XA0300131 IAEA-CN-90/02

POLICIES ON THE DISCHARGES OF LOW LEVEL RADIOACTIVE EFFLUENTS IN TURKEY

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Abstract.

The legal infrastructure in Turkey for the disposal of low-level radioactive wastes covers the liquid, solid and gaseous wastes. Waste tank systems are used to collect and store the low level radioactive wastes and as a part of low-level radioactive effluent discharge policy, these systems are effectively used in Turkey especially for the disposal of biomedical radioactive wastes. The decayed waste is then discharged into sewage system regarding to the discharge limit. Dose assessment was also completed and the annual effective dose that would be received by the workers of the Waste Treatment Facility was calculated and the results are presented.

1. Introduction

Radioactive substances are used in beneficial ways such as the generation of electricity, medical diagnosis and therapy, scientific research and specialized industrial applications. However, many of these activities generate radioactive waste, which occur either in gas, liquid or solid state, should be under an appropriate control program [1]. Airborne and liquid waste may be permitted for discharge into the environment, after treatment, which may include converting gaseous discharge to liquid or reverse, if necessary. Unplanned and/or uncontrolled exposure to radiation can be detrimental to health that is why the regulatory system in any country should be sufficiently robust [2]. An essential requirement of any sound regulatory' structure is to present a clear definition of its scope: certain sources or practices may be excluded from regulatory requirements or exempted from regulatory supervision. One reason for such exemption or clearance is when the radiological risk or detriment associated with the practice is so small as not to warrant the imposition of the system of reporting or prior authorization [3]. For the exemption of any source or practice from regulatory control, the general and widely accepted radiation safety requirements for a member of the public are as follows:

- the effective dose expected to be incurred by any member of the public due to the exempted practice or source is of the order of 10 μSv or less in a year,
- either the collective effective dose committed by one year of performance of the practice is no more than about 1 man Sv, or an assessment for the optimization of protection shows that exemption is the optimum option [4].

For routine discharges of radioactive materials to the environment, the main types of control options are to provide either storage facilities for gaseous and liquid effluents, so that short lived radionuclides can decay before release, or treatment facilities that remove radionuclides from the effluent stream for disposal by other means. Within these two broad categories there may be a number of different options available. The various options should be identified and their features examined as far as possible, including capital, operating and maintenance costs, the implications for waste management, and the effect on individual and collective doses for both the public and workers. There may be a number of complex trade-offs between these various features [5].

The current global approach shaped with the international conventions is toward the limitation of radioactive discharges to the environment. In the *OSPAR Convention* [6] it is stated that Contracting Parties shall require adopting programmes and measures for the purpose of prevention and elimination of pollution from land-based sources, either individually or jointly, the use of: best available techniques for point sources, best environmental practice for point and diffuse sources, including, where appropriate, clean technology.

The *"Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management"* [7] imposes a system of regular peer reviews of the policies and practices of radioactive waste management including discharges to the environment in each Contracting Party.

The limitation of the discharges of radioactive substances should be based upon the optimisation of radiation protection, using best available technique.

2. Legislative infrastructure in TURKEY

The Turkish Atomic Energy Act gives all the responsibility and rights to the Turkish Atomic Energy Authority for the management of radioactive waste management through this privilege Turkish Atomic Energy Authority issued regulations and legislation on radiation protection including waste management, on the other hand one legislation was issued for the discharges of radioactive effluents from the licensed establishments. This legislation gives all the details for the disposal of short-lived (up to 100 days of half lives) low-level radioactive waste.

2.1. Solid radioactive waste

Part of the legislation for the management of short-lived solid radioactive wastes with half – lives less than 100 days implies the disposal of these wastes as hazardous medical waste that is incinerated in the municipality authorized incineration facilities, after the decay of radionuclides with the activities that are statistically indistinguishable from the background radiation. This approach enhances a practical approach for the low level solid radioactive wastes. Sealed radioactive sources can not be disposed as the same way with the short lived low level solid radioactive waste, regarding to this legislation.

2.2. Liquid radioactive waste

The liquid radioactive wastes can be discharged to the sewage system according to the concentration limits set by the legislation, and there is an ongoing study to amend the discharge limit as 10 ALI_{min}/month for each establishment. Short-lived solid radionuclides with half – lives less than 100 days can be discharged to the sewage system regarding to the current legislation and also for the amended version.

2.3. Gaseous radioactive effluents

The current studies for the amendment of the legislation covers also the release of gaseous effluents to the environment with the constraint of not exceeding the effective dose of 10 μSv that could be incurred by any member of the public due to the gaseous release during one year. Short-lived gaseous radionuclides with half – lives less than 100 days can be released to the atmosphere regarding to the current legislation and also for the amended version.

3. Decay and delay systems

The estimated global annual usage of 600 TBq ^{131}I [8] in therapeutic treatments and the dose coefficient of 0.03 man Sv TBq^{-1} [8] for ^{131}I discharged into the liquid effluents makes a contribution of 18 man Sv to the global collective dose. An auxiliary system, as best available technique, should be integrated to the medical establishments to decline the radioactivity of effluents. As the best available technique, waste tanks are used to collect and decay radioactive waste before the discharge of effluents into the sewage system. The single waste tank system makes use of the "**decaying while filling**" principle. Therefore, by the time that the tank is filled, the total activity in the waste tank is many times lower than the total input activity. The multiple tank system takes the advantage of physical decay without input so that the overall capacity requirement can be greatly reduced. The use of multiple waste tanks resolves most of the problem of single waste tank system. However, it is important to design waste tank system with optimum tank number and capacity. Typical design of waste tank system is shown in Figure I.

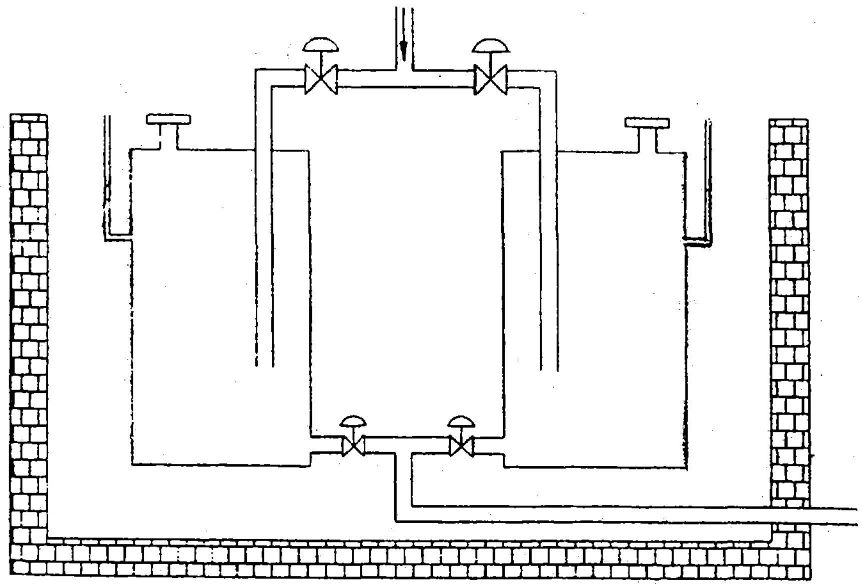

Figure I. Typical design of waste tank system.

4. Dose assessment

Regarding to the risk associated with radioactive discharges, an exposure of 0.03 mSv for a year would equate to a risk of one in a million [9]. Dose assessments due to the low level discharges to the sewage for the worker of the domestic waste facility was reckoned according to the results given in the TECDOC 1000 [10], the individual dose assessment for the Domestic Waste Facility worker was done for the cities with populations of 10, 20, 50, 100, 250, 500 and 1000 thousands and the results are tabulated in Table I and shown also in Figure II. Population of the city becomes important since it determines the concentration of radionuclides in the domestic waste.

Table I. Annual Individual Dose to the Domestic Waste Facility Worker

		Number of Establishment using ^{131}I			
		1	**5**	**10**	**20**
Yearly Activity Discharge - GBq (120 ALI $_{min}$ / establishment)		0.10	0.48	0.96	1.92
Dose Assessment Annual Dose to the Worker of Waste Facility (µSv a^{-1})	**Population of the city** 10 000	*36.1*	*180.6*	*361.2*	*722.3*
	20 000	*18.1*	*90.3*	*180.6*	*361.2*
	50 000	*7.2*	*36.1*	*72.2*	*144.5*
	100 000	*3.6*	*18.1*	*36.1*	*72.2*
	250 000	*1.4*	*7.2*	*14.4*	*28.9*
	500 000	*0.7*	*3.6*	*7.2*	*14.4*
	1 000 000	*0.4*	*1.8*	*3.6*	*7.2*

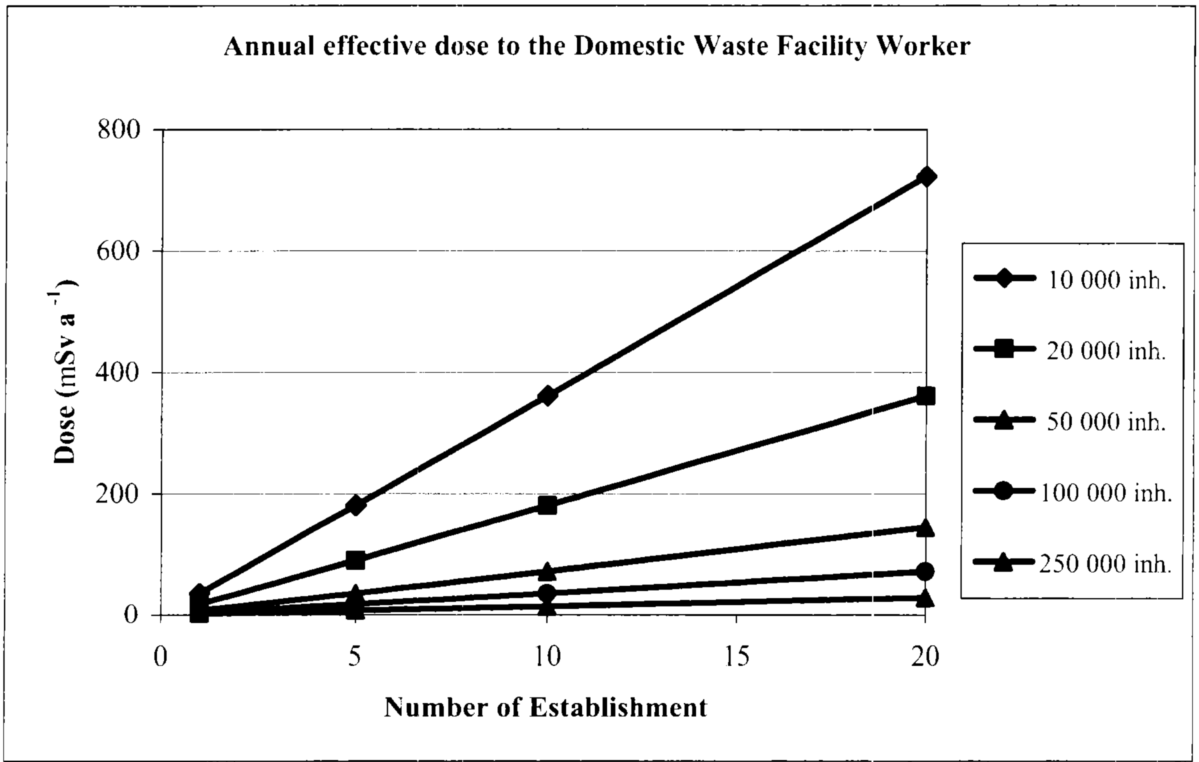

Figure II. Annual Dose that would be received by the Waste Facility Worker depending on the population of the city

It is worth to state that the use of large waste tanks reduces the radiation exposures around the system, and hence is also advantageous in the radiation protection point of view.

It is obvious from Figure II that the dose to the waste facility worker decreases as the population of the city increases. Moreover, number of establishment using ^{131}I period does not affect the annual effective dose too much for the workers working in the waste facilities of highly populated cities.

5. Conclusions

The Turkish Atomic Energy Authority as the regulatory body of Turkey has completed its legislative infrastructure on the disposal of short-lived low-level radioactive waste. All the trends in the disposal of low level wastes and discharge of low-level radioactive effluents are closely pursued. On the other hand the following general conclusions could be made according to the results obtained,

- the annual dose that is received by the domestic waste processing facility is very low,
- decay and delay systems are easy to apply processes and they are very efficient to decrease the discharge activity of any establishment,
- periodic monitoring of discharges should be properly made for the confirmation of theoretical dose calculations.

References

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