Materials Surveillance Program for the RA10 Research Reactor

R. Versaci$^{1,2}$, G. Bertolino$^{3}$, A. Yawny$^{3}$, G. Arias$^{4}$, H. Blaumann$^{4}$

1) Subprograma de Gestión y Extensión de Vida de Centrales Nucleares de Potencia. Gerencia de Area Energía Nuclear (GAEN), Comisión Nacional de Energía Atómica (CNEA).
2) Gerencia Materiales, GAEN-CNEA
3) División Física de Metales, Gerencia de Física CAB, Gerencia de Área Investigaciones y Aplicaciones No Nucleares, GAIyANN-CNEA
4) Gerencia Proyecto RA10, GAEN, CNEA.

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- INTRODUCTION
  Ageing Management Program
  Surveillance Program

- COMPONENTS AND MATERIALS

- LOCATION OF THE SAMPLES

- ADDITIONAL INFORMATION

- FINAL REMARKS
INTRODUCTION

Whereas the RA10 reactor is postulated that the same should reach at the following design objectives: safe operation, high availability, nominal operating cycle 29.5 days and 2.5 days outage.

Developing a Life Management Program is critical to meet these principles in Safe, High Availability and Long Term Operation. Management of Ageing, obsolescence and economics are part of these programs.
AGEING MANAGEMENT PROGRAM SHOULD START WITH THE DESIGN; CONTINUE DURING CONSTRUCTION, INSTALLATION, COMMISSIONING, OPERATION AND DECOMMISSIONING.
Associate an Ageing Management Program must define a Surveillance Program (SP). The goal of SP is to monitor changes in material properties of the critical components for safe operation of the reactor due to the effects of intense neutron radiation to which they are subjected.

These changes include: tensile properties, radiation induced growth and fracture toughness of the materials from which the critical components exposed to radiation.
The components will be considered not replaced during the life of the reactor are: the Reflector Vessel Tank (RVT) and the Could Neutron Source Vacuum Container (CNSVC).
MATERIALS AND SAMPLES

Materials that will be included in the SP are "Zircaloy-4", in order to monitor the RVT, and "Zr-2.5% Nb" to monitor the CNSVC. For these alloys there is little information available on the effect of radiation at low temperature.

The specimens chosen for the tensile tests are miniature specimens, with a minimum dimension of 30 x 8 x 2 mm, of the "dog bonne" type because they are the simplest and can be made small without seriously affecting the validity of the results. Such samples provide information on variations in the ductility and the yield stress of the material (hardening).
For the analysis of the fracture properties of the material CT (Compact Tension) dimensions to ensure the validity of results, respecting the existing rules at the time (ASTM standards). These specimens will be with pretension to analyze the effect of the incorporation of hydrogen and radiation a low temperature for the Zircaloy-4.

To evaluate the hardening and loss of ductility Small Punching Disks were used, with a minimum dimension of 10 mm diameter and 0.5 mm thick.
Materials and samples must be taken into account in the design of the coupon books and also the necessary conditions, monitoring and cooling: Zircaloy-4 Base Material, welded material and heat affected zone, depending on the welding process. Zr-2.5%Nb Base Material, welded material and heat affected zone, depending on the welding process.
According to the distribution of fast neutron flux calculated, and due to the variation thereof with the radius and angle is required to determine more precisely that the faces of the box containers with the samples were placed surveillance in positions A, B and C. The determined position are the inner faces, these are de positions for the Zircaloy-4 samples.
To monitor the zirconium alloy Zr-2.5 Nb, corresponding to the CNSVC, we will determine what position to will be placing the samples. It is proposed as an alternative to analyse, during the development of Basic Engineering, place the samples in a position available inside the Reflector Tank near the CNSVC.
There are 3 boxes available, so there will be 6 coupon books in total. The lifetime of Reactor used six boxes (at 2, 5, 10, 20, 30, and 40).

Each coupon have the ability to accommodate the whole package of specimens that requires each instance of SP that is, not specimens with different coupon books for the same stage of tests will be taken.

For program development is of fundamental importance to have material removed during the manufacturing process of the components.
The reactor design life of RA-10 is 40 years, however, it is estimated that a number of components will be replaced before this time. In some cases it is possible to include these components in the SP and the use of materials for the manufacture of test samples. The main components of Zircaloy-4 in this group are the control rods and the control plate structure, to be replaced after 8-10 years of operation, together with the absorber plates. From these materials we can make Charpy and CT samples and obtain additional information.
In addition we designed an experience to place samples in the area of very high fast flux to analyze the effect on Zircaloy-4 at low temperature.
FINAL REMARKS

For safe operation, high availability and long term operation is essential to have an ageing management plan of reactor critical System, Structures and Components.
Many thanks for your attention