

SPERS TECHNICAL DESIGN DOSSIER

SECTION 4.0: OUTPUT DATA SHEETS

4.1 Energy Balance (Estimated)

Status: Calculated for Mode A (Municipal Remediation)

Parameter	Value	Notes
Input Power (Parasitic)	45 kW	Combined load of Drivers + Pumps + Logic ¹ .
Fusion Thermal Output	140 kW	Primary heat generation from $\text{p}\text{-}\text{Li}$ reaction ² .
Transmutation Output	~20 kW	Variable heat from waste binding energy decay ³ .
Gross Thermal Power	160 kW	Total heat available for exchange ⁴ .
Turbine Efficiency	35%	Standard Back-Pressure Steam Turbine rating ⁵ .
Net Electrical Output	56 kW	Total generation at the turbine ⁶ .
Net Surplus	+11 kW	Self-Sustaining + trickle charge for battery ⁷ .

4.2 System Thermal-Hydraulics

Operational parameters for the Red and Blue Loops.

- **Red Loop (Primary) Pressure:** 150 Bar (maintained via Pressurizer)⁸⁸⁸⁸.

- **Red Loop Temperature:** 280°C (Inlet) to 310°C (Outlet)⁹⁹⁹.
- **Blue Loop (Secondary) Pressure:** 160 Bar (Maintained higher than Red Loop for safety)¹⁰.
- **Trip Threshold (Over-Temp):** $>330^{\circ}\text{C}$ (Triggered by Outer Vessel Thermocouple)¹¹.

4.3 Material Balance (Per 24h Cycle)

Mass flow analysis for standard daily operation.

Stream	Composition	State	Volume/Mass	Destination
Input A	Domestic Waste Slurry	Liquid/Solid	1,000 L	Feed Tank ¹²¹² .
Input B	Li-7 / Graphite	Solid Powder	50 g	Dosing Pump ¹³¹³ .
Output 1	Helium-4	Gas	~100 L	Storage (Sales) ¹⁴¹⁴ .
Output 2	Stable Ash (Si, Zn, Mg)	Solid (Sand)	~5 kg	Scrap/Recycle ¹⁵¹⁵ .
Output 3	Carbon Cake	Solid (Wet)	~2 kg	Recycle to Feed ¹⁶¹⁶ .
Output 4	Heavy Isotopes	Solid (Active)	< 10 g	Hazmat Storage ¹⁷¹⁷ .

Glossary of Abbreviations

Here are the explanations for the technical abbreviations used in this section and the referenced specs:

- **Li-7 (Lithium-7):** A stable isotope of Lithium acting as the primary fuel source. It splits into Alpha particles (Helium) when struck by a proton¹⁸¹⁸¹⁸¹⁸.
- **kW (Kilowatt):** A unit of power equal to 1,000 watts. Used here to measure the rate of energy consumption or generation¹⁹.

- **PSA (Pressure Swing Adsorption):** A technology used to separate specific gas species (like Helium) from a mixture of gases under pressure²⁰²⁰²⁰²⁰.
- **ppm (Parts Per Million):** A unit of concentration. In this system, "2000 ppm" refers to the concentration of Boric Acid in the water (0.2%)²¹²¹²¹²¹.
- **SiC (Silicon Carbide):** The ceramic material used for the reactor inner wall, chosen for its ability to withstand extreme thermal shock²²²²²²²².
- **PZT (Lead Zirconate Titanate):** The piezoelectric ceramic material used in the acoustic drivers to generate the sound waves that crush the bubbles²³²³²³²³.
- **FPGA (Field-Programmable Gate Array):** The digital "brain" of the system. An integrated circuit designed to be configured after manufacturing, used here to control the precise millisecond timing of the fusion pulses²⁴²⁴²⁴²⁴.