RDS-111 to Eclipse HP Upgrading with Improvement in ^{18}F Production

A. Zarate-Morales, A. Flores-Moreno, J.C. Manrique-Arias, E. Zamora-Romo, M.A. Avila-Rodriguez

Unidad PET/CT-Ciclotrón, Facultad de Medicina, Universidad Nacional Autónoma de México, México, D.F., México

The first PET Center in Mexico was inaugurated in 2001 at the School of Medicine of the National Autonomous University of Mexico (UNAM). In that time a self-shielded CTI RDS-111 cyclotron with targetry for the production of the main sequence CNOF radionuclides was installed. Nowadays, there are 3 compact cyclotrons in the country and 11 PET/CT cameras in different hospitals. UNAM´s cyclotron produces FDG for 6 of the 8 PET scanners located in hospitals and clinics of Mexico City, and more hospitals are planning to install more PET/CTs. To satisfy this increased demand of FDG, one of the beam lines of our RDS-111 cyclotron was recently upgraded to an Eclipse HP configuration. In this way, now we have a hybrid cyclotron with BL1 as Eclipse HP and BL2 as RDS-111.

The main features of the upgrade include a new ion source that increased the beam current from 40 to 60μA, a new four-position target carrousel capable to handle 60μA, high power gridded-targets designed to be operated under high pressure conditions (>1000 psi), target body of refractory material (Ta) for the production of ^{18}F, and installation of high vacuum butterfly valves to the diffusion pumps. In addition, the Eclipse HP beam line has no vacuum window, and therefore no helium recirculation cooling system. With this upgrade we practically double the yield of ^{18}F with the same time of bombardment. Table 1 shows the yield of the different radionuclides in both versions while Table 2 summarizes our experience regarding ^{18}F production.

Table 1. Comparison of yields (EOB) obtained in RDS-111 *vs.* Eclipse HP targets.

Radionuclide	RDS-111 (40 μA)	Eclipse HP (60 μA)
$^{18}F^-$	1187 mCi (1h, 1200 μL $H_2{}^{18}O$)	2300 mCi (1h, 2400 μL $H_2{}^{18}O$)
^{13}N	146 mCi (10 min)	213 mCi (10 min)
^{11}C	1547 mCi (40 min)	1902 mCi (40 min)

Table 1. Comparison of ^{18}F production runs in RDS-111 *vs.* Eclipse HP targets.

	Bombardment time	A_{EOB} of $^{18}F^-$	A_{EOS} of FDG	Production runs
RDS-111	747.2 h	536.4 Ci	271 Ci	506
Eclipse HP	393.3 h	839.2 Ci	455 Ci	455
HP/RDS	0.53	1.56	1.68	0.90

The benefits of the upgraded BL were immediate for the production of ^{18}F. The high volume Ta target produces more activity of highly reactive n.c.a. [^{18}F]fluoride compared with the traditional Ag target of the RDS-111 configuration. We are still producing ^{18}F in both targets using the Ta target for the heavy morning-production run, and the Ag target for the second and less heavy production run at midday. Other benefits of the upgrade include a faster (0.5 h *vs.* 4 h) recovery of the vacuum in case of the rupture of a window, and lengthened the maintenance intervals of the ^{18}F target decreasing the radiation exposition to the cyclotron staff. Our plans for this year are to upgrade the second BL to the Eclipse HP configuration with the option for the irradiation of solid targets.