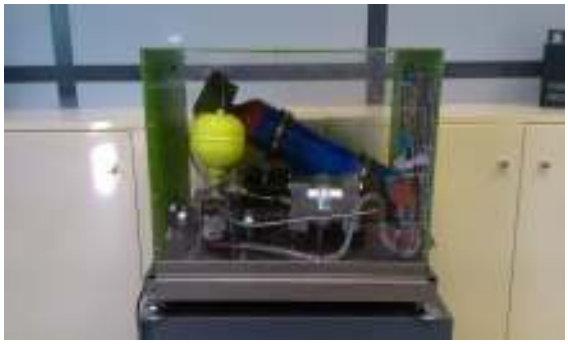
HYPERION KW SERIES SPECIFICATION DATA SHEET- PRELIMINARY[2]



Hyperion C pre-industrial prototype (Casing, isolations and security components omitted)

Description

This document is the preliminary (pre-industrial) spec sheet for Hyperion product market entry.

Hyperions comprise of single and multiple reactor configurations using Nickel and Hydrogen in an exothermic reaction to produce thermal energy in kW range, providing safe and stable products.

Applications

Designed for:

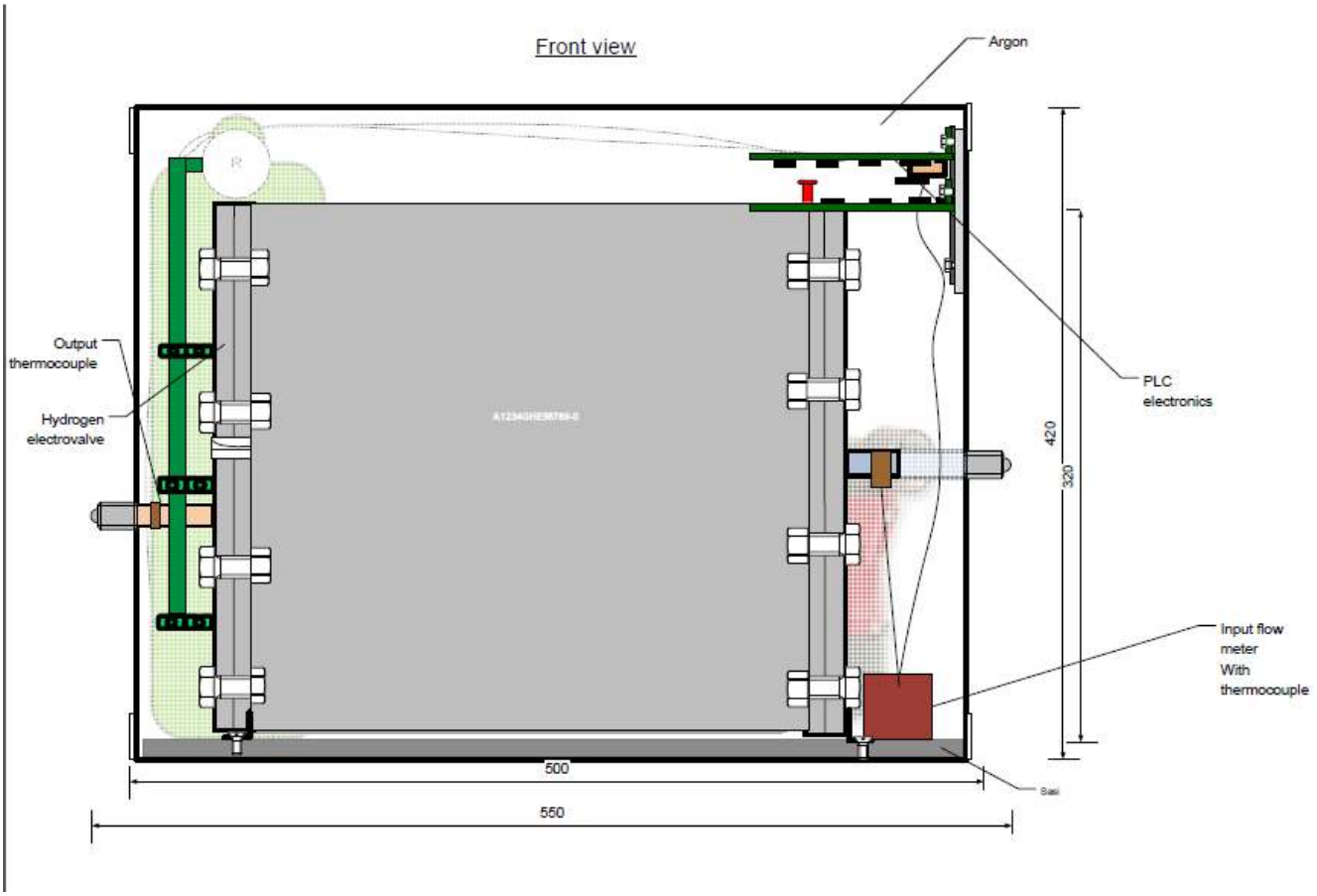
- Domestic or Building
- Agricultural
- Industrial

[2] Specifications based on pre-industrial prototypes. Specs can be changed without prior notice.

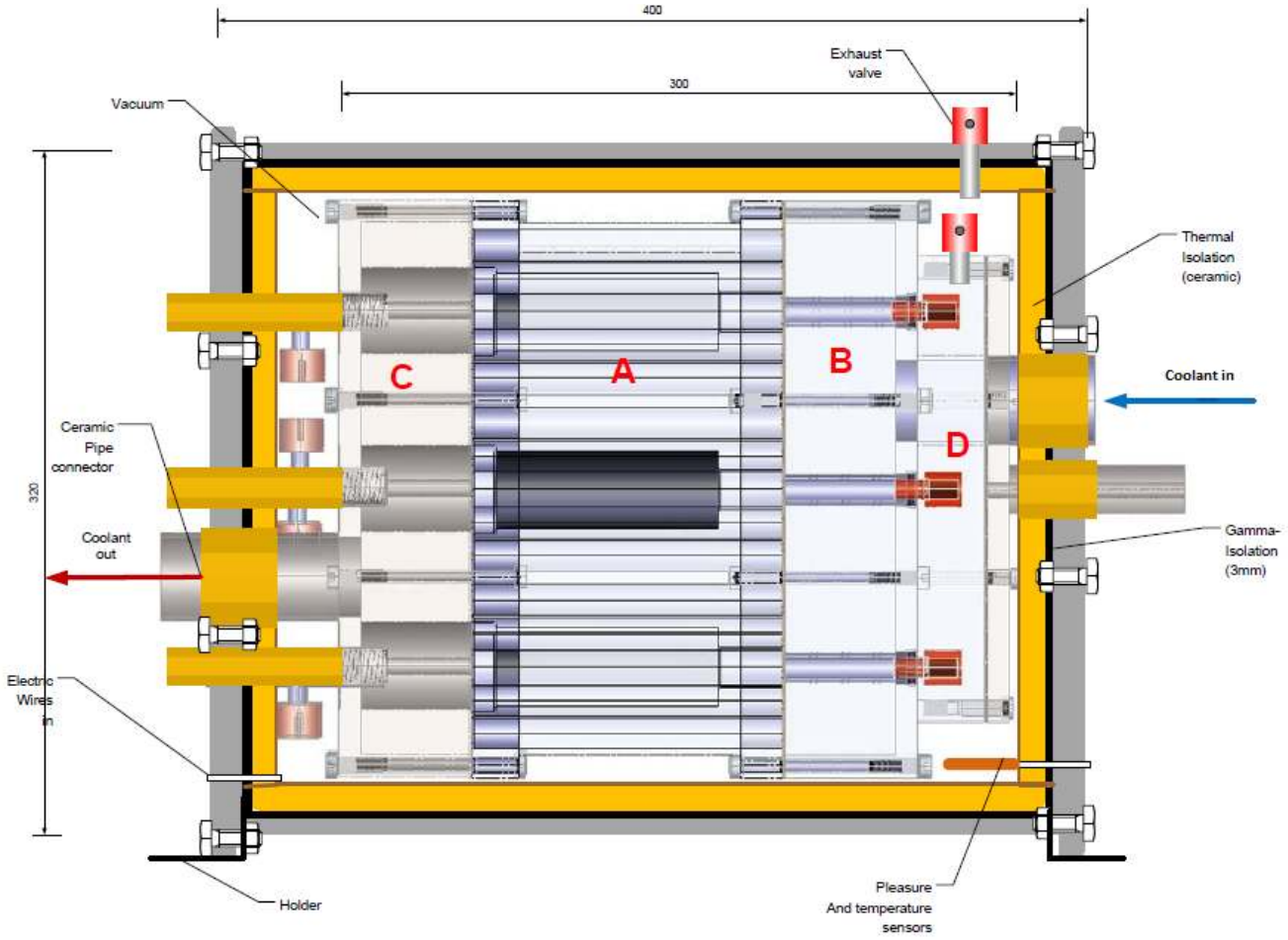
Hyperion subsystems

1. Kernel with embedded coolant interface
    a. Reactor(s)
        i. Chamber
        ii. Ignition system
        iii. Atomic Hydrogen generation
        iv. Ni powder
        v. Sensors
        vi. Exhaust valves
    b. Coolant interface
    c. Thermal isolation
    d. γ-shielding
    e. Sensors
    f. Casing, leakage proof and exhaust valve
2. Coolant/heating management
    a. Media
    b. Pump
    c. Pipes and Connectors
    d. On line calorimeter
    e. Controls and electronics
3. Hydrogen circuit
    a. Media
    b. Tank
    c. Valves and controls
    d. Pipes and connectors
    e. Thermal isolation and anti-explosive blankets
4. Functions and tele-monitoring
    a. Modes of operation
    b. I/O
    c. GPS
    d. GSM
5. Security
    a. Self destructing method
    b. Controls and Electronics
    c. Other
6. General
    a. Operation and operational conditions
    b. Casing
7. External features
    a. External heat exchangers
    b. Piping
    c. Interoperability with third party products

Hyperion kW series overall architecture



Hyperion schematic internal architecture (multi-reactor model)



Hyperion Kernel and Inbox design (multi-reactor model). Labels used in Spec sheet

1. Kernel with embedded coolant interface[3]			
Kernel Body (Area A, B, C, D)	Material	Steel BS S 162	
		Series C & D models	Series A & B models
	Dimensions in cm	12 x 12 x 12	26 x 30 x 26
	Volume	1728cm^3	20280cm^3
	Weight	4,5 kgr	32kg
	Paint (outer surfaces)	Ceramic	
a. Reactor(s) (Area A)	Number of reactors per Kernel	1 in Hyperion Series C & D models 9 in Hyperion Series A & B models	
i. Reactor Chamber	Dimensions (cylinder)	Diameter: 4cm Length: 10cm	
	Internal volume	<125,6cm^3	
	Interfaces	At reactor's chamber flanged covers	
	Electric heating element	M10 thread, electrically and heat isolated	
	Hydrogen & recharge circuit	Thread M10	
	Exhaust valve	Thread M10	
	Sensors	Thread M10	
	Security/Destructing	Not to be disclosed	
ii. Ignition system	Method	Two Phase pre-heating and H_2 charge	
Phase I	Electric power preheating		
Heating element	Heating resistor fixture	Nut: M12, Thread: M10 x 1.25, Pre-heat: 6 seconds, Volts: 24, Amps: 6, Max operating temperature 1050^{o}C	
Phase II	Chemical assisted preheating		
	Media	Not to be disclosed	
iii. Atomic Hydrogen generation	Method	Proprietary, embedded within reactor's structure	
iv. Ni powder			

[3] Numeric notation in all tables follows the European standard. 1.500,7 is one thousand five hundred and seven tenths

1. Kernel with embedded coolant interface[3]		
(row material)		
	Sub Sieve Particle Size	3-7 microns
	Bulk density	1,8-2,7gr/cm^3
	Typical surface area	0,4m^2/gr (BET)
	Chemical composition (Wt%)	Carbon: 0,07 Sulphur: 0,0001 Oxygen: 0,008 Nitrogen: 0,001 Iron: 0,001 Cobalt: <0,00002 Total other: <0,001 Nickel: Balance
	Preparation method	Proprietary
v. Catalysts involved in reaction	Yes	Proprietary
vi. Chamber Conditioning	Clean conditions at production	Chemically cleaned ($CHCl_3$) Thermal and vacuum cleaned
	In all modes	H_2 pressured (less than 50 bar)
vii. Sensors (within reactor)	Thermocouple	Type K Max temp: 1100°C Accuracy ±1,5% at 375°C (±0.004×T between 375 °C and 1000 °C)
viii. Reactor Exhaust valve	Maximum pressure	150bar
	Connection	M10, Threaded with face sealed
	Media	Steel
	Actuation	Pressure
	Exhaust to	Area D in Kernel's body
b. Coolant interface		
i. Structure	Type	Tube One pass Tube holes embedded within Kernel's structure

1. Kernel with embedded coolant interface[3]			
		Coolant concentrator chambers (cool in and hot out) within kernel structure (Area B and C in Kernel's body)	
ii. Dimensions	Tube	Diameter: 1,2cm Length: 14cm	
	Reservoir (in and out)	Series C & D models	Series A & B models
	Volume (coolant space)	190 cm^3	1710 cm^3
iii. Contact of coolant with reactor's chambers	Distance from reactor chamber	>0,5cm	
iv. Number of tubes per reactor	Number	6	
c. Kernel's Thermal isolation	Type	Refractory Ceramic Fibre (RCF) vacuum formed	
	Classification temperature (EN1094-3)	1300°C	
	Continuous use temperature	Max 1100°C (no shrinkage or Crystallisation)	
	Testing methods	ASTM C-201 and EN 1094-1	
	Blanket Thickness	1,8cm	
	Thermal conductivity	0,11 W/m.K at 600°C	
	Other structural thermal isolation	RCF structured thermal bridges in Hydrogen circuit (designed by DGT and manufactured specially for Hyperions)	
	Health and Environmental	Under the new CLP regulations: non-hazardous.	
d. γ-shielding	Type	ECOMASS compound Polyether Block Amide Nontoxic alternative to Lead (Pb) for radiation shielding applications	
	Thickness	0,3cm	
	Density	6,9gr/cm^3	
	Reference	http://www.ecomass.com/index.html	
e. Sensors (in kernels casing, outside reactor or kernel)	Thermocouple	Type K Max temp: 1100°C Accuracy ±1,5% at 375°C (±0.004×T between 375 °C and 1000 °C)	

1. Kernel with embedded coolant interface[3]			
	Pressure sensor	Vacuum and pressure	
	Media	Stainless steel	
	Output type	Voltage	
	Maximum operational pressure	500bar	
	Accuracy	0,075±FS	
	Power	8VDC-32CDC	
f. Casing, leakage proof and exhaust valve			
i. Kernel and isolations casing	Type	Steel box flanged, damper resistance	
		Series C & D models	Series A & B models
	Dimensions (WxDxH) in cm	17x 22x 17	32 x 40 x 32
	Air-tightness	Class D (according to EN 14239), tested according to European Standard EN13053	
	Conditioning in all modes	Vacuum	
ii. Exhaust pressure valves	Maximum pressure	150bar	
	Connection	M10, Threaded with face sealed	
	Media	Steel	
	Actuation	Pressure	
	Exhaust from	Area D in Kernel's body	
	Exhaust to	Inside Hyperion box	

2. Coolant/heating management

a. Coolant media

Type	Synthetic thermal oil (*alkyl aromatic)* *General purpose in Hyperion Systems*
Maximum Bulk Fluid Operating Temperature (no vapor presence at all temperature ranges)	349°C
Pumpability (2000cP) minimum	-37°C
Auto-ignition Temperature	450°C
Thermal conductivity	At 185°C: 0,113W/m.K At 315°C: 0,106W/m.K At 349°C: 0,08W/m.K
Note	For temperature ranges 350°C-430°C, use of melted salts (used for stress testing)

b. Pump

i. At setup output temp ranges[4] <185°C

Type[5]	Magnetic Drive
Liquid flow	0,03 to 8,37lt/min
Discharge pressure	0,03 to 45bar
Media maximum temperature	185°C
Max Viscosity	60.000 cP (CentiPoises)
Max Capacity	100cm^3/rev
Speed (rev/min)	10 — 80 rev/min
Flow Rate	0.2 mLt—8 Lt/min
Power features	Adjustable Speed, Continuous Duty, Corrosion Resistant, Explosion Proof Control Device, Sealless, Filter, Thermal Overload control, PLC Controls, Data Logging
Energy consumption	30-55Wh

[4] At external heat exchanger outlet
[5] Standard type. Other types also available for low-end applications

2. Coolant/heating management

ii. At setup output temp ranges <315°C

Type	Magnetic Drive
Liquid flow	0,03 to 8,37lt/min
Discharge pressure	0,03 to 96,5bar
Media maximum temperature	315°C
Max Viscosity	60.000 cP
Max Capacity	120 cm^3/rev
Speed (rev/min)	10 — 80 rev/min
Flow Rate	0.2 mlt—9,6 Lt/min
Power features	Adjustable Speed, Continuous Duty, Corrosion Resistant, Explosion Proof Control Device, Sealless, Filter, Thermal Overload control, PLC Controls, Data Logging
Energy consumption	50-110Wh

iii. At setup output ranges <414°C

Type	Gear -motor drived (placed outside Hyperion on primary circuit)
Liquid flow	0,03 to 12Lt/min
Discharge pressure	0,03 to 96,5bar
Media maximum temperature	430°C
Max Viscosity	60.000 cP
Max Capacity	150 cm^3/rev
Speed (rev/min)	10 — 120 rev/min
Flow Rate	Up to 18 Lt/min
Power features	Adjustable Speed, Continuous Duty, Corrosion Resistant, Explosion Proof Control Device, Sealless, Filter, Thermal Overload control, PLC Controls, Data Logging

2. Coolant/heating management

	Energy consumption	0,5-0,77kWh
c. Pipes and Connectors (primary circuit within Hyperion)		
	Circuit Type	Closed circuit
	Pipe type	TP304 Stainless steel NDE Seamless
	Dimensions	½"
	Connectors	Stainless steel TP304, male and female easy connectors
	Thermal Isolation	Refractory Ceramic Fibre (RCF) blanket
	Leakage classification	Class A (according to EN 14239)
	Decompression method	Outside Hyperion product
d. On line calorimeter	Specs	• ±1.0% accuracy within 1/10th to max flow rate • High turn down ratio • Vortex frequency measuring principle of operation • For use with all kinds of oil or thermal oils • Media maximum temperature: 435^{o}C (continuous operation) • Reverse direction counting (subtracts in case of sucking back oil) • Operating voltage 5.7 to 15 VDC • Creates very little pressure drop • Non volatile memory recording last measuring data • Robust Aluminum-titanium solid casing • CE approval • International patent pending • Designed and developed in house
	Interface with coolant circuit	Vortex, pipe mounted
	Thermocouples at flow-meter	Type K Max temp: 1100^{o}C Accuracy ±1,5% at 375^{o}C (±0.004×T between 375 °C and 1000 °C)
	Energy consumption	0,7-1,5Wh

2. Coolant/heating management

	Dimensions (W x D x H) in cm	12 x 4 x6,5
e. Other sensors in circuit		
	Thermocouple at coolant circuit output	Type K Max temp: 1100°C Accuracy ±1,5% at 375°C (±0.004×T between 375 °C and 1000 °C)
f. Controls and safety/operational electronics		
	Type	PLC Board, ATEX certified
	Controls	Pump, hydrogen circuit electro-valves, electric circuit
	Measurements	All thermocouples, on-line calorimeter, pump, pressure valves, electric and battery backup
	Sampling of all measurements	Per 1 sec
	Functions	Safety and balancing algorithms (Defkalion proprietary), Delta monitoring on in/out (calories and temperatures), automatic readjustment of functional conditions, functional I/O and display, self checking/diagnostics, maintenance/ recharge sync, performance and alarms to tele-monitoring system
	Energy consumption	<10mWh

3. Hydrogen circuit

a. Media		
	Hydrogen type	N60
	Reference	http://www.airliquide.gr/
b. Hydrogen tank		
	Type	Certified for Hydrogen
	Material	Chrome Moly EN10083
	Volume	2Lt
	Pressure	200bar
	Dimensions (without valves)	Diameter: 10cm Height: 35,5cm
	Weight empty (without valves)	3,8kg
c. Valves and controls		
i. On/off-Reducer valve	Type	Manual
ii. Electro-valve (per reactor)	Type	Two way normally closed valve high pressure, solenoid
	Standard port size	1/8" NPT
	Pressure	0-200bar
	Flow (CV)	0,022-0,100
	Energy consumption	<10mWh
iii. Backup switch	Type	Mercury
	Actuation	Temperature driven
iv. Pressure sensor	Type	Sensor /Transducer
	Working pressure range	0 to 689 bars
	Accuracy	0,25±%FS
	Signal output	Digital
	Other	Temperature Compensated
d. Pipes and connectors	Type	EN10216-5TC2 14541ACT- A269 TP321 NDE Seamless MS2 CFA Heat
e. Thermal isolation		

3. Hydrogen circuit

and anti-explosive blankets		
i. Thermal isolation	Structural thermal isolation	RCF structured thermal bridges in Hydrogen circuit (designed by DGT and manufactured specially for Hyperions)
ii. Anti-explosive blankets	Type	Kevlar K49 formed

4. Functions and tele-monitoring

a. Modes of operation	Test mode	Only in production's factory Safety electronics ON Security electronics OFF
	Stand by mode	In packaging or storage Safety electronics OFF Security electronics ON
	On mode	Installed Safety electronics ON Security electronics ON
	Stop mode	Installed, Reactor(s) stopped Safety electronics ON Security electronics ON
	Recharge mode	During on site maintenance/ recharge in installation site by authorized support personnel Safety electronics ON Security electronics ON
	Cancelled mode	In case of bridge of security
	Manual Mode change	Only by authorized personnel, software controlled
b. I/O	Display	(To be defined)
	Functional I/O and service ports	2 USB2.0 ports
	Power supply (from grid)	IEC 60320 C-13 plug/ 230V-50Hz

4. Functions and tele-monitoring		
c. GSM	Type	On board, embedded to all Hyperion products (different cell network formats under development)
	Antenna	Internal and External (optional)
	Data send by Hyperions to Defkalion GT Maintenance Support Centers	Performance data (periodically) Alarms
	Producer	In house
d. GPS	Type	On board, embedded to all Hyperion products (different cell network formats support under development)
	Antenna	Internal and External (optional)
	Producer	In House
e. Backup battery	Type	2 units Lead Acid Rechargeable
	Power (each unit)	12V, 16Ah
	Powers	i. Security Electronics/sensors and GPS/GSM ii. All system in case of grid failure Note: OFF during test/measurements

5. Product Security System		
a. Self destructing method		(Not presented in designs or photos of spec sheet)
	Method	Chemical non hazardous
b. Controls and Electronics	Type	Not to be disclosed
c. Sensors	Type	Not to be disclosed

6. General

a. Operation and operational conditions		
i. Operating conditions	Temperature	-20°C to 60°C
	Humidity	0-92%
ii. Operations	Type	Automatic monitoring of Δ calorimetry on ON/OFF mode
	Parameters loading	Upon installation, software controlled
iii. Multi-reactor configuration	Reactors operation	Independent
	Maximum (2-9) allowed concurrent reactors in operation	As defined during installation
b. Casing		
i. Types of casing	Types	Desktop Rack mounted (for MW arrays)
ii. Inner conditions	Inner environment	Argon, monitored conditions in compartment A
iii. Sensors	Thermal, pressure and other security related	
iv. Compartments	Compartment A: Tamper resistant including	Kernel with coolant interface Electronics and sensors Pipes
	Compartment B: Service area[6] under room conditions including	Hydrogen tank, Backup batteries, GPS/GSM electronics, pump, pipes
v. Visible features on casing		Plug to electric grid Service USB ports GPS/GSM plugs (for external antennas) Display (to be defined) Coolant inlet and outlet connectors Product label

[6] Accessed only by authorized service personnel

7. External features and optional

a. External heat exchangers		
	Low entry configurations	Stainless steel/copper braze plates Typical Reference: http://completewatersystems.com/product/brazepak-stainless-steelcopper-braze-refrigeration/
	All configurations	Steel shell U-Tube heat exchanger Typical Reference: http://completewatersystems.com/product/b300sx2000u-steel-shell-u-tube-shell-tube-heat-exchanger/
	High end configurations	Shell U-Tube multi pass heat exchanger, designed by Defkalion engineering
b. Piping (primary circuit outside Hyperion)	Type	Closed circuit
	Media	Steel, cooper or PVC thermally isolated
	Pipes and fittings	½" – 1"
c. Interoperability with third party products		
i. General	Communication method	Δ Calorimetry
ii. Operational Parameters	Parameters	Output kW (only in multi reactor models), maximum temperature, Δ range in Calorimetry
	Stored at	Hyperion Safety/operational electronic's libraries
iii. Testing and approvals	Mutual, based on agreements	

Overall Hyperion kW series system specs

	Single reactor Kernel	Multi-reactor Kernel (9 reactors per Kernel)
Type of equipment (according to Greek classification codes)	Electric appliance/ Boiler	
Thermal source	Chemically Assisted Low Energy Nuclear Reaction (CALENuR) Ni-H	
Thermal power (measured at external heat exchanger outlet)[7]	Range: 5-11kW Nominal in Hyperion pre-industrial prototypes : 5kW	Nominal in Hyperion pre-industrial prototypes: 10-45kW
Max Output temperatures (measured at external heat exchanger outlet)	Series A: 285°C Series C: 185°C	Series B: 414°C Series D: 185°C
Hyperion external dimensions (WxDxH)	55cm x 45cm x 42cm	
Hyperion Weight (with no coolant and external heat exchanger)	≈19,5 kg	≈ 47,6- 51 kg[8]
Maximum electric energy consumption per hour at ON mode	<200Wh	<310Wh
Hydrogen can recharge every	6 months	6 to 12 months
Powders renewal every	6 months	6 to 34 months
COP	Better than 1:25	Better than 1:32

[7] Based on test and measurements protocols to be released
[8] Depending on the pump in use

Environmental and Safety

γ-radiation emission	≤0,18 μSV/h
Other emissions	None (in all modes)
Toxic materials used or produced in all modes	**Ni powder** Handled, processed and stored in vacuum within Hyperion product. If material exposed to no-controlled conditions: **Hazards Identification** *R40 - Limited evidence of a carcinogenic effect.* *R43 - May cause sensitization by skin contact.* ***Ecotoxic effects***: Non toxic ***Biological data*:** Fish toxicity Br. rerio LC50>100mg/1/96h; ***Daphnia Toxicity*:** Daphnia magna EC50:>100mg/1/48h; ***Algeal Toxicity:*** Selenastrum capricornatum IC50: 100mg/1/72 (suspension); ***Bacterial toxicity:*** Pseudomonas fluorescens EC50: 250mg/1/48h ***Further Ecological Data:*** *Due to poor solubility of the material, no harmful effects on aquatic organisms are to be expected when handled and used with due care and attention.* ***Coolant media:*** As described in the coolant media's safety reference sheet **Other:** None
Radiation materials used or produced in all modes	None
Noise level	12- 41dB at 5 m distance (depended only from the pump in use)
Leakage classification	• ANSI Class IV: for all hydraulic subsystems • Casing: Air-tightness class D (according to EN 14239), tested according to European Standard EN13053 • Hydrogen circuit: Class D (according to EN 14239), tested with vacuum, hydrostatic, Helium and Argon leak tests at 200bar
Safety	• According to EU Directive 94/9/EC (ATEX 95 / ATEX Equipment Directive) • Hydrogen handling according to ANSI/AIAA Guide to Safety of Hydrogen and Hydrogen Systems, NFPA 55 and 70 (class I/division 1 and 2) guidelines and EU/national SEVESO II legislation (http://www.minenv.gr/1/12/121/12102/g1210201.html) • Fire protection according to EU CEN 8/9/2009 13478:2001+A1:2008 Safety of machinery - Fire prevention and protection
Certificates	Pending
Recycling	>98% (in weight) of Hyperion product is made from recyclable materials

Recharge method & Maintenance

Recharge method

Hyperions are recharged periodically *in situ* by authorized technical personnel only. There is no need to uninstall/install the product during recharging. Recharging of Hydrogen is done with a new Hydrogen tank whilst all powders are changed and renewed in vacuum using *Hyperion Recharge Units* (RU) (suite case type- designed and developed by Defkalion GT).

Maintenance

First line support/maintenance: By authorized trained personnel only using tools, diagnostic software and protocols provided by Defkalion GT and supported by local licensees Maintenance Support Centers (tele-monitoring) by country.

Second line support/maintenance: Tele-monitoring and maintenance or repairs only at authorized factories of local licensees by country.

Third line support/maintenance/repairs: Only at Defkalion GT factories or labs.

Recycling: At authorized factories of local licensees by country.

MTBF (Mean Time Between Failure)

To be defined

Warranty period

To be defined

Handling and storage

Hyperions are high tech safe products. Their handling is allowed only by authorized personnel following Defkalion GT's protocols and guidelines. Any attempt to violate such handling procedures may cause product's self-destruct with no hazardous or dangerous effects to its environment.

Packaging and logistics of Hyperions are in accordance to the EU regulations (89/391/EC of 12/6/1989)

About the reaction

Defkalion's scientific R&D team have successfully managed to trigger and monitor Chemically Assisted Low Energy Nuclear Reactions caused by Nickel and Hydrogen nuclei. Following extensive experimentation on the preparation, cleaning and degassing of Nickel clusters and atomic Hydrogen systems, valuable knowledge has been gained. The data was obtained from conventional, non-specifically designed for LENR instrumentation, such as mass-spectrometer, gas-chromatographer, Wilson camera, SEM spectra and others.

Such measurements of phenomena gave us strong evidence on the activation mechanisms of Nickel that allow the nuclear capture of Hydrogen (the "breaking" of the Coulomb barrier), as well as the thermalization mechanism in a dynamic system of multi-stage set of reactions. Due to the elapsed time between the phenomena and their measurements using the above mentioned instrumentation, an incomplete proof of theories still exists. However, the obtained data provide us with a solid basis to control the triggering and termination conditions of the Ni-H reactions within Hyperion reactors, as well as the necessary conditions for stable performance.

As a result, the above mentioned efforts led to the design of safe and stable Hyperion pre-industrial product, following the specifications described in this document.

Defkalion GT is an industrial company and not an academic or research institute with a role to state, prove and reject theories; as such, we recognize that products do not need to be based on theories. However, we do recognize the importance of scientific knowledge for further scientific research and product development. For this reason, we have decided to invest on a new series of on-line real-time mass spectrometers, designed specifically for LENR and Hyperions, that we are developing and testing in Greece. It is our intention to publish all relative measurements in scientific journals and events, when our tests are finally concluded.

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