Development of $[NH_3]$ Ammonia target for Cyclone-30 at KFSH&RC

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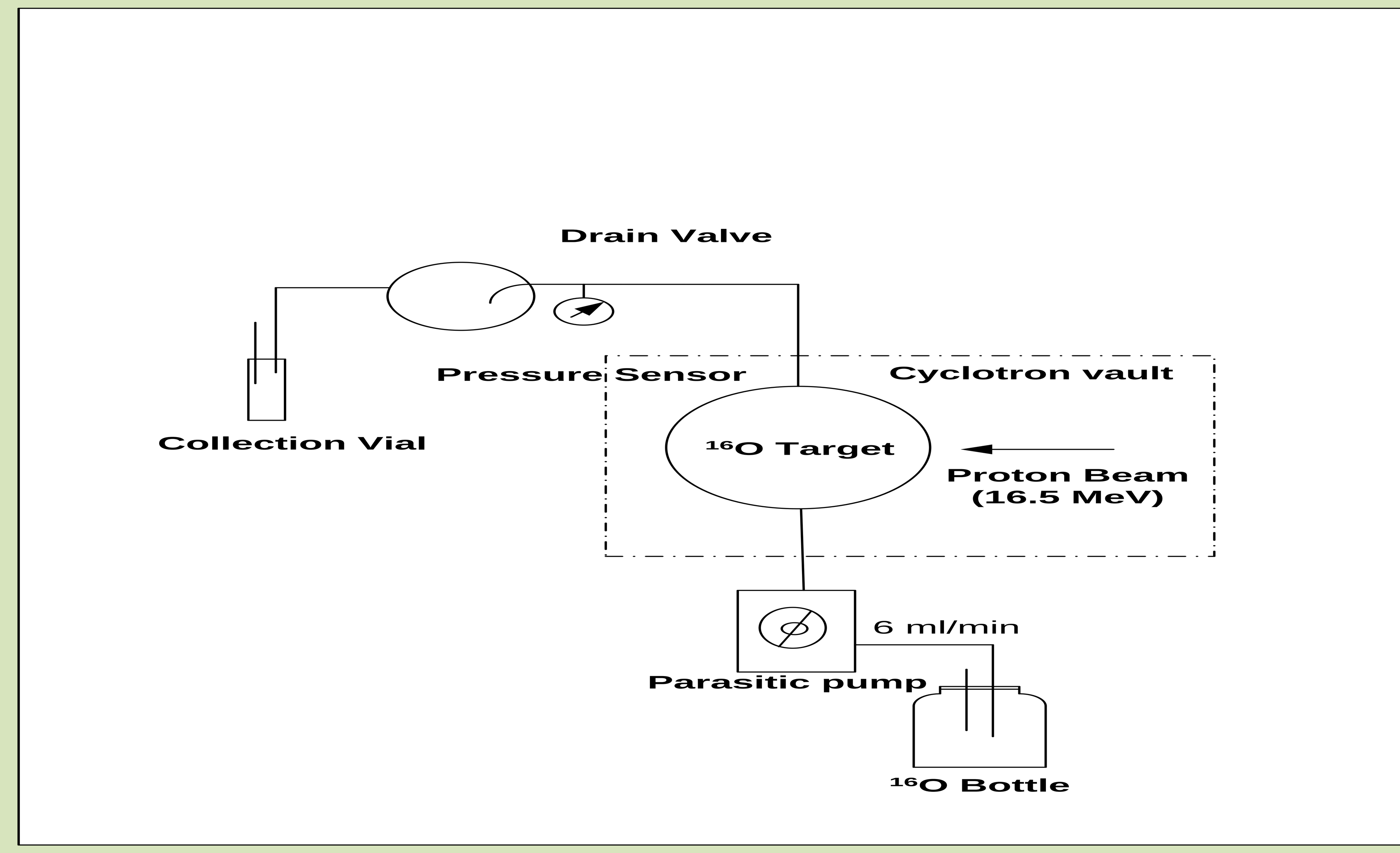
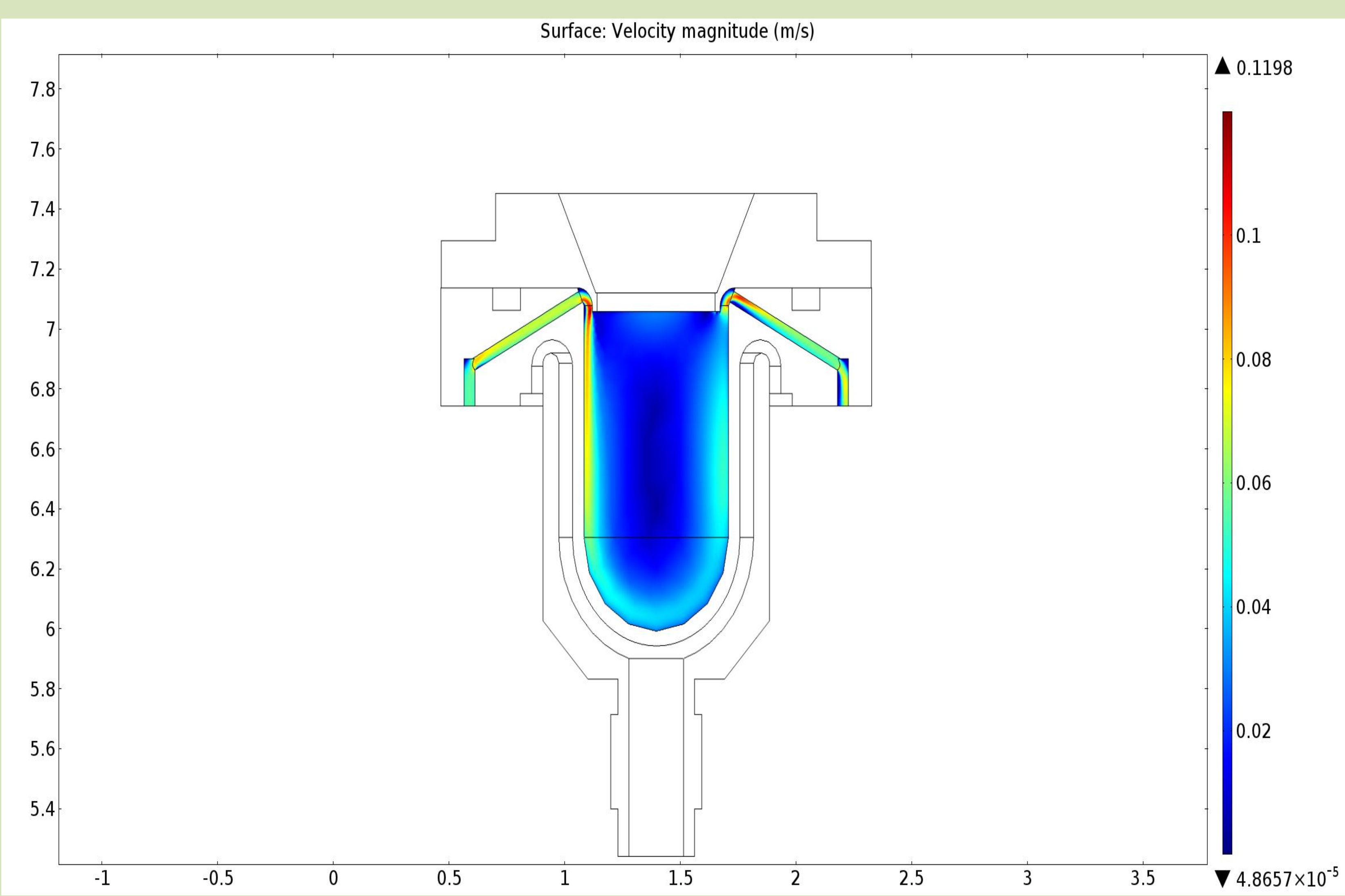
INTRODUCTION

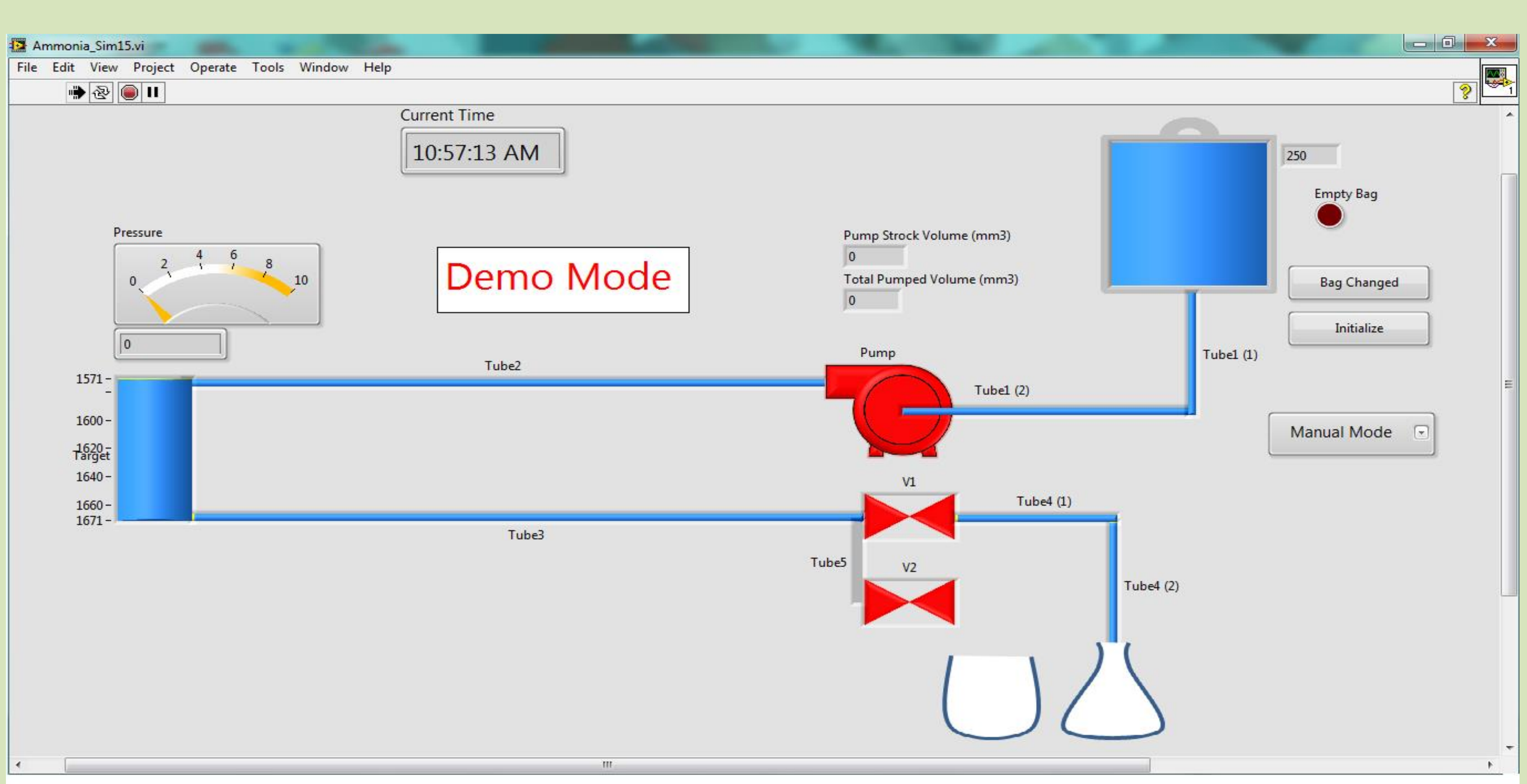
Nitrogen $[^{13}N]$ NH_3 is a liquid radioisotope, produced by medical cyclotrons for nuclear medicine application and widely applied for evaluation of myocardial perfusion in clinical assessments [1 and 2]. Owing to its short half-life (10 minutes), the unloading procedure of the radioactive solution of $[^{13}N]NH_3$ from the target is crucial in saving the activity produced for patient. The new design of the target was proved to add 30% of activity when the unloading technique improved. In our experiments, the production of ^{13}N was produced by the $^{16}O(p,\alpha)^{13}N$ reaction. The energy of proton beam was 16.5 MeV.

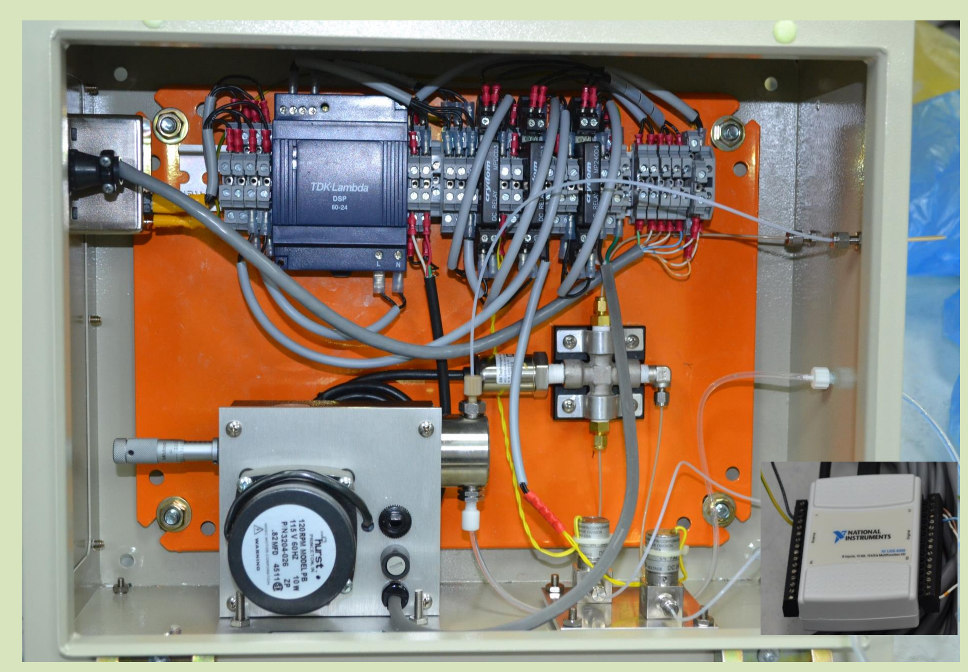


MATERIAL AND METHOD

A 2D model was developed using COMSOL Multiphysics to simulate the inner geometry of $[^{13}N]$ Ammonia target. In the 2D model, water and aluminum were used as materials for, respectively, the inner body and outer boundary (walls) of the geometry. The physics equations used to solve the problem of allocating proper place for the loading/unloading opening is Turbulent, k-ε Module being extracted from fluid flow module. The result of simulating water flow on the target water channels. The entrance of the pushing solution (for unloading) was designed to create a turbulent flow inside the target body and, hence, to collect most of the activity inside the target.





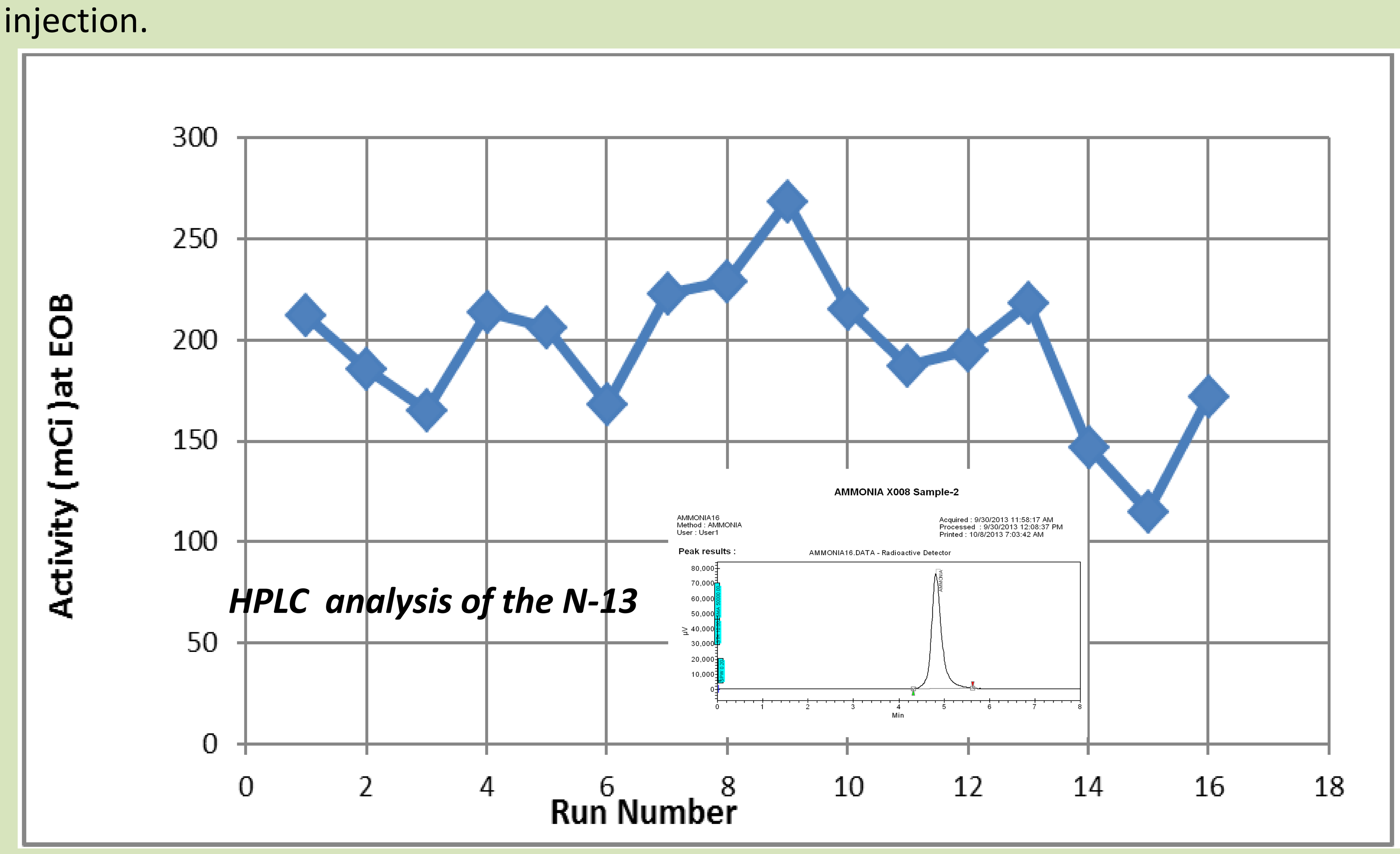


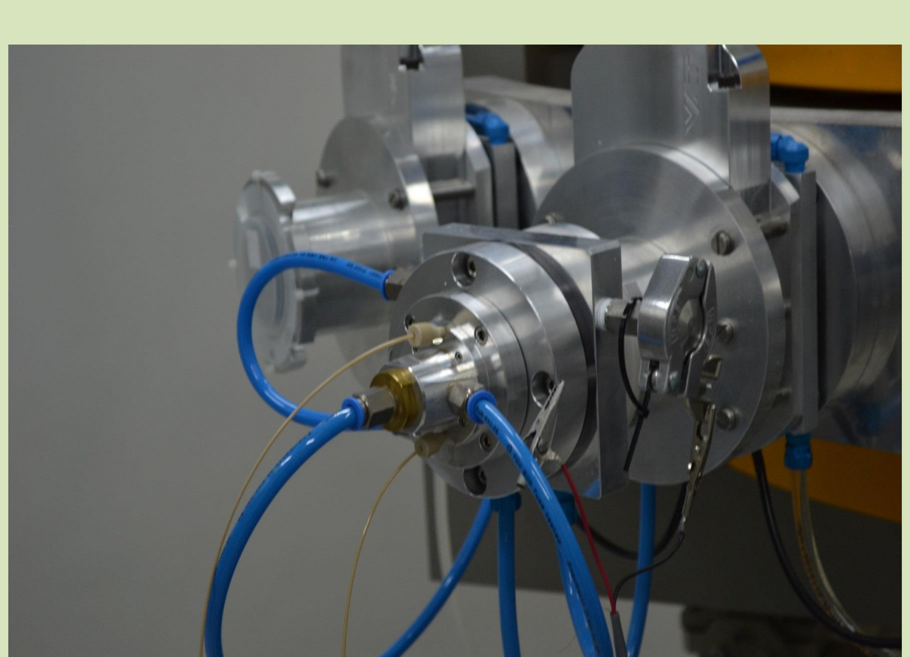
CONTROL SYSTEM

The control system for loading and unloading is based on a data acquisition card: USB6008. A Labview based software was written to allow full control on the target by single user. The software allows you to monitor the activity As it pushed from the target to its final Destination.

RESULTS

The activity produced in milliCuri (mCi) for several patient runs. The activity obtained in some experiments up to 330 mCi when we irradiated the target with 25 uA for 15 min. This was satisfactory to be delivered to nuclear medicine for patient injection. Moreover, $[^{13}N]$ purity was above 95% to which it meets the standard regulation for patient injection.





TARGET FABRICATION

The target was made of Aluminum material with ability to collimate the beam up to 10 mm. Now, it is connected to line 5 in PET vault. The cooling system is based on water being maintained at 18° C and flow rate Of 3.0 L/min. The water is push in Jet way to the back of the target t o increase the efficiency of heat dissipation.

N-13 target being installed in C-30 Cyclotron

CONCLUSION

In conclusion, the present system, which is totally automated from a target loading in the irradiation vessel to the collection of final product in a vial with feedback control by combined use of a personal computer (NH_3 software) and sensors of flow and pressure, can supply a sufficient amount of readily injectable $[^{13}N]NH_3$ in a high radiochemical purity at 10-20 min intervals.

REFERENCES

[1] Rajeev Kumar, et.al "Production of Nitrogen- 13-labeled ammonia by using 11 Mev medical cyclotron: our experience. Hellenic Journal of Nuclear Medicine".2009; 248-250.
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