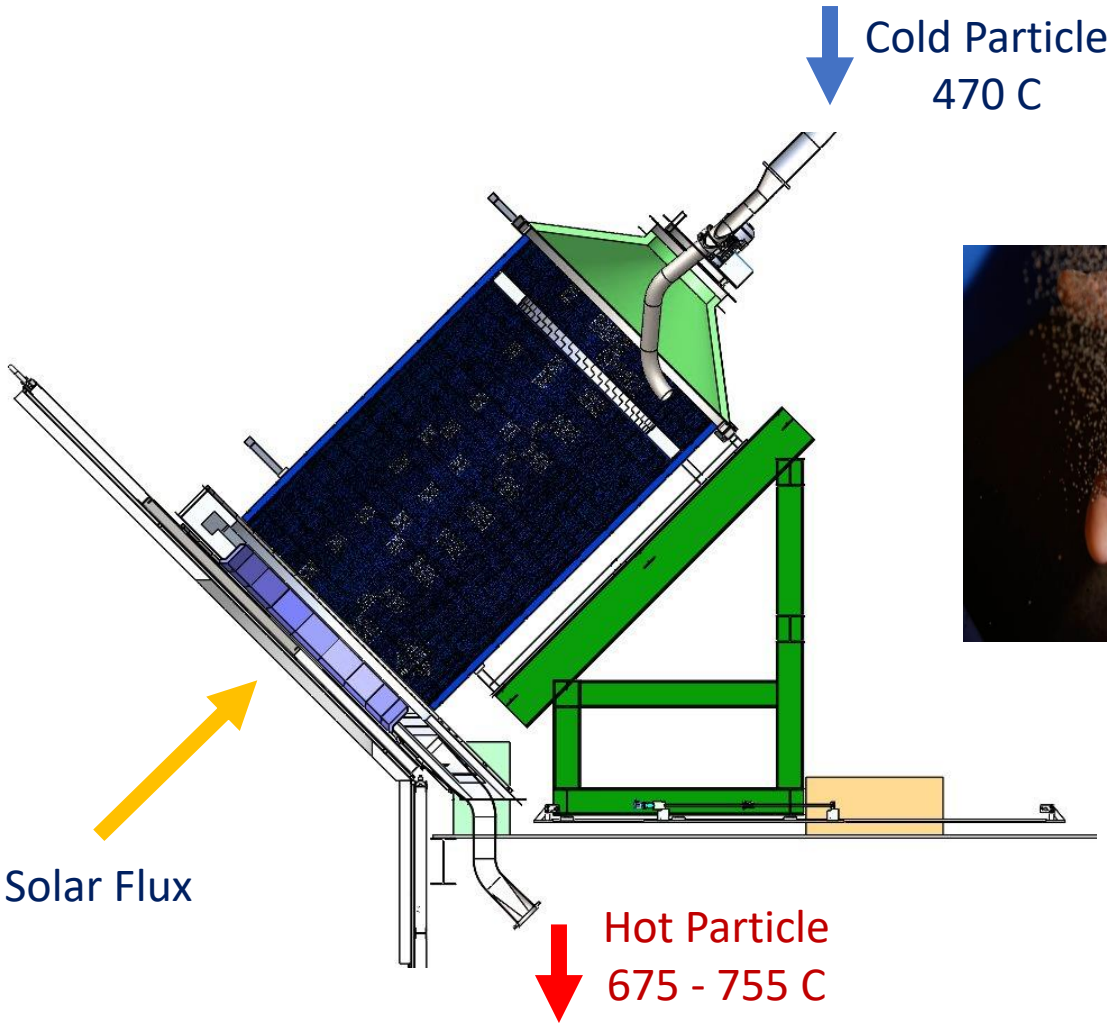
Advisian
Worley Group

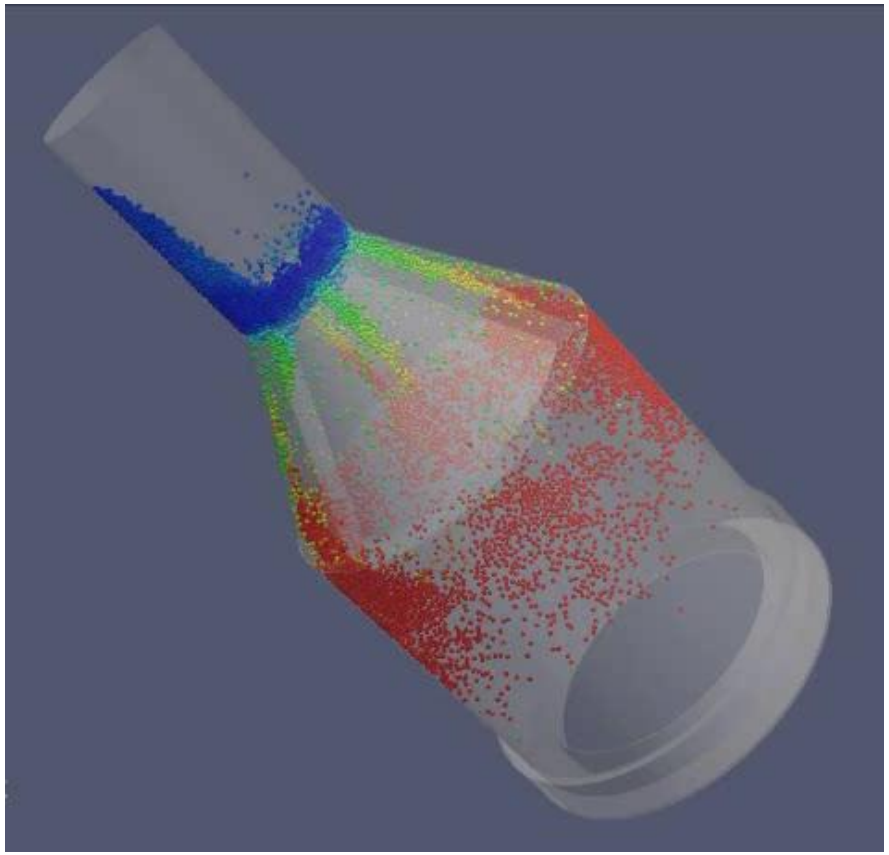


1. Receiver Feeder Bin
2. Receiver feed line with newly developed FI-FCV
3. Bypass line to Hot Silo
4. Particle Receivers (A) operational (B) Maintenance Positions

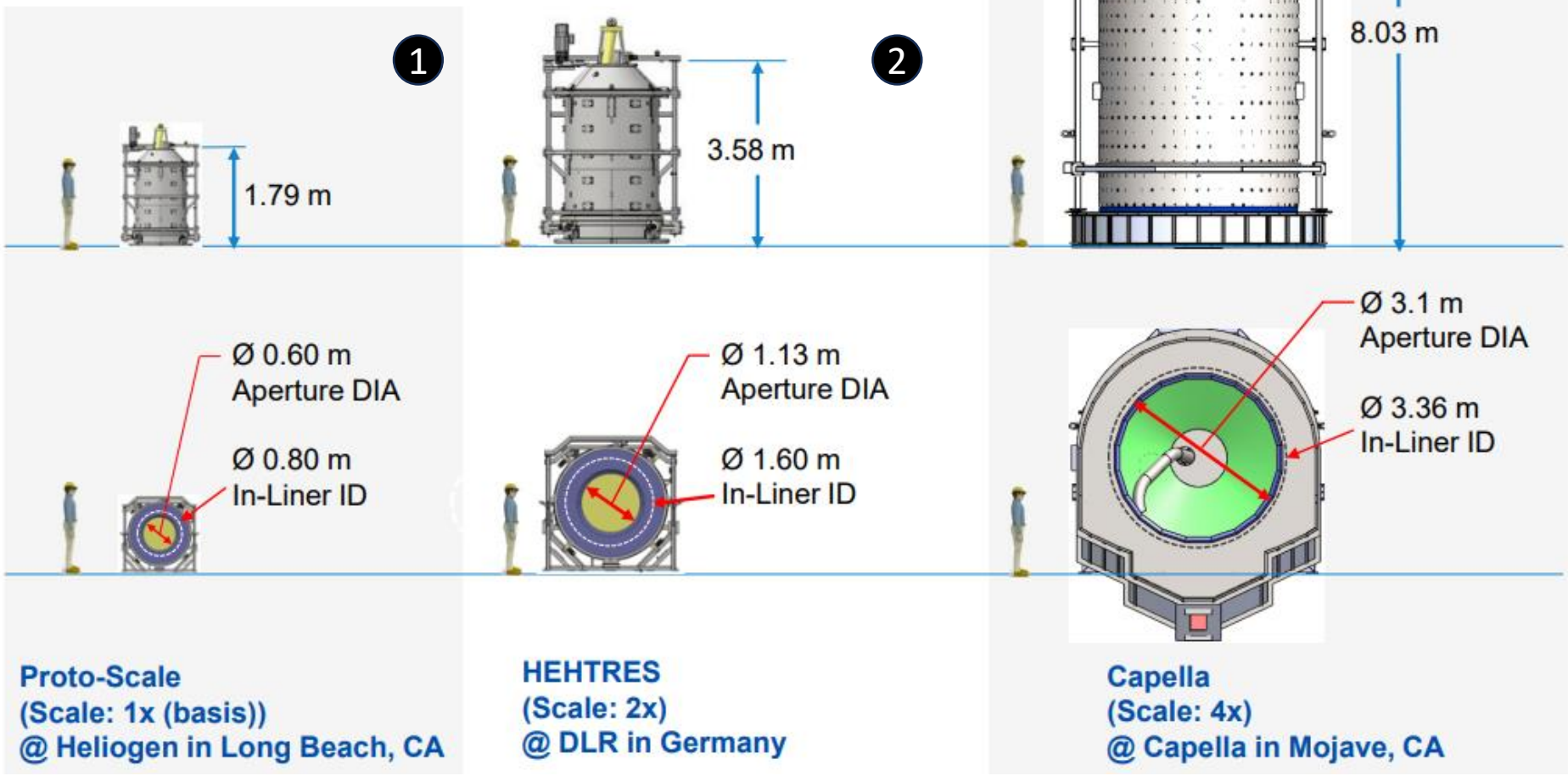
Particle Receiver

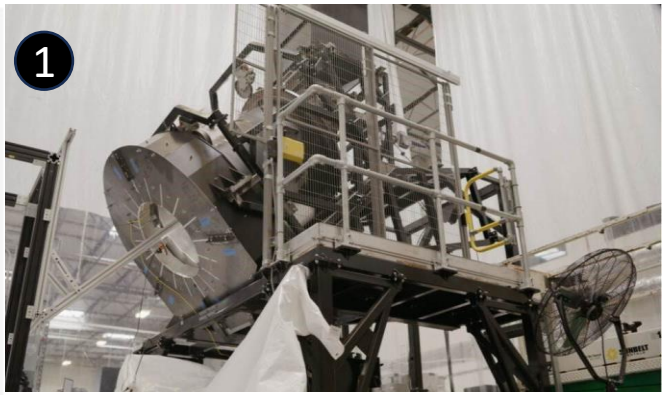
- Enables **direct irradiation of particles** for high temperature and high efficiency
- Solid particles are **low cost, thermally & chemically stable**
- Rotating design provides **better control** under varying conditions

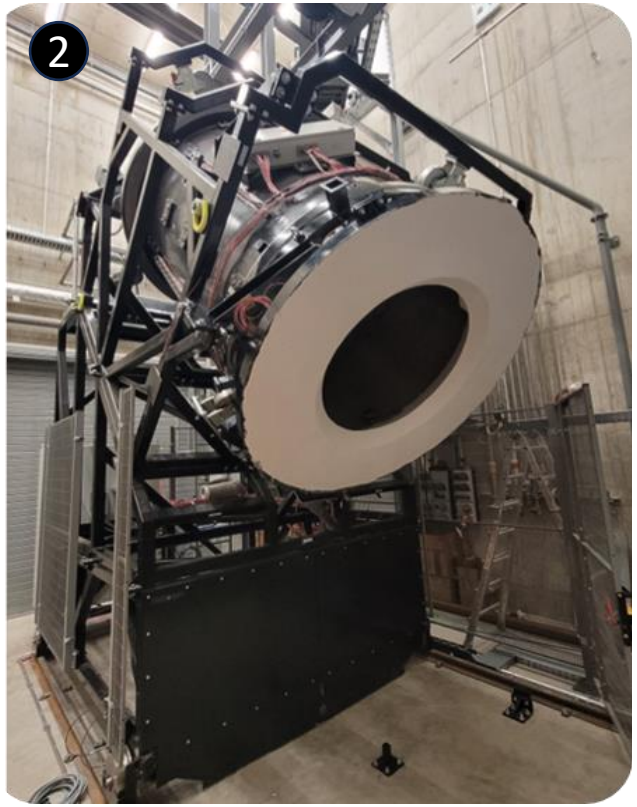


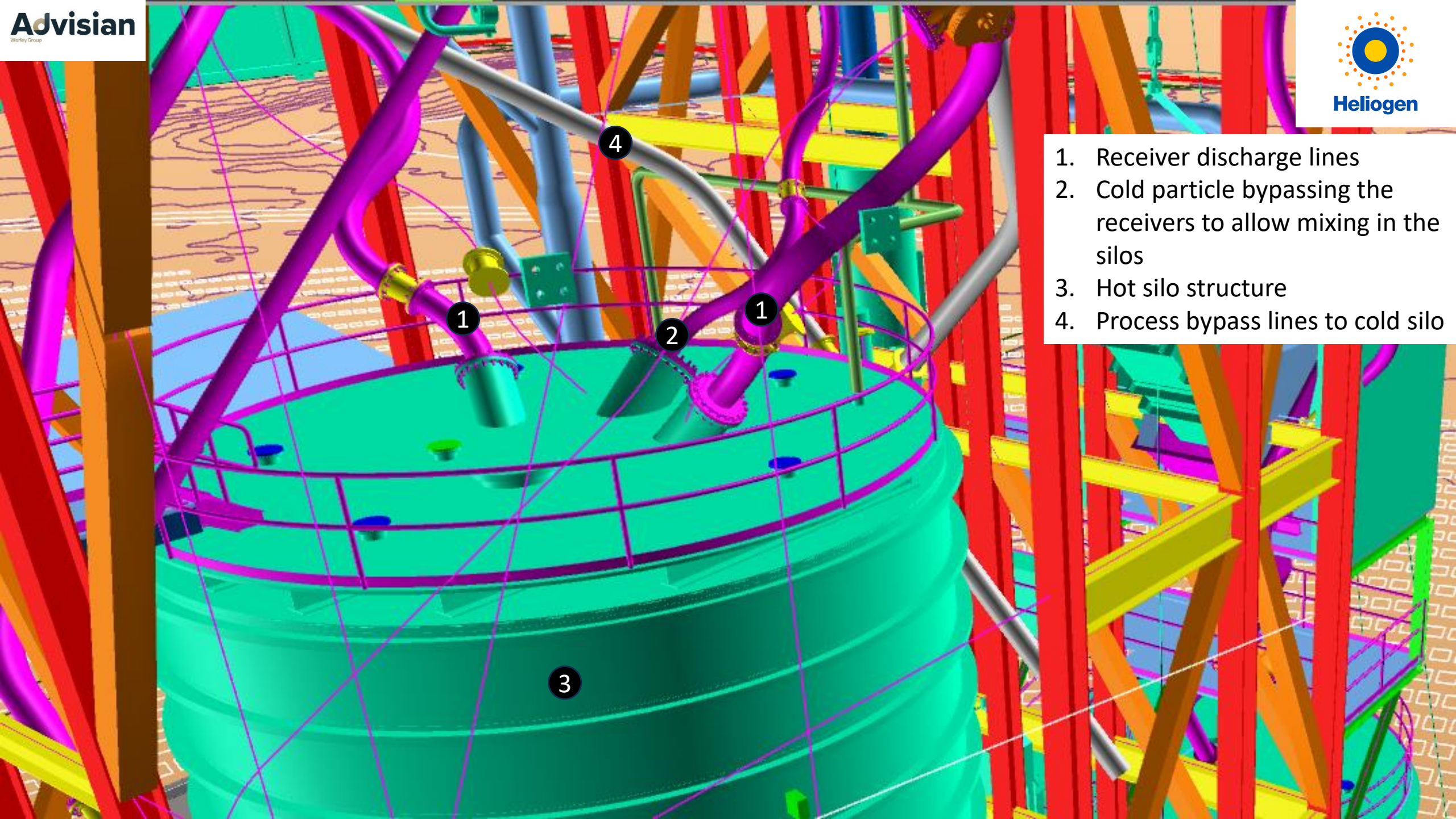


Receiver Development and Scaleup





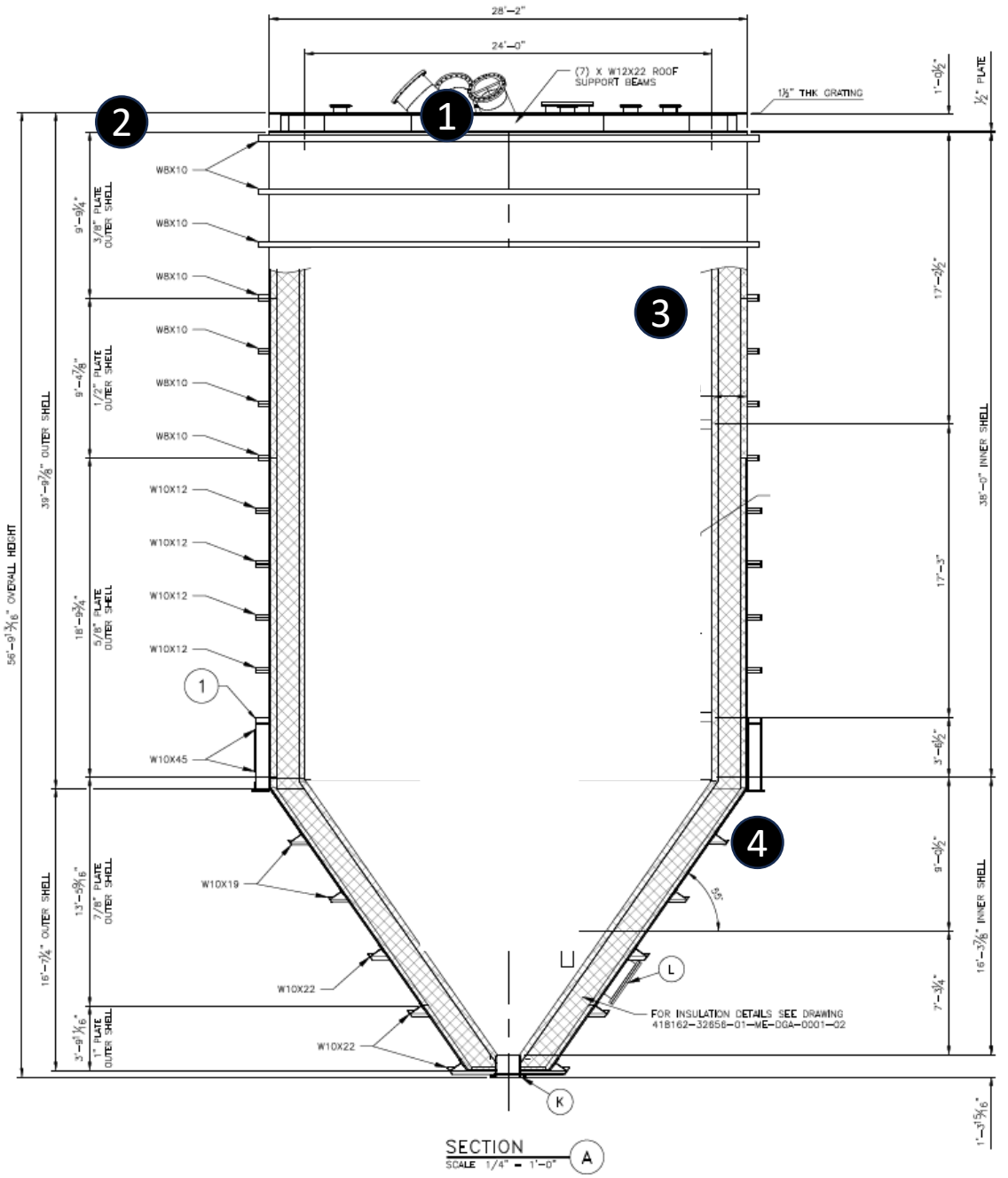




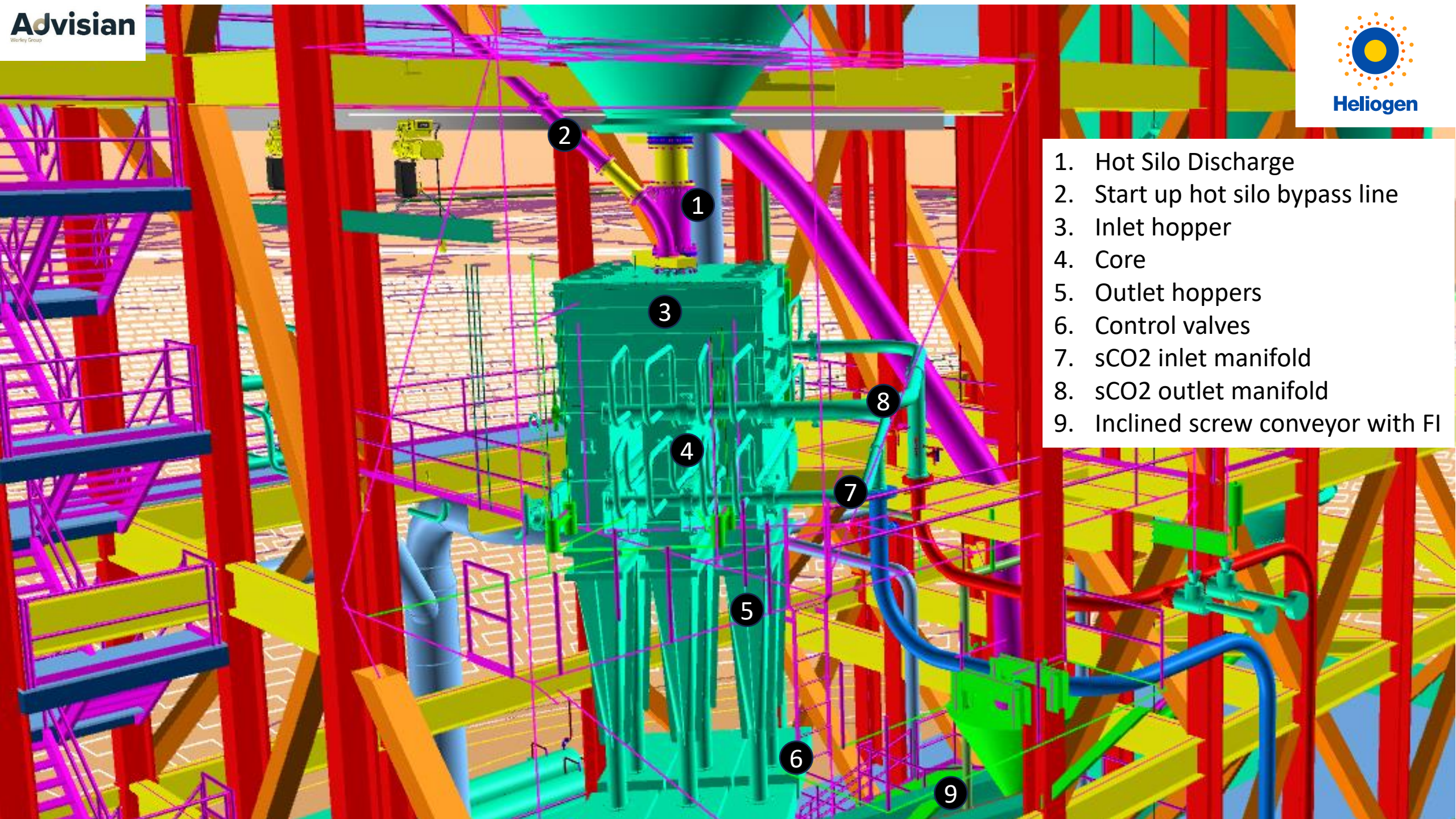
1. Receiver discharge lines
2. Cold particle bypassing the receivers to allow mixing in the silos
3. Hot silo structure
4. Process bypass lines to cold silo

Particle Silos Construction

1. Inlets/flanges
   - 1x to 3x for process inlets
   - Others for instruments, inspection, maintenance
2. Steel shell with stay plates
   - 3/8” to 1” plate
3. Internal insulation system
4. Conical bottom configuration

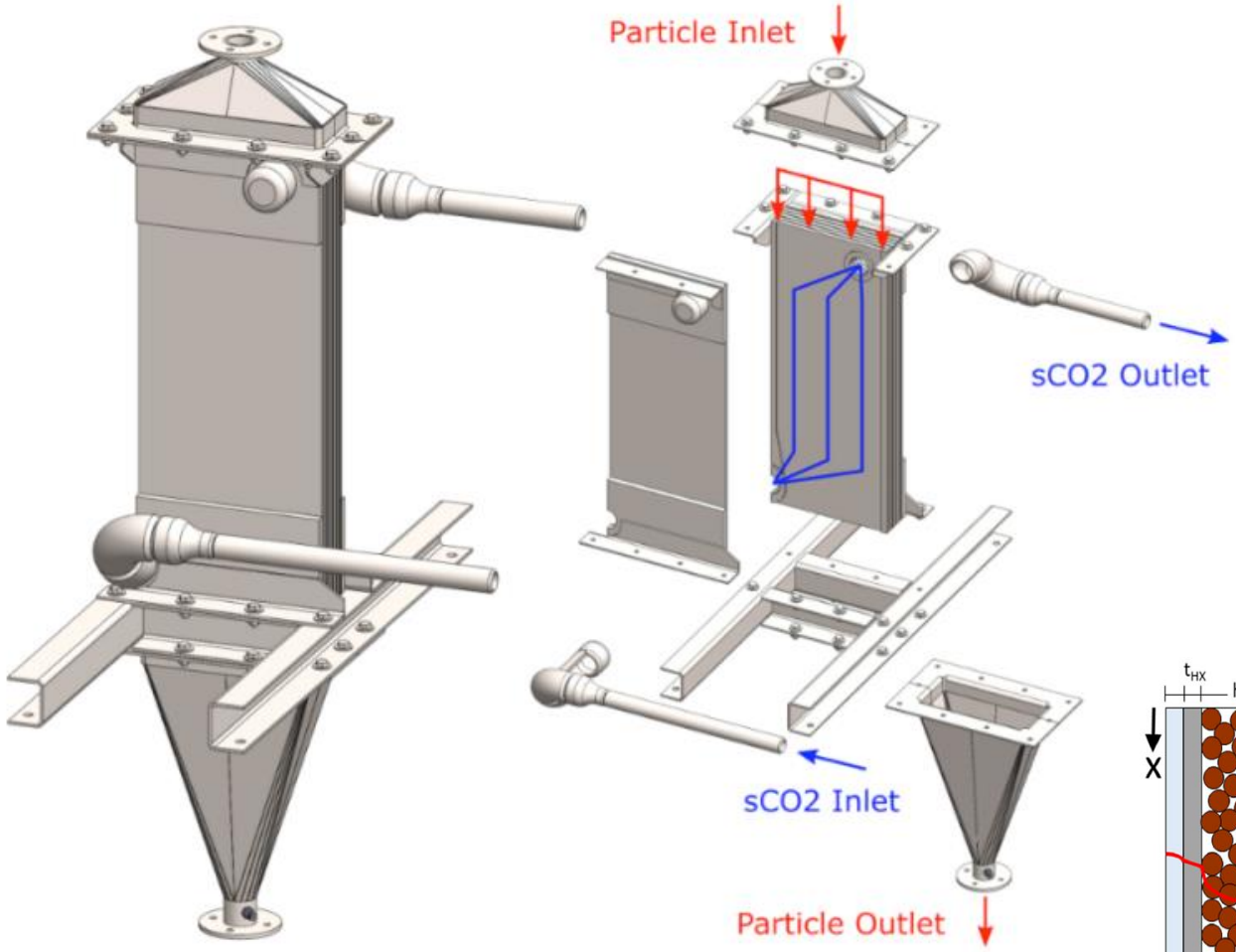


Heliogen

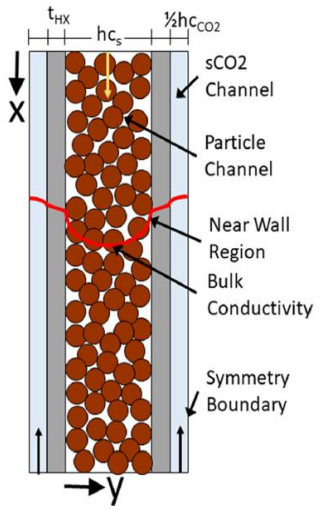


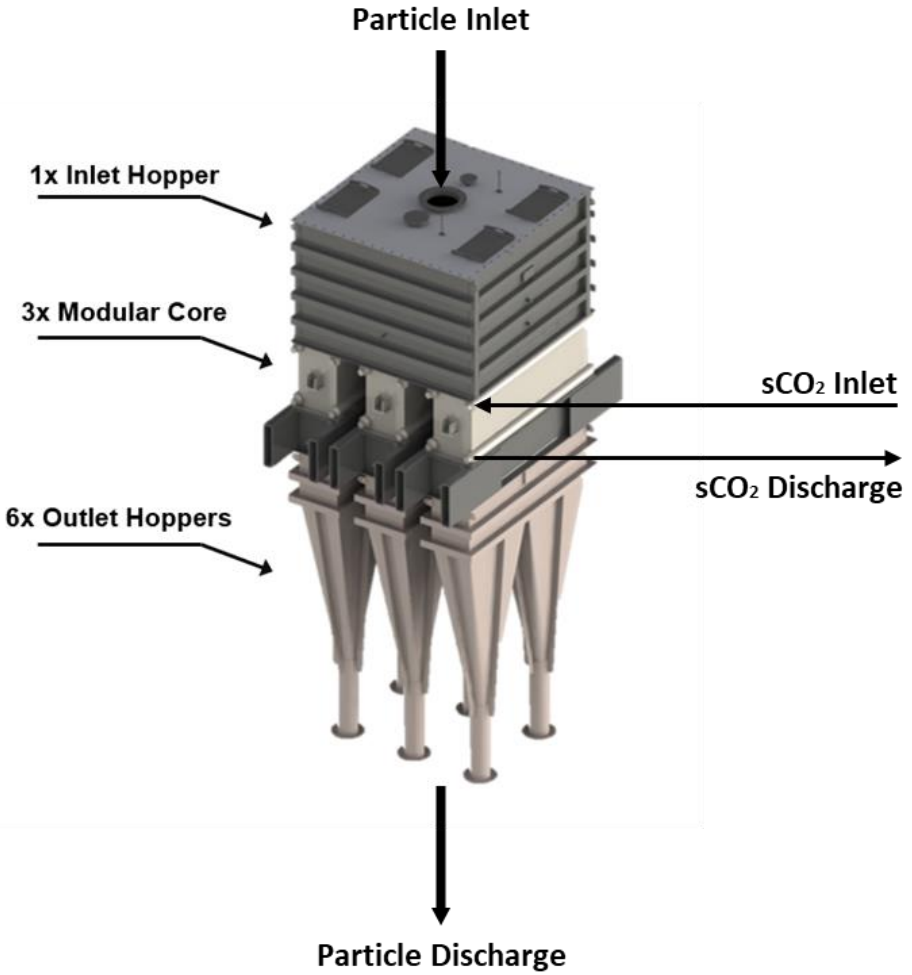
1. Hot Silo Discharge
2. Start up hot silo bypass line
3. Inlet hopper
4. Core
5. Outlet hoppers
6. Control valves
7. sCO2 inlet manifold
8. sCO2 outlet manifold
9. Inclined screw conveyor with FI

Particle-sCO2 Heat Exchanger (PHX)



(image curtesy Vacuum Process Engineering VPE)





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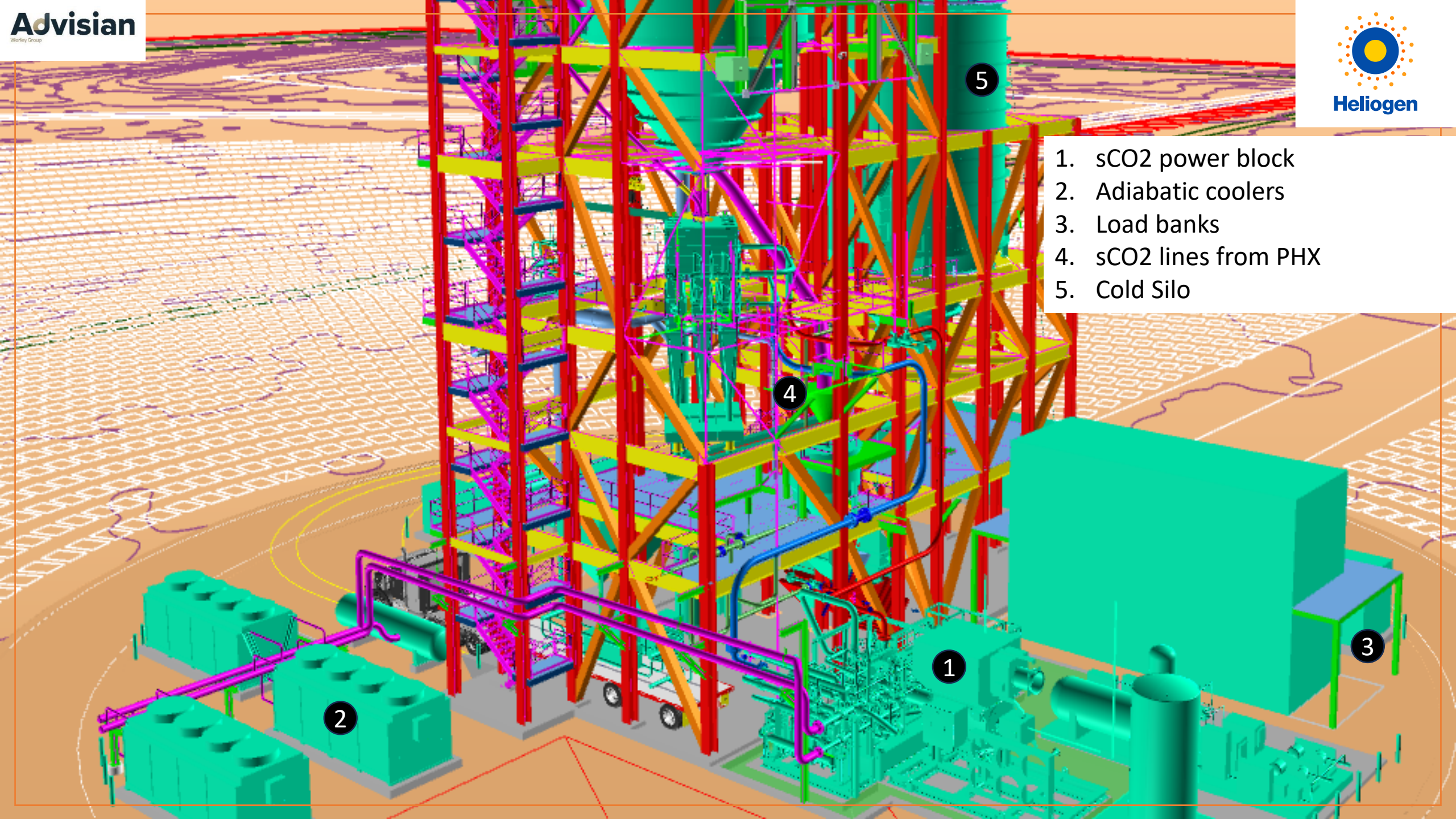
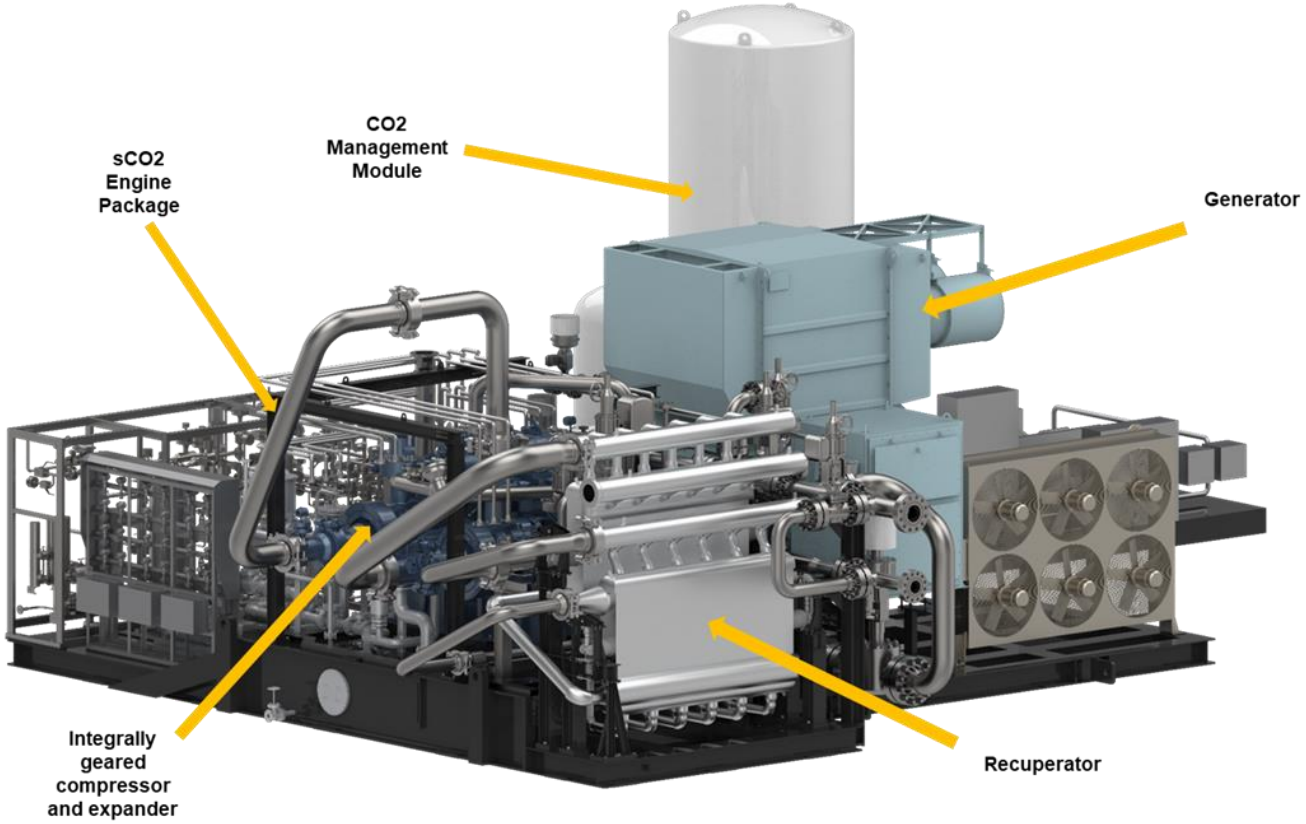


1. sCO2 power block
2. Adiabatic coolers
3. Load banks
4. sCO2 lines from PHX
5. Cold Silo

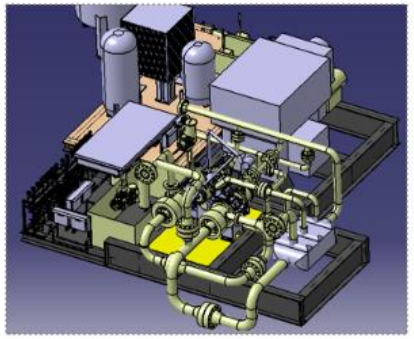
Hanwha Supercritical CO_2 Power System Module Layout

- **Power Block Subsystems:**
  - sCO_2 Core
  - Recuperator
  - sCO_2 Inventory Management System
  - Lube Oil System
  - Dry Gas Seal System
  - Main Electrical Equipment
  - Pre-cooler (air cooled)

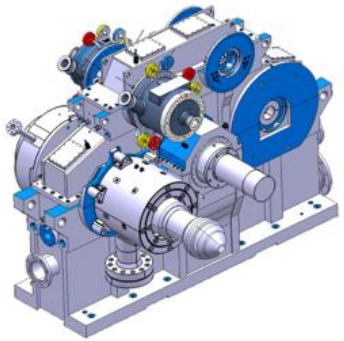


3-D Rendition provided by PSM

(Image curtesy Hanwha Power Systems)



Modular power block



Integrally geared turbomachinery

Shrouded Radial Turbine

Advanced power generation technology

1.Small size allows for prefabricated, modular power block

2.sCO2 provides **high efficiency** at small (5 MW) size

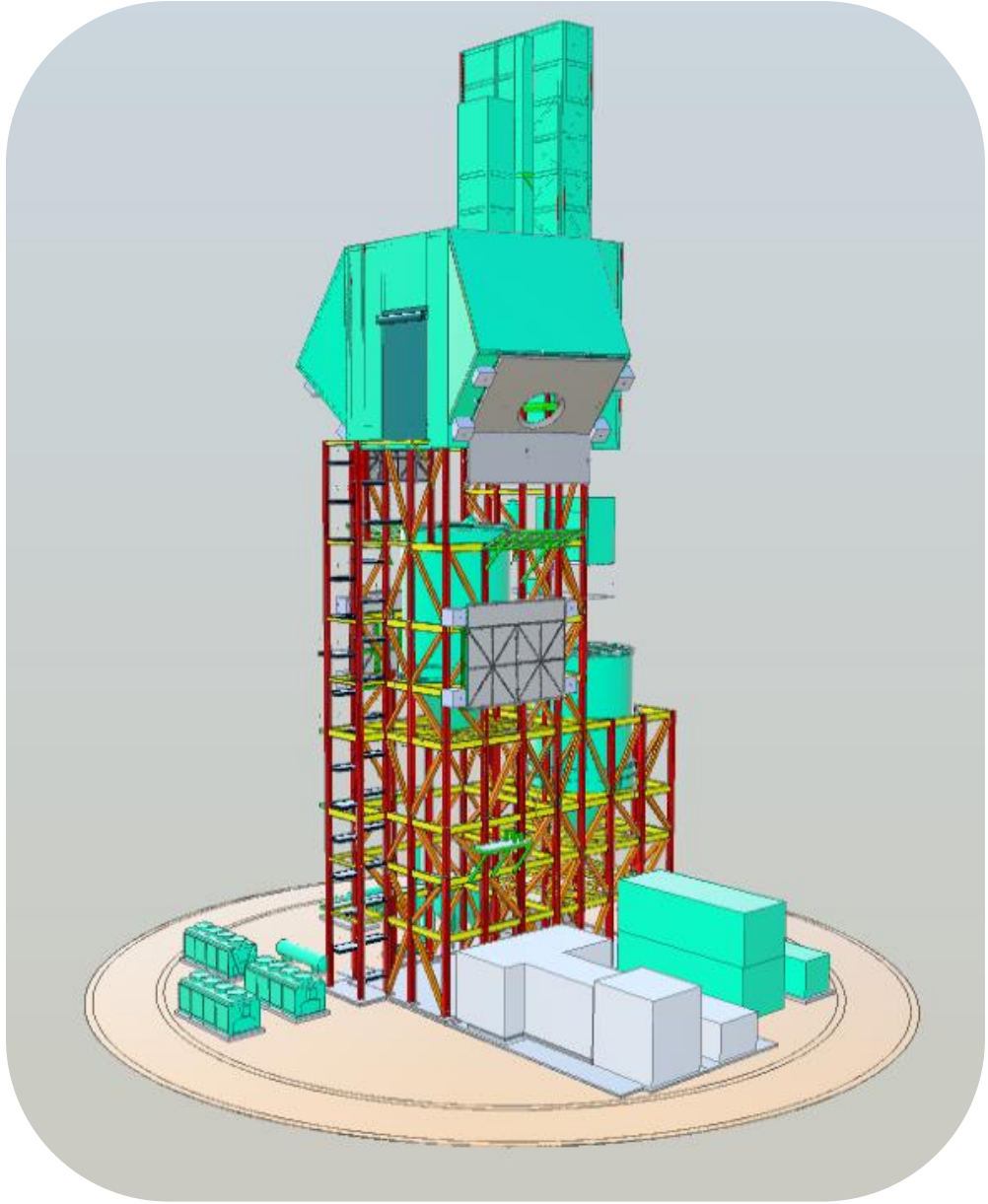
3.Closed system can **operate autonomously** with remote supervision

Questions?

Masih Jorat
Lead Systems Engineer, Heliogen

- **CAPELLA KEY SPECS**

  - Capacity Factor: Design Target ≥25% CF
  - Annual Energy Collected: ≈ 37.7 GWh annually
  - Number of Heliostats: up to 22,000
  - Tower Height [aim, total]: [≥43.3, ≥55.3] m
  - Number of Receivers: 2
  - Thermal Energy Storage: 4hrs @ PHX design duty (60.2 MWth-hr)
  - Primary Heat Exchanger (PHX): 13.4 MWth Diffusion bonded, particle-sCO_2
  - Power Generation System: 5 MWe net (cycle) sCO_2 recompression



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