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Maintenance of the buried neutron irradiator

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ABSTRACT

The Argentinean Nuclear Regulatory Authority (ARN) has developed a neutron irradiation facility at the Ezeiza Atomic Centre to provide support to regulatory activities. In order to perform a preventive maintenance of the N40-BG-M-2 neutron irradiator (Hopewell Designs Inc.), a bearing was changed by a new one.
The first step was to take out the radioactive sources “housed in” and to install them in different shields. The radioactive sources were Cf-252 (41 µg to 10/2010) and AmBe of 5 Ci. The transport package that was originally sent by the manufacturer was used as a temporary storage.
For the extraction operation, a special device was designed to avoid operators irradiation.
This resulted in an operation that did not deliver dose to operators. However, little doses could not be avoided while manipulating packages.
Problems arising from mechanical operation to select sources were solved after replacing the bearing.
Previous attempts had been focused on the air pressure line as well as to the irradiator pipe which had been also purged by air blowing and a treatment to remove the rusty affecting the bearing.
The irradiator was successfully reassembled and the sources installed again.
Once the device was up to work, performance tests on sources motion were carried out. The collective dose of all operations was less than 66 µSv.m.
In this paper a detailed description of every step achieved to get the best performance of the irradiator, is presented.
Results of the tests showed that the reparation of the irradiator was successful.

1. INTRODUCTION

This paper describes the tasks performed for the repair and safe operation of the irradiator system. The irradiator, provided from the U.S., was assembled and put in stand by with personnel of the ARN and Projects & Designs Co. This organization built the foundation and support according to drawings provided by the ARN. It has a part for the underground storage of radioactive sources. Using a pneumatic selector system the source is extracted and placed in position for irradiation, two meters above the floor. This device must have to work with compressed air supply and electrical power in order to management PLC system commands. The irradiator operated continuously for 5 years, before the operators reported problems such as errors in the source position, stacking sources, hardness in the selection mechanism and lack of retention of the source in irradiation position.

2. MECHANICAL SYSTEM CHECKING

Assuming that the problem could be due to lack of air pressure, the status of the compressor, pipes, pressure regulators and pneumatic actuators were checked. The compressor were controlled in a inspection out schedule, oil level gauge, condition of the belts and voltage, rpm, and consumption of the electric motor were verified and showed parameters within correct values.
The main air supply and air filter also checked, no obstruction were found so they worked correctly.
The proper operation of the pressure control valve located within the equipment enclosure was also verified. The operation of the vacuum ejector was inspected with a provide vacuum gauge in order to check the retention of the selected source on the top tube of the irradiator. Due the measured values were not satisfactory, the filter was changed, and then the pressure grew up to acceptable values. The pneumatic piston system was removed and watched, it worked properly. After checking the system, the selector (carousel) was turned manually, detecting braking performance than service. The pressure of the piston was increased and the system worked normally. The laboratory irradiation returned to normal operation, with the proviso that the system does not evolve into rotation and subsequent hardening of the mechanism.

3. MAINTENANCE SCHEDULE

After running a time and within the scheduled maintenance period was made an unassembled of the mechanical system and being carried out the following tasks:

1. Removing sources and put it in shielded containers. *(Figure1-2)*
2. Removing the control box located on the top of shield underground.
3. Unassemble the rail’s support of detectors, testing dosimeter of irradiation.
4. Armed gantry, a rail winch was mounted in order to lift whole shield and carousel. *(Figure 3)*
5. Removing of the carousel shielding from his pit. *(Figure 4)*
6. Disassembly of the shield.
7. Disarming the System axis-carousel slide sources. *(Figure 5)*
8. Removing shaft bearings.
9. Placement of new bearings. *(Figure 6)*
10. Axis mounting system carousel device.
11. Assembling the shield.
12. Lifting, positioning, alignment and mounting it in his pit.
13. Assemble of control box.
14. Assemble rail’s support.
15. Placing of sources into irradiator.

After that, was proceeded to load service compressed air in tanks and later, the system was energized to test the equipment running. The tests were: different sources selection order, holding sources on top in short or long irradiation periods, rush through moving irradiation position and kept safely underground.

Figure 1. **Removing sources**

Figure 2. Shielded containers

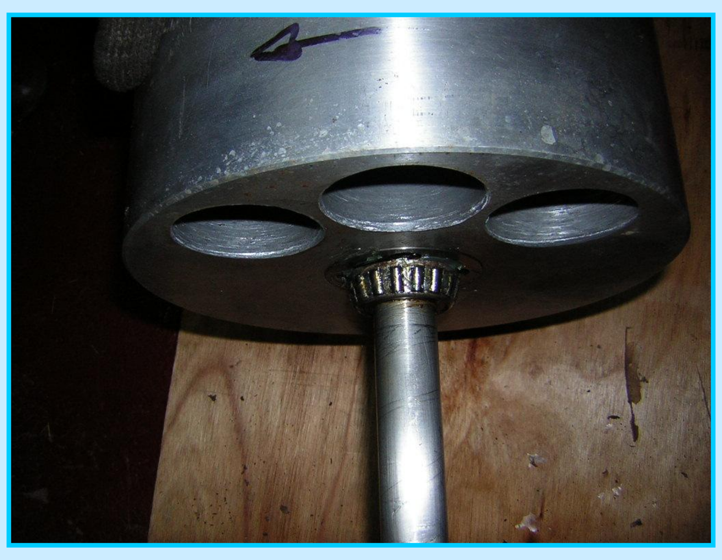

Figure 3 & 4.

Figure 5. **Carousel.**

Figure 6. Bearings

Shield integrity

4. CONCLUSIONS

The maintenance tasks were performed successfully. Performance tests were fully overcome. The effective dose received by workers involved the tasks was negligible. This was achieved because during the sources transfers, the only proximity to radioactive sources was for the movement of shielded containers.