I-123 Nuclide production system constructed by Cyclotron 30

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1. Introduction

These are the feasible nuclear reaction from proton of 30 MeV Cyclotron being investigated by the Xe-124 gas target system.

$^{124}Xe(p,pn)\,^{123}Xe(T_{1/2}=2.1hr) \rightarrow {}^{123}I$ (1)
$^{124}Xe(p,2n)\,^{123}Cs(T_{1/2}=6min.) \rightarrow {}^{123}Xe \rightarrow {}^{123}I$ (2)
$^{124}Xe(p,2n)\,^{123}I$ (3)

Main productions of I-123 are nuclear reaction (1) and (2). While the cross-section of (3) is very little to recognize. The purity of radionuclide is I-121(γ=212 keV) and I-123(γ=159 keV) which can be found by High Purity Germanium detector and multichannel analyzer. Anticipated impurity nucleus are I-121 and I-125.

$^{124}Xe(p,4n)\,^{121}Cs(T_{1/2} = 136s) \rightarrow$
$^{121}Xe(T_{1/2} = 39min) \rightarrow {}^{121}I(T_{1/2} = 2.12\ hr)$ (4)

I-121 can be produced by the nuclear reaction as shown in (4). Because Te-121 collapses and has 2.1 hours of half-life, the amount is less than 1×10^{-7}% after the calibration date, 2days

I-125 can be produced by the nuclear reaction by $^{126}Xe(p,2n)\,^{125}I$. Its half-life is 59.9 days, so enrichment target air must contain less than 0.02% of Xe-126. We have constructed the I-123 production SYSTEM in order to infer these reactions by constructing a program called PCvue.

2. Methods and Results

2.1 Target

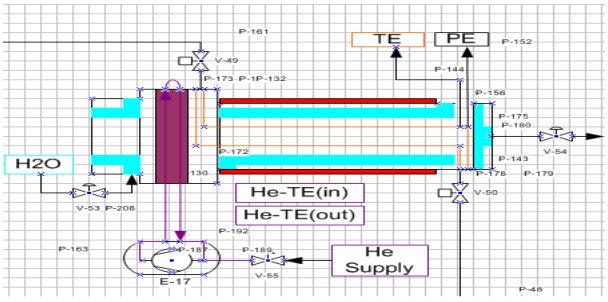

Fig. 2-1 A Schematic Diagram of Target

Target was constructed as shown in Fig. 2-1, Helium Supply is to cool the Havor Foil. Water has the job of cooling down the temperature when Xe Gas is being investigated in the target. Temperature and pressure gauge are attached to be checked easily.

2.2 GPM (Gas Process Manifold)

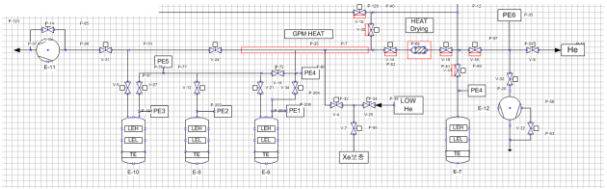

Fig.2-2 A Schematic Diagram of GPM

GPM has the part that prepares to transport Xe Gas (Fig. 2-2). There are storage vessel that stores Xe Gas, the cold trap that filters humidity and impurity and lastly 9N1 storage vessel that temporarily stores Xe Gas. All those parts have pressure gauge, vacuum gauge, pump and heater. Xe Gas moves by the difference of temperature and pressure of the liquid nitrogen. Xe Gas re-filler only operates when it replenishes Xe Gas.

2.3 WPM (Wash Process Manifold)

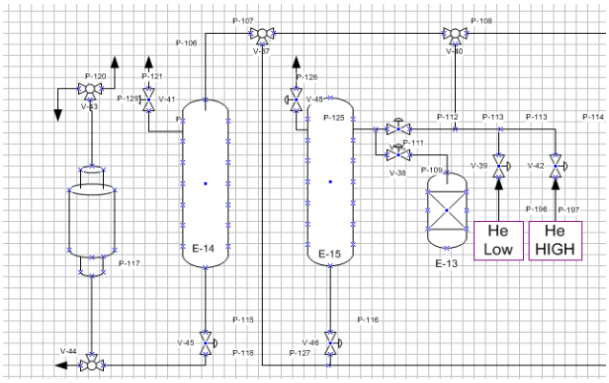

Fig. 2-3 A Schematic Diagram of WPM

WPM has a column and two bottles. Only two of them are put to reduce its usage. It retrieves Iodine that is produced by wash liquid and helium in the target. All those pipes are filled with helium and this is the reason how those pipes are kept clean. WPM, unlike GPM is

located at hot cell, so they are far from each other. All the pipes that enter WPM are made of 1/8 thick of the others.

2.4 HCS(Helium Circulation System)

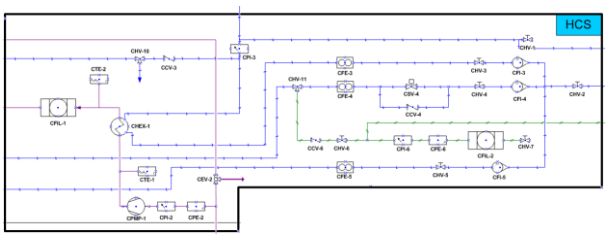

Fig. 2-4 A Schematic Diagram of HCS

HCS can gauge various pressures. There are pressure gauge and regulator in HCS. The pressure gauge gives the exact pressure, then the regulator controls the pressure of the helium. This change can be seen on the UI screen.

2.5 PLC(Programmable Logic Controller)

SIMATIC S7-400H, CPU 412-5H,
CENTRAL UNIT FOR S7-400H AND S7-400F/FH,
5 INTERFACES: 1X MPI/DP, 1X DP,
1X PN AND 2 FOR SYNC MODULES 1 MB MEMORY (512 KB DATA/512 KB CODE)

Fig. 2-5 SIMATIC S7-400H, CPU 412-5H of SIMENSIE PLC

There are many sensors in I-123 Nuclide Production System and we should treat at once accurately. PLC will control the pressure gauges, vacuum gauges, heaters, pumps in the System. Furthermore, PLC is easy to maintain.

3. Conclusions

Hot cell and Target room are far from each other. When We product the I-123, a lot of I-123 get scorched and stick in the pipes. Therefore, We will construct the Pipe lines are nearest each other. Existing I-123 nuclide production system was located in storage vessel and cold trap in hot cell, but storage vessel and cold trap are established with in the target room. Thus, If we will product the I-123, we can expect better yield. Also The system will be organized to minimize the exposure of people when repairing.

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