SWITCHING IRRADIATION FACILITY IN JORDAN FROM CO-60 TO E-BEAM X-RAY

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Jordan Atomic Energy Commission (JAEC) is intended to switch the existing Co-60 irradiation facility to an e-beam/X-ray 5MeV irradiation facility, due to the high measures of security of Co-60 sources, as well as increasing prices of Co-60 sources, and the complicity of transportation to the unstable area (Middle East), which has been an issue in recent years. Some stakeholders are financially supportive to the switching mechanism from Co-60 to e-beam/X-ray in order to sustain the irradiation technology. The option of having e-beam/X-ray irradiation technology will allow JAEC to irradiate a wide variety of products no matter the density or dimension of product at high production rate by choosing e-beam or x-ray irradiation.

OBJECTIVE:

The existing facility will be used as e-beam/X-ray facility with some modifications. Source hoisting room will be used for the e-beam/X-ray machine (accelerator), or adding another room beside the existing facility for the accelerator. And for the existing concrete biological shield which must be increased to suit X-Ray applications. The power consumption for both e-beam/X-ray applications will be covered by the existing solar system of 50kW generation capacity to be increased to about 150kW. Also new ware house will be constructed. Modification of biological shield and power consumption will be considered from economical point of view whether it is feasible or constructing new building.

METHODOLOGY:

Biological shield: According to shielding calculations done by: E. Peri and I. Orion, using MCNP Monte Carlo Code [1], it is needed to add about 40 cm for the existing walls of irradiation room (180 cm), which can be done. In case of dimension restrictions lead could be combined with concrete to minimize thickness.

The first option is to get benefit from the existing biological shield, it is assumed to put the accelerator over the irradiation room in the old source hoisting room, using the 90^{o} orientation accelerator, and the ray-tube will pass through the opening of the plug in the ceiling. As the source hoisting room will be used for the e-beam/X-ray machine, so new walls will be constructed over the existing walls. In case of dimension restrictions lead could be combined with concrete to minimize thickness, the top of these wall will be in stairs shape, 20 cm width and height as shown in figure (1). The ceiling will stay opened during commissioning of the e-beam/X-ray machine, after that a precast reinforced concrete slabs will be put to close the ceiling, taking into consideration that the slabs width dimensions is different in each step so that breaks is not continuous through the ceiling.

Even though the possibility to add another room beside the existing facility for the accelerator, as second option, and hole in the side wall for the ray-tube, which can be done by using core (up to 3m) and wire cutting, as shown in figure (1), But this option is costlier than the first one.

Power consumption: There is an existing solar power system of 50kW power (average daily output 250kW/day), which can be extended by adding 100kW, as there is empty place for that, the total power generation will be 750kW/day during the year, and if the holidays are not considered the daily power generation will be 1MW/working day; this will give opportunity to operate 5 hours at full capacity in the working days, which is more than needed.

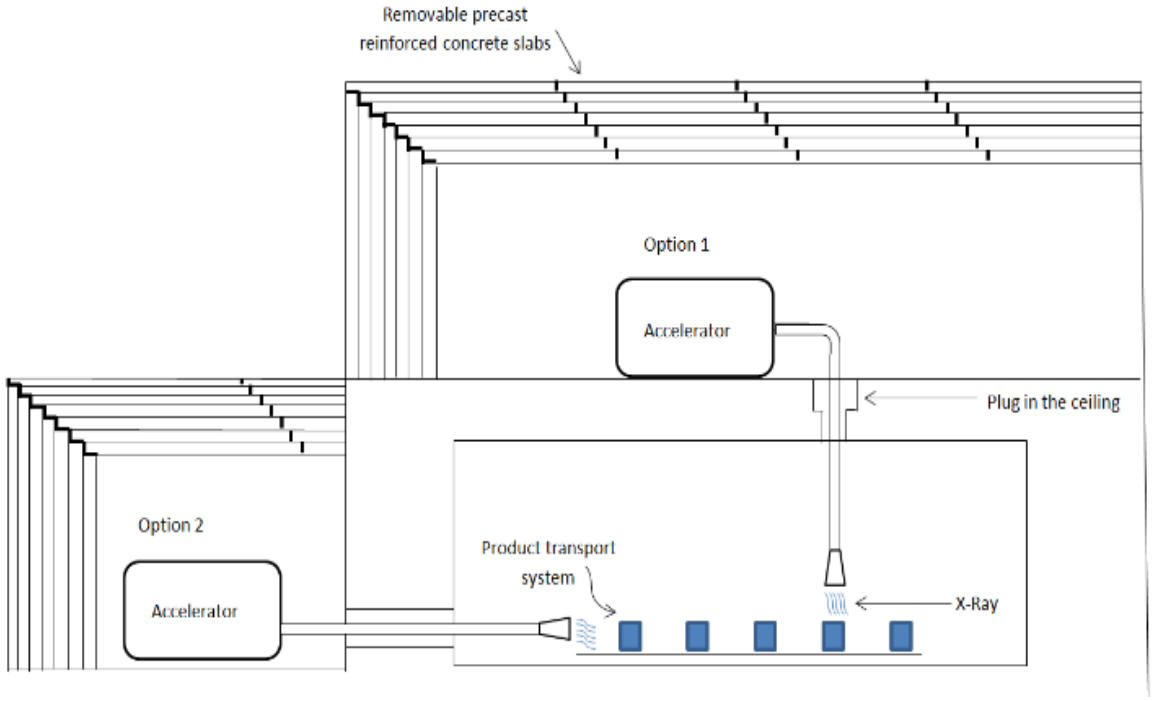

FIG. 1.

RESULTS

The existing facility can be switched to e-beam/ x-ray facility with extra shielding for the walls of source hoisting room, which is less in cost than constructing new building, the existing shield will cover more than 80% of the needed shield. Later the shielding calculations will be done by using MCNP Monte Carlo Code. The solar power generation potential is high in Jordan, so that the switching will be feasible on the long run operation. The new products transport system will be judged later according to the space left, and radiation protection aspects.

REFERENCES

[1] EYAL PERI, ITZHAK ORION, "Shielding Calculations for Industrial 5/7.5MeV Electron Accelerators Using The MCNP Monte Carlo Code" American The European Physical Journal Conferences, (2017)153:03011.