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Management of Ageing and Modifications for research reactors

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Egypt has two research reactors, the first reactor was designed by the Former Soviet Union, it has a power of 2MW, tank type, light water moderated and reflected and the fuel type is EK-10 which consists of Uo2 fuel rods with 10% enrichment.

The reactor was commissioned on 1960 and was working until 2010. After that it has been in an extended shutdown state due to ageing of mechanical systems and the termination of the fresh fuel in the international market and for safety considerations.

Based on the in-service inspection which was implemented for the 1st reactor in 1999, the following systems were modernized:

- 1. Computerized Safety Logic System.
- 2. Process parameters measurements
- 3. Neutron parameters measurements
- 4. Control circuits for the movement of control rods.
- 5. Control circuits for opening and closing the horizontal channels
- 6. Power supply systems. (transformer and circuits)
- 7. Radiation protection system.

Some of these modifications were implemented through technical assistance with IAEA and others by internal bids from Hungary or France or Egyptian companies. A brief description and the knowledge obtained from each modernized activity will be presented, showing the steps which were implemented to achieve the high performance and availability of the first reactor during its operation period.

The second reactor is a Material Testing Reactor (MTR) type using plate type fuel elements with 19.75% enrichment and power equal to 22 MW. It went critical in 1997, and used mainly for production of Mo-99 from Low Enriched uranium (LEU) targets. Ageing is defined as a process in which characteristics of components, systems and structures gradually change with time or use. The service conditions can be a major factor for ageing. In order to achieve the overall safety objective for a research reactor the defence in depth concept and multi barriers should be preserved. The ageing process can accelerate the failure probability of a barrier component and ultimately to the failure of the barrier.

The ETRR-2 reactor has a good ageing management program for all the mechanical, electrical, Instrumentation and control systems. This program includes; periodic maintenance activities, periodic calibration and testing program, in-service inspection. The program should meet the safety requirements from:

- General safety objectives for research reactor to protect individuals, society and the environment.
- Safety analysis report (SAR).
- Operational limits and conditions (OLCs).
- Regulatory body.
- Reactor management.
- Manufactures recommendations

Also, there is a program to avoid the corrosion in the ageing cooling system by using special chemicals in order to preserve the water quality in the permissible limits. The outlines of ageing management program to achieve the high performance, reliability and availability for the second Egyptian research reactor consists of:

- Preventive maintenance, Predictive maintenance, Corrective maintenance,
- · Repairing and replacing of components,
- · Maintenance procedure and format and Work permit,
- Service conditions and its effects on ageing,
- Ageing mechanisms which lead to failure of components or systems,
- Maintenance report:

o weekly maintenance performance report

- o performance analysis report,
- Surveillance and review program,

• Examples of practical safety related events during the last period of operation due to ageing problems or deficiency in the management of ageing program.

• Safety Committee Review and assessment of the maintenance program before sending it to the Regulatory Body for approval.

Organization

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Country

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