NEW FACILITY FOR PRODUCTION OF MEDICAL ISOTOPES

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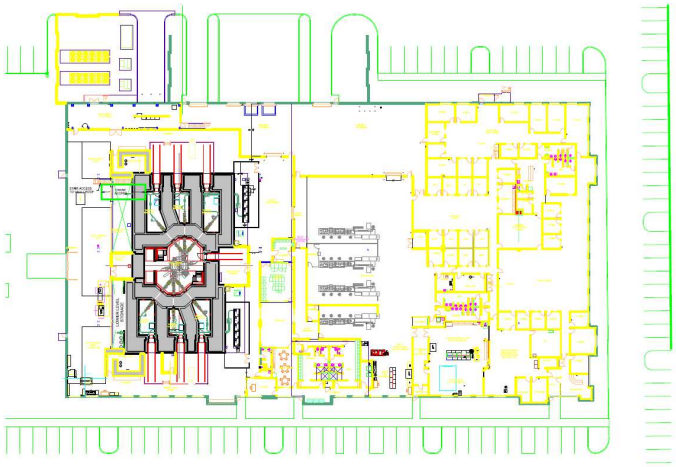
Abstract

A new facility for production of medical isotopes has been constructed in Indianapolis, IN and equipped with Cyclone 70P®, capable of delivering two simultaneous beams up to 350 uA each. Cyclotron is manufactured in Belgium by Ion Beam Applications, S.A. This is the first commercial 70 MeV cyclotron dedicated to medical use in the United States.

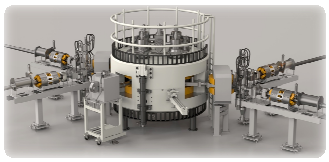
At present, 70 MeV Cyclotron facility has started the large scale manufacture of Sr-82 for Rb-82 generators for use in the diagnosis of cardiovascular disease. The cyclotron will also be employed to produce a wide variety of other radionuclides for both research and clinical applications. For this purpose the facility equipped with 6 target vaults and beam lines, two of which are currently equipped with target stations designed for irradiation of pneumatically transported targets.

Between September 2016 and April 2017 total of 14 irradiations have been carried out at Zevacor facility utilizing beam currents from 150 to 250 uA, and 13 batches of Sr-82 were prepared with batch activity varying from 0.5 to over 14 Ci EOB. Future plans include increasing beam current and developing new targets.

Facility



70000 Square foot (6500 m^2) building is located in the town of Noblesville, approximately 20 miles (32 km) north-east from Indianapolis. Approximately 40% of the building is occupied by a cyclotron and associated support equipment, separated into a restricted zone. The rest is used for laboratory and office space and reserved for future expansion.



70 MeV H^- cyclotron manufactured by IBA (Louvain-la-Neuve, Belgium) was purchased in 2013, delivered in 2015 and commissioned in 2016. Commercial operations commenced in 1st quarter 2017.

The C70 cyclotron is capable of simultaneous extraction of up to two 350 uA proton beams which can be directed into 6 beam lines.

Facility is equipped by a variety of specialized protective equipment suitable for handling of radioactive materials and target materials sensitive to air.

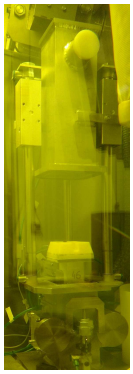
Quality control department is equipped for HPGe gamma spectroscopy, elemental analysis by ICP-MS and various X-ray studies of materials structure and composition.

Portable HPGe gamma spectrometer from Canberra with set of removable collimators made in-house is used to survey irradiated targets and other high activity sources, providing invaluable information which is necessary for radiation safety, production planning and quality control

Targets

Optimized metallic Rubidium target for production of Sr-82 was developed in cooperation with INR (Troitsk, RF) and LANL (Los Alamos, NM). This target has been extensively tested to demonstrate integrity and tolerance to heat and pressure. Rubidium target is placed near the beam entrance of the shuttle. Degraded beam exiting rubidium target is further used to produce Ge-68 or Zn-62 irradiating respectively gallium or copper targets.

All targets are compatible with pneumatic transport system supplied by IBA, based on 10x10 cm square aluminum pipes laid under the floor. We designed, and manufacture special transport shuttle which can carry any number of stacked targets. In practice typically two targets are used. The shuttle is shown in the picture is being loaded into the sending/receiving station inside of a hot cell.



Production of Isotopes

In addition to two hot cells used for receiving irradiated targets there are 6 additional cells for processing and dispensing of various isotope products and several new hot cells are being built fir future expansion.

Hot cells are designed to process highly activated targets soon after irradiation. Typical target activity at the time of processing is 10-200 Ci.

All specialized processing equipment including target assembly/disassembly device, dissolution an purification stations and dispensing station was designed and manufactured in-house.

Processing areas and enclosures are ventilated through a dedicated air handling system equipped with several in-line and sampling monitors to control radioactive effluent release.

Currently, Zevacor facility produces three isotopes with more products to be introduced in 2018. Current products are listed in table below:

Product	Half/life	Target	Energy range	Yield, mCi/uAhr	# of irradiations YTD
Sr-82	25.35 d	Nat. Rb	68-35	0.25-0.35	20
Ge-68	271 d	Nat. Ga	25-0	0.004-0.009	5
Zn-62	9.2 hr	Nat. Cu	25-17	3-6	2

Acknowledgements

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Technology for manufacturing of Sr-82 was transferred under WFO/FIA Contract NFE-15-0019 with Department of Energy, through Los Alamos National laboratory, and a collaboration agreement with Institute for Nuclear Research of Russian Academy of Sciences (Troitsk, Russia).

Zn-62 development was supported in part by NIH grant 1R01CA202695-01A1 entitled "Integrated tools for Quantitative Whole-Body Tumor Perfusion Imaging", under contract with Indiana University (Indianapolis, IN).