Remote Target Handling and Radioactive Isotope Collection and Handling for CERN’s MEDICIS Facility

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Outline

• Introduction
  • ISOLDE
  • MEDICIS

• Robot

• Monorail shuttle

• Shielding doors and air locks

• Isotope collection and transfer

• Concluding remarks / questions
Introduction

• CERN is a particle physics research lab in Switzerland + France (since 1954)

• MEDICIS is a new facility under construction at CERN

• MEDICIS is built next to ISOLDE which produces isotopes for physics research (since 1967)

• MEDICIS will produce a wide range of isotopes for medical research (diagnostics and therapy)

• MEDICIS will use “waste” proton beam from ISOLDE to produce the isotopes
ISOLDE isotope production method

1.4 GeV protons

mass separation

spallation + fragmentation + fission

radioactive ion beams

proton beam (1 GeV)

target - ion source

analysing magnet

ISOLDE Target
MEDICIS will use ISOLDE waste protons

90% of proton beam passes through ISOLDE target into beam dump

Need to be able to remotely position MEDICIS targets here

Then remotely move targets to a mass separator for collection of isotopes;
Then store the targets.
Targets + radiation

MEDIĆIS target
ISOLDE target
(~30 kg)

Radiation levels during proton pulse

(Black is 1MSv/h)
ISOLDE and MEDICIS Facilities
Facility layout

- Existing ISOLDE lab + target buildings + robots
- Extension for MEDICIS and storage
- ISOLDE and MEDICIS irradiation points
- Target shuttle transfers
- Robot target handling
- MEDICIS mass separator
- MEDICIS chemical lab
- Radioactive target storage

Protons from PS booster
ISOLDE Target Robots

Kuka robots suspended from rail on ceiling
Operational for 3 years

Preparation:

Electronics removed (60m cables)
Motors and resolvers replaced
Cables replaced
Some plastic components replaced

MEDICIS uses the same robot and rail etc

Kuka robots during installation in ISOLDE
Monorail shuttle system

**Main requirements:**
- Radiation tolerant
- Reliable
- Simple remote control
- Fail safe
- Recovery possible (redundant locomotive + redundant power rails)

Based on industrial product (Montrac)

Mock up tests with DC motors
Target shuttle transfer system

- Main exchange station
- Shuttle for Medicis
- Shuttle for Isolde
- Shuttle for Rescue & inspection
- Irradiation point for Medicis
- Fire door
- Ventilation door
Monorail positioning MEDITCIS target in ISOLDE proton beam

MEDICIS Target will be outside faraday cage

MEDICIS Target (on right) in position before locomotive disconnects
Automated shielding doors in front of target storage shelves

MEDICIS Target and Isotope Handling
Keith Kershaw
Video…
MEDITCIS Isotope Collection and Transfer

Collection chamber

Mass separator magnet

Target
Collection chamber + mechanism

Collection on small plates aligned with beam of isotopes

In-vacuum sample transfer arm holds plates (UHV design)

Vacuum valve

Collection plates moved into sealed container (manual operation of arm)
Shielding around collection equipment

MEDICIS Target and Isotope Handling

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Conceptual design of transfer system

Transfer step a) insert new container

From rear

Or from front

Sealed transfer container
Transfer step b) - dock trolley to port

Move into place

Dock and lock
Transfer step c) lift box up to port

- Hoist lifts box
- Box lifts port door
- Align and secure

Port door
Transfer step d) connection to collection point

Connect the container to collection point

Transfer arm pulls the collection plates out of the container and holds them for irradiation

Push then Twist to lock

Decoupling and transfer follow same basic steps – transfer to antechamber on shielded fume cupboard
Concluding remarks

• The robot, monorail and doors have been tested together

• The MEDICIS beam line is currently being installed

• The isotope collection and transfer system is under design – installation early 2018

• Work is underway on the next stages of the process – chemical purification onwards…
SPARE SLIDES
Conceptual design for transfer...

Shielding around the collection point

Transfer port

Transfer trolley

Antechamber with 2nd Transfer port (not represented here)

MEDICIS laboratory
Antechamber mock up trials
Abstract

A new medical research isotope production facility, “MEDICIS,” is currently under construction at CERN. The new facility will use the leftover particle beam of the ISOLDE facility - after it has passed through ISOLDE targets - to irradiate additional targets to produce isotopes for medical research work.

In order to transfer, precisely position and store these additional targets, the isotope production process will use a new remote target handling and storage system. To ensure compatibility with radiation levels, which preclude the presence of electronics in the target handling and storage areas, the remote target handling system integrates modified versions of an industrial robot suspended from a linear axis mounted on the ceiling and industrial monorail transfer system working with custom–designed automated shielding doors, an air lock and remote handling cell.

The isotopes extracted from the irradiated targets also require shielded handling and transfers; for which a new system has been designed.

The MEDICIS facility will be briefly introduced, followed by a description of the target remote handling and storage system and the isotope collection and handling system design.
First ideas and prototypes for target transfers
Fluka simulation for design of MEDICIS shielding

During robot transfer

On the mass separator
Shuttle monorail – ISOLDE portion
Air lock doors between ISOLDE and MEDICIS allowing target shuttle passage

- Conveyor shutter, EI60, air tight
- Monrac rail
- Parking Spot
- Switch, For surveillance
- Ventilation door on hinges
- "Gabarit", bolts head inside the corridor
- Maintenance door, lockable, interlocked by MEDICIS-ISOLDE PPS
Automated shielding hatch for robot arm passage