Enhancement the Surveillance Programme of Nuclear Facilities based Safety and Security Synergy

Dr. Magdy Mahmoud Zaky Abdelaal

Manager of ETRR-2, EAEA, EGYPT

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Introduction

- The Egyptian Atomic Energy Authority (AEA) was established in 1955, its mandate being to enable the country of the efficient utilization of the peaceful applications of nuclear energy.
- Peaceful applications of this technology covered health, industrial, agricultural, mining, oil and other fields.
- According to the law of regulating nuclear and radiological activities No. 7 for the year 2010
- A new organization take over supervision and inspection of nuclear and radiological activities exerted on the land of Egypt.
- This organization called "Egyptian Nuclear and Radiological Regulatory Authority (ENRRA)"

ETRR-2 Description

- **Reactor Core:** Is arrangement in matrix (6*5) elements, which contains 27 fuel elements, two for Molybdenum target and one position for the cobalt source irradiation.
- **Fuel:** 19.7% Enriched Uranium
- **Average Flux:** $8.1*10^{13} nv.$
- **Maximum Flux** $\approx 2 * 10^{14}$ nv.
- **Reactor Power:** 22Mw
- **Reactor Type:** Open Pool
- **Control system:** (6 control plates)
- **Coolant & moderated by light water**
- **Reflector:** Beryllium

Nuclear Safety and Nuclear Security

- **Safety was altered after the TMI accident. Historically and after the TMI accident, the concept of risk became more popular and the design basis accident (DBA) became a part of the whole spectrum of possible accidents.**
- **Nuclear safety has a concerning worldwide by the date of TMI accident 1979 and following by Chernobyl 1986, then Fukushima 2011 due to those extreme external events.**
- **After September 11, 2001, the perception of global nuclear security and physical protection of nuclear facilities and associated materials changed.**
- **After September eleven, 2001 the world known the reality of terrorist risk and concerning on the consequences of nuclear attacks.**
- **Nuclear security became an attractive issue due to the risk of proliferation of nuclear materials.**
- **Common risk consequences may result from safety and security malicious acts .**

Nuclear safety and nuclear security cont.

- Safety always concerning on the impact of the nuclear risk to the workers, public and environment from those internal and external events.
- Nuclear security focuses on the risk of theft/sabotage or unauthorized removal and terrorism attacks.
- Safety addresses accidental with potential impact on the global environment.
- Security is related to risks originating from malicious act independently from those nature events.
- Safety design based DID, while security design based DBT
- Common risk consequences of safety and security systems failures probably will be the same depending on what is their initiator.

Surveillance Programme of the Reactor

1. Surveillance of the reactor systems is a part of the maintenance program and it covers the majority of the safety systems, safety related and non safety related systems.
2. The objective of maintenance, periodic testing and inspection is to ensure that the SSCs function in accordance with the design intents and requirements and in compliance with the safety analysis report (SAR) and the operation limits and conditions (OLCs), to ensure the long term safety of the reactor.
3. The applied programme for maintenance, periodic testing and inspection should meet the requirements for safety of the reactor such as the following: The SAR, OLCs, Regulatory body requirements and the integrated management system (NS-G-4.2).

Reactivity Control System of ETRR-2

- **The reactivity control system of the ETRR-2 reactor consists of two in-core elements: *guide box and neutron absorber plates.***
- **Each guide box has the function of housing three neutron absorber plates, ensuring that they are guided the entire path, guarantying the right performance in normal operation and also in case of an accident.**
- **It is localized by two lateral guides, placed in two opposed walls of the chimney, it rests in the upper part of the core grid and it is fixed in its upper end by a bolt.**
- **A nipple allows transmitting the upward-downward movements to the control absorber plates, as it is jointed to the upper piston of the rod movement device, which moves the plates.**

Reactivity Control System of ETRR-2 cont.

- This system shutdowns the reactor when a parameter has reached its triggering value, or at operator request.
- This system consists of six rods provided for control and safety, where the safety action overrides the control action.
- At least any five of the rods have to be inserted to shutdown the reactor.
- This means that the FSS success criterion is 5/6.
- On this basis, the system is considered to have failed when two or more of the rods fail to be inserted

Synergy between safety and security

Parameters of safety and security synergy

- Objective of safety and security systems;
- Legal and regulatory framework;
- Culture;
- Maintenance;
- Graded approach;
- Responsibility;
- Design concepts and design criteria;
- Operating principles and procedures;
- Emergency and contingency plans;
- Licensing;
- Risk assessment and management

Problem Description

The problem can be described as follows:

1. **How to close the inspection task according to the inspection plan, which affect the reliability, operability of the system.**
2. **Re-housing of control rod in its guide box;**
3. **How to integrate safety and security staff to accept the proposed solution;**
4. **How to persuade both safety and security staff that the solution is a part of integration of safety and security.**
5. **Time is very important because the reactor covers the local marketing of Molybdenum-99, Technisium-99 and Iodine-131 and serves many of the medical centers in Egypt.**

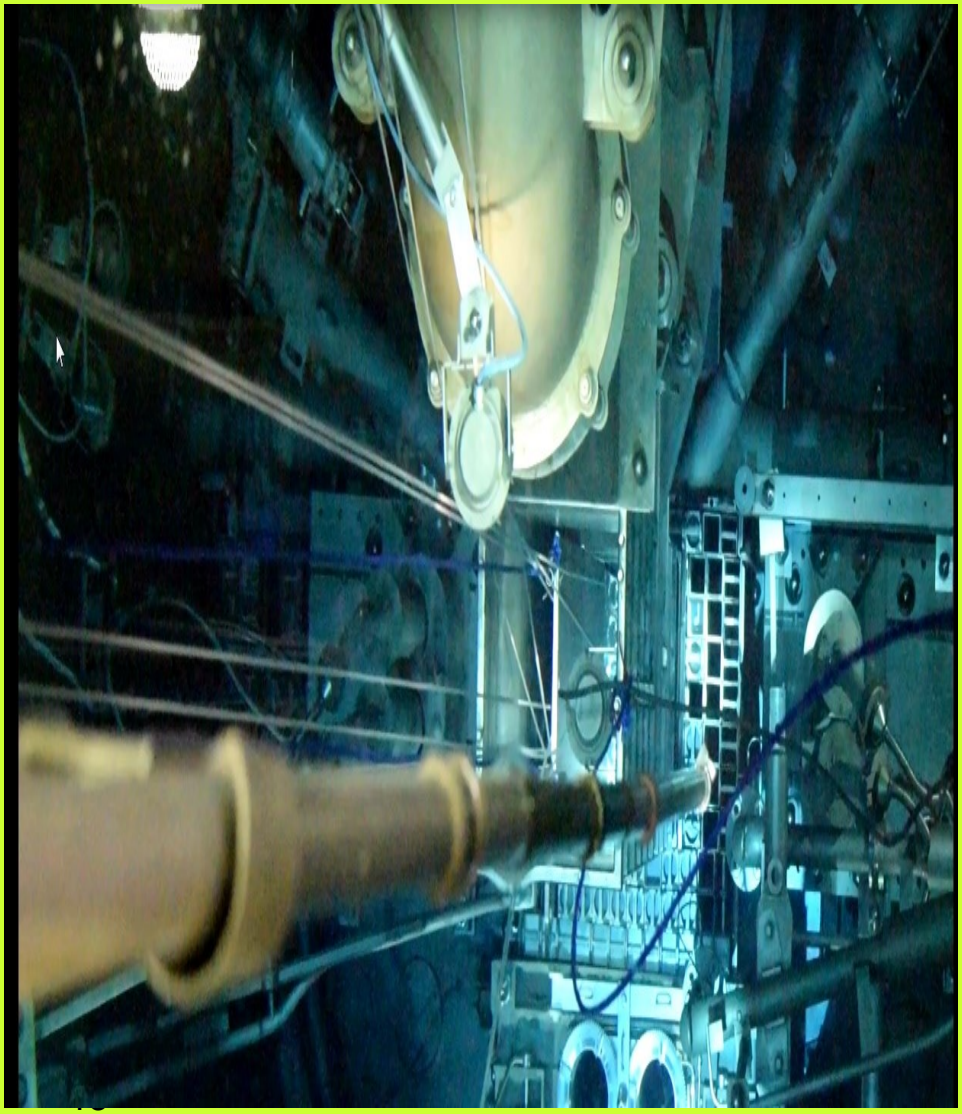
Problem Description cont.

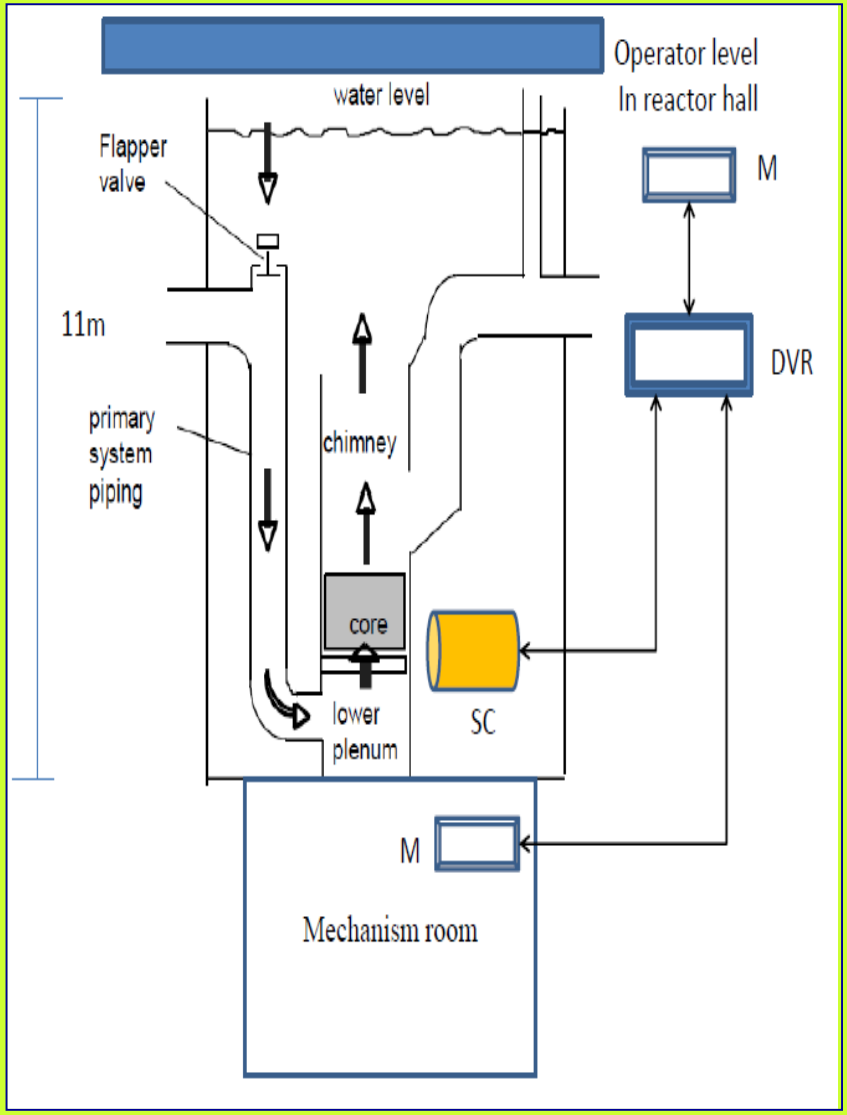
1. The inspection and maintenance task is very difficult because of the depth of water and because the reactor mechanism is below the reactor pool;
2. Operation and maintenance teams are working in different areas.

Solution based synergy concepts

- The solution depends on the used of a complete network of Closed Circuit Television (CCTV) system by using a sealed camera with Digital Video Recording (DVR) to enhance the surveillance programme, inspection and maintenance of the control rods of the ETRR-2.
- Synergy between safety and security enhanced two points, one is maintenance and the other is the culture.

Proposed CCTV Network





Maintenance based Synergy Concepts

- using a sealed camera with four channels DVR to connect the operators working area at reactor hall and the maintenance area at the mechanism room.
- The proposed solution facilitates the reloading the control rod and the guide box to the correct position.
- There is no effective coast because we used the allowable materials and equipment.
- The full task is recorded and will be used for training and education of the reactor staff as a lesson learned of the synergy between safety and security applications.
- Maintenance procedures are modified.

Conclusion

- The complete CCTV network is successfully used to inspect the control rods
- The reliability and time to restart up of the reactor are improved and enhanced the safety and security culture of the staff.
- The system will be used regularly to inspect the underwater components and connection parts.
- Safety and security staff have the basic level of acceptance to work together to deal with the maintenance management program, safety and security emergency events.
- Safety and security culture improved according to the impression after the task completed.
- Planning for training on security culture and synergy between safety and security

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