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Specifics of physical protection of CNST

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1. General requirements to PP system and the site perimeter protection

Centers for Nuclear Science and Technologies (CNST), designed and constructed by Rosatom for foreign customers, usually contain: multipurpose irradiation center (MIC) with gamma-irradiator Co-60, pool-type nuclear research reactor (NRR) and proton cyclotron complex with medical laboratories. These intallations are located at the CNST site in separate buildings. In accordance with the IAEA recommendations and guidance of Nuclear Security Series [1-4] the physical protection (PP) measures of CNST shoul take into account characteristics of nuclear and other radioactive materials and the associated facilities at the site.

Following IAEA recommendations [3] on PP of nuclear material (NM), used for operation of the NRR at the site, the reactor facility should be protected within a limited access area (LAA). Gamma-irradiator facility, containing radioactive source (RS) of category 1, should be also in LAA, surrounded by a fence barrier with lightings and cable lines and equipped with access management tools at personnel and vehicle checkpoints.

Functioning of PP detection and delay equipment and guard/ response operations, require appointment and training of special facility protection forces, appointed by the State authorities. Number and required skills and competencies of these forces depend on PP system equipment and design basis threat, developed by the State Competent Authority.

2. Measures for protection of MIC

Gamma-irradiator of Co-60 of category 1 [1], e.i. the most dangerous type of RS. Access management measures for the irradiator include intrusion detection sensors and alarm assessment techniques along the MIC building perimeter and/ or fence, continuous observation of the radiation room and control of the source in operation and in its storage pool. Important is to apply CCTV monitoring of irradiation process when the source in use and access control with person identification biometrics.

3. PP sub-system of research reactor

Pool-type NRR of CNST is usually designed for thermal power of 0.1 to 10 MW and powered by low-enriched (near 19%) uranium fuel, containilg category III [3] nuclear material of mass less 5 kg of U-235. It defines recommended measures against unauthorized removal (theft) of the NM. Measures against radiological sabotage of the NRR depend on its potential radiological consequences. Using IAEA example of graded approach [4], the reactor facility may be considered as sabotage category B facility, which doeds not require additional intrusion detection and access control measures in comparison with the theft prevention measures. As

of response measures, the NRR protectors should be aware of adversary task time for sabotage, which is shorter than in case of theft.

Activity of radioisotopes, produced at the NRR facility, is usually below category 3 of dangerous RS [2] and require such a protection measures as inventory of irradiated targets (samples) and control of their transportation at the site and outside by radiation monitoring system.

PP measures for NRR building include access control, interior intrusion detection and alarm assessment cameras and procedures for transferring custody of the category III NM to the succeeding handler for protection from insider threat. Technical means and procedures for access control, such as keys and computerized access lists, protected against compromise and interior CCTV monitoring are also required.

4. Protection of cyclotron and the associated laboratories

The cyclotron facility and the associated laboratories do not operate nuclear material, nor very dangerous radioactive sources and will produce low-activity radionuclides for medical applications, e.g. diagnostics. Computerized inventory of produced radioactive materials (RM) and radiation monitoring at the facility site and in case of transportation outside CNST is strongly recommended. In addition, access control at the cyclotron entrance, locks at doors and gates of the building are necessary for the cyclotron facility building(s).

5. Conclusion

Current PP system requirements are based of so-called “prescriptive approach”, described in IAEA NSS #27 for NM category III facilities [4]. This approach is also suitable for protection of irradiators and other radioactive sources of high activity [2].

Advantage of the “prescriptive approach is a relatively simplicity in understanding and application of PP measures by nuclear operator and PP inspection by nuclear regulator This approach is very useful for “nuclear newcomer” States, planning and constructing their first nuclear research facility, but not experienced in “performance based approach”, requiring development of DBT, for the site with access rights for multiple sub-contractors, service providers, external medical personnel and patients. Finally, the prescriptive approach for protection of CNST seems well justified.

References

1. Code of Conduct on the Safety and Security of Radioactive Sources, IAEA, 2004.
2. Security of Radioactive Sources, IAEA NSS # 11, 2009.
3. Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities NSS #13, 2012.
4. Physical Protection of Nuclear Material and Nuclear Facilities (Implementation of INFCIRC/225/Revision 5), NSS # 27, 2018.