

# Radioisotope Production System

The Siemens Eclipse™ family of PET cyclotrons is a comprehensive solution for radioisotope production. Eclipse Cyclotron is an 11 MeV, negative ion, single particle accelerator designed for the clinical and commercial production and distribution of  $^{18}\text{F}$  radiotracers. The Eclipse product line is composed of Eclipse RD and HP.

## Accelerator design

Eclipse's unique sector design, with a valley-to-hill gap ratio of 27:1, enables high quality beam focusing. This means improved beam transmission, higher production yields and greatly reduced internal activation.

## Magnet design

Eclipse uses a patented single-coil magnet that increases reliability and dramatically reduces the system's power consumption. This guarantees high production capabilities and low operating costs.

## RD target carousel

The automated target carousel holds up to eight targets, enabling both rapid and remote target changes.

## HP target carousel

A four-position automated target carousel can be installed on either of two beamlines. Targets are easily changeable within either carousel. Optional configurations include the HP/HP, RD/RD and HP/RD.

## Self-shielding

Eclipse's self-shielded system substantially reduces radiation levels without the expense and space required for a vault. The dose at room boundary (24' x 23' x 14' height) is <2.0 mR/hour.

## Small volume targets

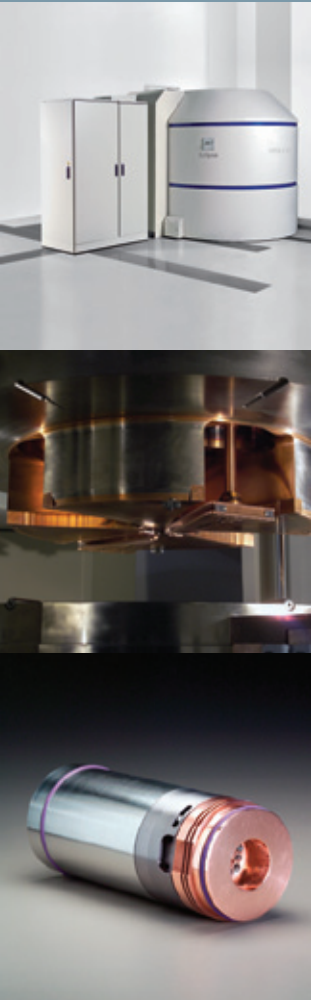
Using advanced technology, Eclipse targetry offers efficient production of PET isotopes with the minimal use of enriched starting materials, such as  $^{18}\text{O}$  water.

## Ease of serviceability

Vertical mounting of the ion source and extraction mechanism provides easy access and reduced maintenance time. The extraction carousel's multiple, long-lived stripping foils enable extended operation before service is required.

## Automated system control

All major systems on Eclipse are automatically controlled through a PC-compatible workstation. The control software incorporates an easy-to-use interface.



## Eclipse Cyclotrons

[www.siemens.com/mi](http://www.siemens.com/mi)

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## Typical System Performance

Product	Chemical Form	Irradiation Time (min)	HP Typical Single Target Product Yield at 60 $\mu$ A on Target*	RD Typical Single Target Product Yield at 40 $\mu$ A on Target*
<sup>18</sup> F	F <sup>-</sup>	60	2200 mCi (82 GBq) <sup>a,e</sup>	1200 mCi (45 GBq) <sup>a</sup>
	F <sup>-</sup>	120	3500 mCi (130 GBq) <sup>a,e</sup>	2000 mCi (74 GBq) <sup>a</sup>
	F <sub>2</sub>	40	525 mCi (20 GBq) <sup>a</sup>	400 mCi (18 GBq) <sup>a</sup>
<sup>15</sup> O	O <sub>2</sub>	10	2300 mCi (85 GBq) <sup>a</sup>	2000 mCi (74 GBq) <sup>a</sup>
	CO <sub>2</sub>	10	700 mCi (26 GBq) <sup>b</sup>	600 mCi (22 GBq) <sup>b</sup>
	CO	10	900 mCi (33 GBq) <sup>b</sup>	800 mCi (30 GBq) <sup>b</sup>
	H <sub>2</sub> O	10	850 mCi (32 GBq) <sup>b,d</sup>	750 mCi (28 GBq) <sup>b,d</sup>
<sup>13</sup> N	NH <sub>3</sub>	10	200 mCi (7.5 GBq) <sup>a</sup>	100 mCi (4 GBq) <sup>a</sup>
<sup>11</sup> C	CO <sub>2</sub>	50	2000 mCi (74 GBq) <sup>a,c</sup>	1500 mCi (56 GBq) <sup>a,c</sup>
	CO	50	1300 mCi (48 GBq) <sup>b</sup>	975 mCi (36 GBq) <sup>b</sup>

a. End of bombardment (EOB)

b. End of synthesis, decay corrected to EOB

c. Specific activity >25 Ci/ $\mu$ mole

d. Computer-controlled target purging enables repetitive delivery of 20-25 mCi doses for <\$4/dose

e. Using Tantalum targets

\* See acceptance test for specified minimum yields.

## System Specifications

Energy	11 MeV	<b>Target Current</b>	
<b>Magnet: 4-sector azimuthally varying field, single strip coil</b>		Eclipse RD	40 $\mu$ A single beam; 80 $\mu$ A dual beam
Power	3 kW	Eclipse HP	60 $\mu$ A single beam; 120 $\mu$ A dual beam
Mean field	1.2 Tesla	<b>Vacuum (in Torr)</b>	
Valley-to-hill gap ratio	27:1	Base pressure (mm Hg)	5x10 <sup>-7</sup>
Magnetic field at room boundary	<1 Gauss	Operating pressure	<1x10 <sup>-5</sup>
<b>RF System: Four Dees</b>		<b>Power Consumption</b>	
Fundamental mode	72 MHz	Standby	<7 kW
Max. amplifier power	10 kW	Operating	35 kW
<b>Ion Source: Penning Ion Gauge</b>		<b>Heat Rejection</b>	
Max H- current	2 mA	Air	52,000 BTU/hr
<b>Beam Extraction: Carbon Foils</b>		Water	90,000 BTU/hr
# Foils/carousel	3	<b>Shielding</b>	
Foil lifetime	10,000 $\mu$ A-hr	Eclipse RD	2.0 mR/hr (20 $\mu$ Sv/hr) total n+g @ 2x40 $\mu$ A at room boundary
Beam size (RD)	8 mm	Eclipse HP	2.0 mR/hr (20 $\mu$ Sv/hr) total n+g @ 2x60 $\mu$ A at room boundary
Beam size (HP)	10 mm		

### Installation Options

- Self-shield – Movable shield for radiation safety
- Shipping – System shipping is dependent upon destination country
- Installation and applications – Installation and on-site applications training is dependent upon destination country

### System Options

- Vacuum system – Isolation valves
- Tantalum target – The optional tantalum target body offers unparalleled uptime, and is the backbone of today's major FDG production facilities
- Second target system – Second extraction port, including target water purge valve and either a four- or eight-position target carousel. Second extraction port allows two target carousels to be mounted to enable the simultaneous production of two different isotopes or the dual production of one isotope
- Switching valve option – The switching valve is required if the system has more than one target. It enables unloading target to any one of four different locations.
- Targetry – Targetry can be expanded to accommodate other target systems in a modular format, including but not limited to,  $^{11}\text{C-CO}_2$ ,  $^{15}\text{O-O}_2$ , and  $^{13}\text{N-NH}_4^+$
- Chemistry modules – Automated chemistry modules for the production of radiochemicals:
  - Explora FDG<sub>4</sub> – Multirun FDG
  - Explora FM – Formulation module
  - Explora GN – General nucleophilic module
  - Explora LC – Semi-prep HPLC purification module

Technical Data	HP/RD	
<b>Cyclotron</b>	10,000 (kg)	22,000 (lbs)
Width	150 (cm)	59 (in)
Depth	150 (cm)	59 (in)
Height	173 (cm)	68 (in)
<b>Movable Shields</b>	14,450 (kg)	31,800 (lbs)
Width	240 (cm)	95 (in)
Depth	184 (cm)	73 (in)
Height	230 (cm)	90 (in)
<b>Stationary Shields</b>	3,400 (kg)	7,400 (lbs)
Width	66 (cm)	26 (in)
Depth	83 (cm)	73 (in)
Height	230 (cm)	90 (in)
<b>Control Cabinets (1 unit)</b>	1,000 (kg)	2,200 (lbs)
Width	81 (cm)	32 (in)
Depth	142 (cm)	56 (in)
Height	210 (cm)	83 (in)
<b>Heat Exchanger Cabinet</b>	450 (kg)	1,000 (lbs)
Width	81 (cm)	32 (in)
Depth	81 (cm)	32 (in)
Height	210 (cm)	83 (in)

### Physical, Environmental, and Power Data

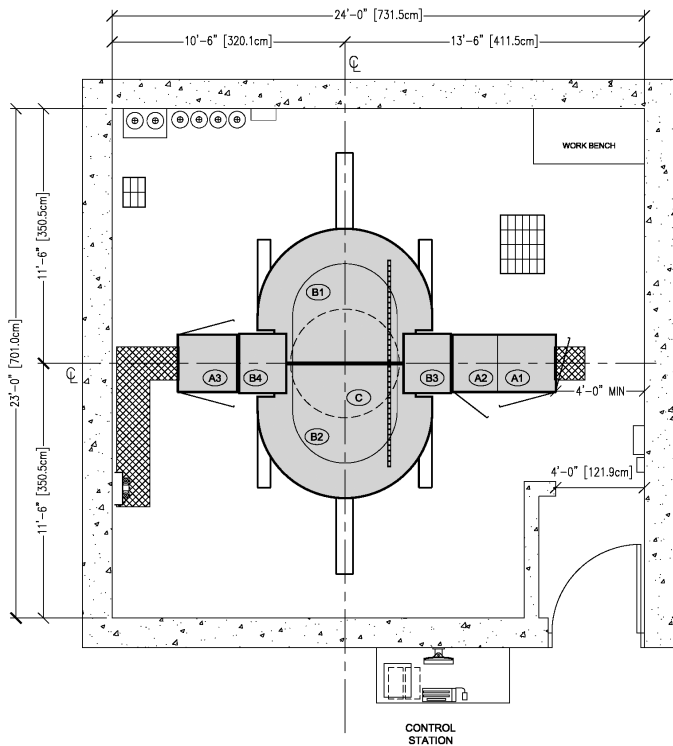
#### Power Requirements

Europe	208 (±5%) VAC, 150A, 3-phase 50 Hz standard
U.S./Asia	208 (±5%) VAC, 150A, 3-phase 60 Hz standard (50 Hz optional), 380 (±5%) VAC, 150A, 3-phase 60 Hz (optional)

#### Environmental Requirements

Normal operation requires an ambient temperature of 21°C (70°F) with relative humidity of 40 – 55%, noncondensing.

Control Band	±1°C (3°F)
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A1, A2: Control Cabinets (1 unit)  
 A3: Heat Exchanger Cabinet  
 B1, B2: Movable Shields (x2)  
 C: Cyclotron

The automated chemistry modules are delivered as laboratory equipment for the production of radiochemicals. No claim is made as to the suitability for human use of the products made with these modules. It is the exclusive responsibility of the user to determine if such products can be used for human subjects according to local and federal regulations, and Siemens disclaims all responsibility in this respect.

ISO 9001:2000 and ISO 13485 certified, meeting internationally recognized quality standards.

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Siemens reserves the right to modify the design and specifications contained herein without prior notice. Product performance depends on the choice of system configuration.

Please contact your local Siemens sales representative for the most current information or contact one of the addresses listed below.

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