Institute of Nuclear Physics
Academy of Science of Uzbekistan

Ageing Management for WWR-SM Research Reactor

A.A.Dosimbaev, N.R.Maksumov

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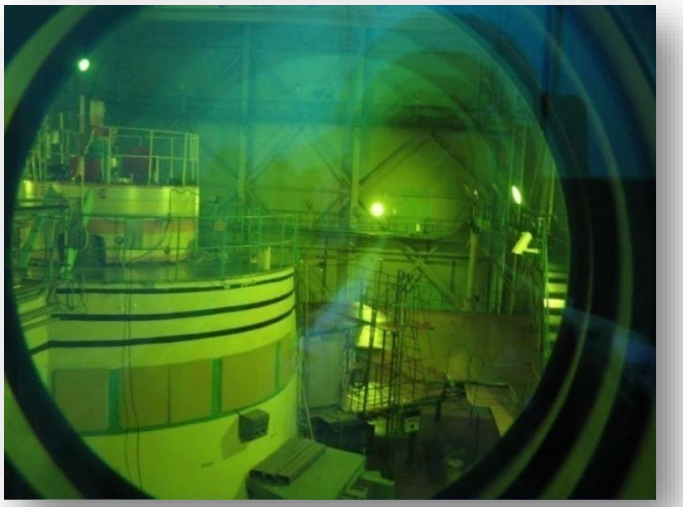
WWR-SM Reactor

1959 – Reactor is put into operation with 2 MW power

1972-78 – Reactor upgrading and raising the power to 10 MW

Parameter name	Value
Thermal power	10 MW
Number of FA in the active core	24 pcs
FA's enrichment	< 20%
Maximal thermal neutron flux	$1,5\times10^{14}$ neutr./$cm^2\times s$
Maximal fast neutron flux	$1,0\times10^{14}$ neutr./$cm^2\times s$
Maximal reactivity excess	14,7 βeff
Total efficiency of operating elements of I&C system in the active core state with maximal reactivity excess.	20,3 βeff
Maximal thermal flux density	740 κW/m^2
Distillate excess in the primary circuit	1230 m^3/h

WWR-SM Reactor



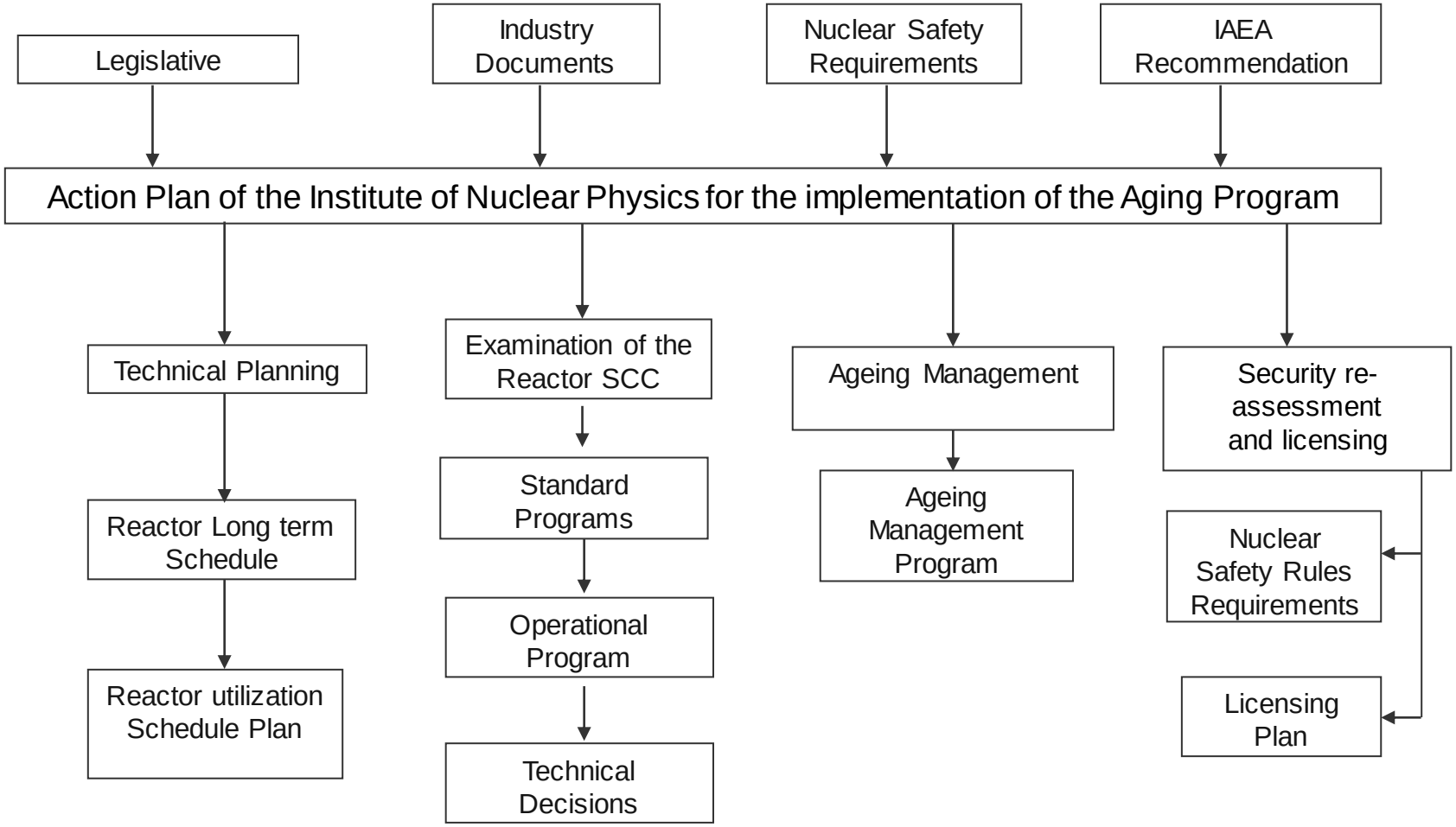
Radionuclides:

P-32, P-33, S-35, Cr-51, Mn-54, Fe-55, Co-58, Co-60, Mo-99, Y-90, I-125, I-131, Pm-147, Ta-182, W-188, Ir-192

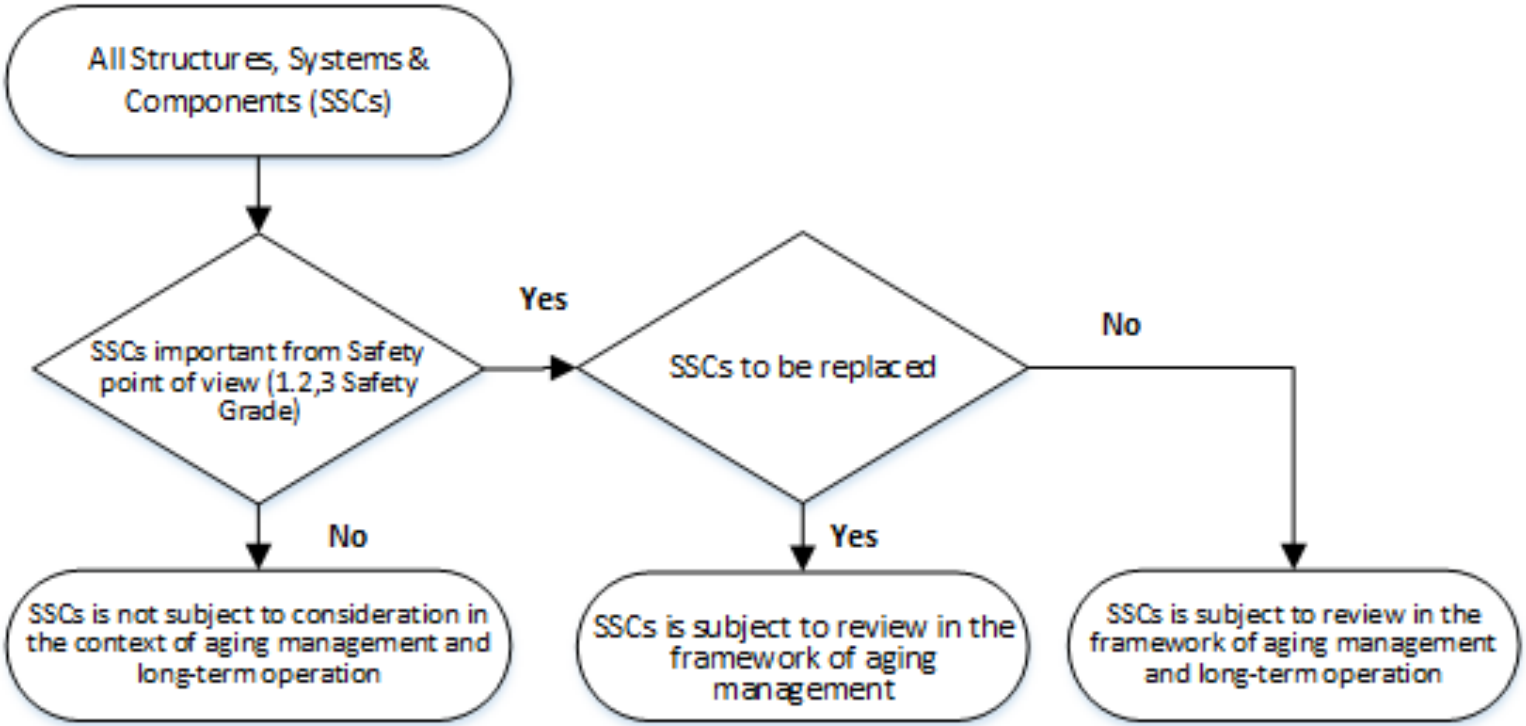
Research Area:

Material science
Activation analysis,
Radiochemistry
Nuclear physics
Nuclear spectroscopy
Radioisotopes production
Irradiation of natural minerals
Testing new fuel assemblies

Regulatory and Technical Documentation System on the Extension of the Reactor Utilization



SSCs selection scheme for aging management and long-term maintenance



The main stages of assessing the technical condition of SSCs of Reactor

1. Establish/define/agree on the scope of the aging management process;
2. Establish the requirements, methodology, and process for Ageing management;
3. Select the controls and management to evaluate aging and identify the mechanical stresses caused by aging;
4. Define testing and inspection tools and maintenance requirements to mitigate the effects of aging;
5. Document the aging management process, including the organizational aspect of aging management, quality assurance factors, Research Reactor long-term strategy, and how data reporting and the results of tests and surveys should be organized and supported;
6. Implementation of measures to improve the Reactor elements ageing management

Establish/define/agree on the scope of the aging management process

The list includes:

List of critical elements:

- Part 1 - elements assigned to Class 1, Class II and Class III of the Classification in force which are non-removable, irreplaceable, or whose replacement is costly;
- Part 2 - Elements assigned to Class 4 of the Safety Class by the existing Classification which are non-removable, undetectable or costly to replace);

List of elements for which the scope of maintenance and repair work does not allow to control the aging process.

Establish the requirements, methodology, and process for Ageing management

Methodology:

- understanding the aging phenomenon and determining its (potential) impact on monitoring and control equipment. This understanding can be derived from investigations, work experience and other sources;
- assessment of the impact of aging on the reactor plant, taking into account the specifics of the operating conditions, risk analysis, selection of control equipment and its components, analysis of the operating conditions of the reactor facility and assessment of the degradation of equipment as a result of ageing process;
- perform the necessary compensatory actions to counteract the effects of ageing.

These methodologies should be implemented in the management of the ageing process.

The process of the reactor elements physical ageing management should include actions aimed at identifying parts of the reactor SSCs which characteristics change over time.

Select the controls and management to evaluate aging and identify the mechanical stresses caused by ageing

The selection procedure is as follows:

- A list of elements is compiled, the failure of which leads to significant consequences for security systems;
- from this list of safety-related elements, those that may be susceptible to aging mechanisms are identified.

For identification, it is necessary to make a list of all the functions, systems and control equipment that ensure the safety of the reactor plant.

It is necessary to analyze the parts of the equipment or elements in relation to the impact of their failure on the safety function in the aggregate of operating conditions.

It is necessary to consider the types of malfunctions and failures caused by aging mechanisms.

Until the opposite is confirmed, it is assumed that all elements are susceptible to ageing process.

Define testing and inspection tools and maintenance requirements to mitigate the effects of ageing process

The purpose of the measurements is to prevent unacceptable degradation due to aging process.

If the exact performance characteristics of the SSCs cannot be measured, a conservative evaluation is performed to determine the acceptability of the equipment performance parameters. Periodic measurements are performed at appropriate intervals.

If necessary, the components are replaced, conduct more frequent tests of elements that demonstrate the onset of degradation or deviation from specifications due to aging.

Adaptation of functional characteristics (recalibration, change of setpoints, etc.) to account for acceptable degradation due to ageing

Document the aging management process

The aging management process should be documented in a report that provides the organization of the process, the method and results of the various stages of the aging management program, summarizes the chronological data of the test results, reports on the results of the analysis, and provides recommendations on what actions to take to mitigate the effects of aging.

An appropriate method and format should be identified for summarizing and presenting data on ageing management, as well as for maintaining and updating detailed information and reference materials.

It is necessary to maintain a database containing information about the equipment and elements in which the acquired knowledge about the mechanisms of aging and their impact on the equipment is updated

Implementation of measures to improve the Reactor elements ageing management

- ✓ Application of appropriate methods to minimize degradation of reactor systems and components,
- ✓ Continuous monitoring and evaluation of reactor performance indicators;
- ✓ Implementation of practical measures to improve safety.
- ✓ Include maintenance, periodic testing, inspection, and periodic safety reviews in the aging management program;
- ✓ Development, implementation and continuous improvement of plans for the management, reconstruction and modernization of reactors to ensure their cost-effective use.
- ✓ Conducting an independent review of the aging program by local and international competent organizations

Reactor new Control Panel

Reactor new Control Panel

Before

After

Radiation Control System

In 2008, the modernization of the radiation monitoring system was completed. The automated radiation monitoring system "PELIKAN", developed and manufactured at the NPP "DOZA" (Russia), was commissioning.

Reactor Exhaust ventilation System

Pumps Electric motors

FVEA-3500-2/F type Aerosol filters and FAI-2000-1E type Iodine filters

System control cabinet

Remote control panel

Reactor Power Supply

=48 V и =110 V

UPS-40kW

UPS-80kW

UPS-160kW

AC Shield

Transformers and 40 kW Diesel generator

Primary cooling circuit System

Secondary cooling circuit System

Before

After

THANK YOU FOR ATTENTION!