Belarus Streamlining of operations by implementation of x-ray blood and research facilities: Multiple sites.

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Abstract

The "Isotope Technologies" (IT) company has acquired significant experience in the implementation of replacing radioactive sources with Alternative Technologies under the scope of the U.S. Office of Radiological Security (ORS) Program in Belarus. During 2019-2020, IT removed and replaced Cesium 137 irradiators at three facilities. Two units were in medical facilities which housed Cesium blood irradiator devices; another one was a research laboratory conducting biological irradiation. Two IT teams coordinated to accomplish the removal and replacement. One team was responsible for decommissioning Cs-137 irradiator devices, and the other for installing X-Ray devices. The main challenge for the first team was to remove the radioactive sources safely and transport them to the national waste disposal facility. The installation team challenge was to rapidly install the X-ray devices (to minimize interruption of blood irradiation and research operations) during the exchange period. An additional challenge was retraining site personnel in using the new alternate technology. Success was realized from three sequential steps: preliminary project promotion to site management, quick and smooth device exchange, and training of personnel. IT would like to share our experience and lessons learned during the safe decommissioning of Cesium 137 irradiators and replacement with alternative X-Ray technologies.

Various Belarus sites utilize radiation technologies for medical, industrial and research purposes. Most users employ radionuclide gamma-radiation irradiators based on Co-60 and Cs-137 isotopes. In 2019 two hospitals in Minsk with gamma blood irradiators, and one biological research gamma irradiator had sources whose useful service life was either expired or very close to expiration. In the case of the biological irradiator, the machine itself was outdated and needed to be replaced. Due to public concern, local regulators were pressuring the site administrations to increase safety and security measures, or abandon such potentially dangerous techniques. With assistance from the ORS Alternative Technologies Program solutions were found for replacing the Cs-137 units using X-Ray machines.

1. **Replacement of blood irradiator at the Minsk Scientific-Practical Center of Surgery, Transplantation and Hematology.**

   The replacement consisted of two phases:

   1.1. **Phase I:** Decommissioning of the blood irradiator IBL 437 with Cs-137 radioactive source activity 62.9 TBq (1674 Ci).

Pic 1. IBL 437 Cs-137 blood irradiator.

Pic.2 Dismantling the irradiator

Pic.3 Rigging the radiation head

Pic 4. Loading the irradiation head to the KMZ container on the truck.

Pic 5. Placing the radiation head with Cs-137 source at the waste disposal facility “EKORES”

1.2. Phase II: Commissioning of the X-Ray blood irradiator RS3400 (160kV).

Most critical in this project was the need to minimize the gap between decommissioning the old machine and commissioning the new one. This was further complicated in that the new machine would be installed into the same room from where the old one was just removed.

Pic. 6 Rigging the RS3400

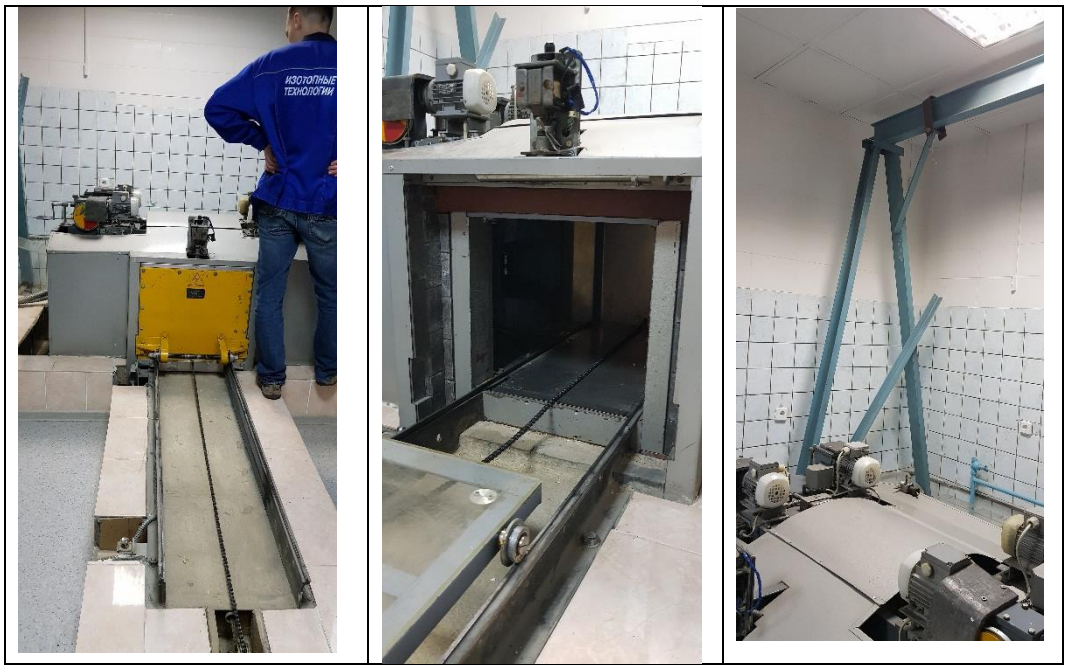
Pic.7 Installation of the X-Ray Blood Irradiator RS3400.

2. Replacement of the biological research irradiator at the Research Institute of Radiobiology (IRB, Minsk, Gomel).

According to the statement of work, IT had to decommission 2 biological gamma irradiators that were placed in Minsk, and commissioning X-Ray biological irradiator at the IRB headquarter in Gomel.

The replacement consists of two phases:

Phase I: Decommissioning of the biological irradiator IGUR-1 (Pic. 8) with eight Cs-137 radioactive sources total activity 150 TBq (4059 Ci) and an additional small irradiator (Pic.9) gamma flow detector GAMMARID 192/120 with Cs-137 radioactive source with activity 15.1 GBq (0.41 Ci).



Pic.8 IGUR-1 gamma irradiator

Pic.9 Irradiator made on GAMMARID 192/120

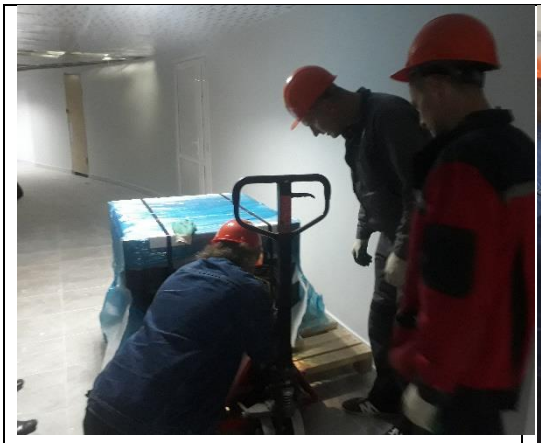
Pic.10 Dismantling of the IGUR-1

Pic.11 Removal the radioactive sources units

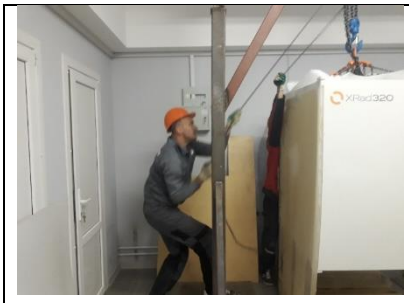
Pic.12 Loading the source’s units to the container.


Pic.13 Uploading the source's units at the radioactive waste disposal facility (EKORES).

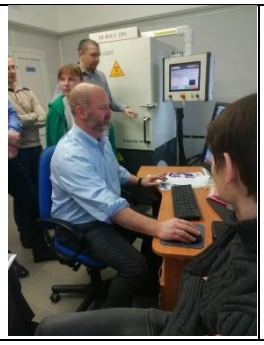
Phase II. Installation of the X-Ray biological irradiator X-RAD-320 (320 kV) in Gomel




Pic.14 Rigging of the X-Ray irradiator X-RAD-320




Pic.15 Installation of the X-RAD-320


Pic.16 Staff Training

3. **Replacement of blood irradiator at the Minsk Republic Scientific and Applied Center for Pediatric Oncology and Hematology.**
   The replacement consists of two phases:
   Phase I: commissioning of the X-Ray blood irradiator RS3400 (160kV).


Pic.17 Rigging and Installation of the RS3400

Phase II: Decommissioning of the blood irradiator Gammacel-3000 with Cs-137 radioactive source activity 33.4 TBq (902 Ci).
The X-Ray blood irradiator was installed in a different room from where the gamma irradiator had been. This project went smoothly, without a gap in the operation of the two irradiators.


Pic.18 Dismantling of the Gammacell-3000

Pic. 19 Loading the radiation head to the KMZ container.

Pic.20 Disposal of the radiation head with Cs-137 source at the waste facility.

Conclusions and Lessons Learned

Successful accomplishment of Alt Tech implementation in Belarus is based on following factors:

- Strong support by ORS in funding the project. The Cs-137 replacement was fully funded, allowing implementing new technologies in blood irradiation. When Co-60 irradiators are exchanged, the project funds only radioactive source removal. This does allow customers to concentrate their funds on linear accelerator purchases.
- There were a few completed projects by other ORS teams which provided worldwide examples of such implementations. This helped Belarus customers realize reliability of those technologies.
- Proper planning and scheduling of all operations to avoid long gaps between exchange phases.

Despite the enthusiasm of the Belarus regulators and sites' administrations some physicians and researchers remained skeptical of the new technologies. The greatest concern was among blood processing physicians: they worried whether X-Rays could be as effective as Cs-137 to prevent the transfusion-associated graft-versus-host disease (TA-GVHD). More information about technical aspects of the X-ray alternative to gamma radiation would be very helpful in future such projects. This will promote the Alt Tech concept to all potential customers.