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ANAIS - PROCEEDINGS

REVIEW OF CRITERIAS FOR SHALLOW BURIAL SITES AND GEOHYDROLOGICAL EVALUATION AROUND THE SITE OF TEMPORARY STORAGE OF LOW-LEVEL SOLID RADIOACTIVE WASTES OF IPEN-CNEN/SP.

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Abstract

Some comments about norms of pollutants release from nuclear and other industries are made. For radioactive discharges, the strictly implemented national norms/criterias, are much more advanced technically than those existing for other pollutants.

Based on the criterias of site selection and site evaluations, the site of IPEN for temporary storage of low level solid radioactive wastes has been evaluated geohydrologically. Rainfall infiltration rate (297 cm/y) was determined by tritium labelling technique. Ground water velocity (max. 46.1 cm/d) and direction (to north) was determined by various radioactive (Br-82, I-131, Cr-51) tracers using single well techniques. The earliest arrival time of ground water to Pinheiro canal from the site is about 1209 days (3.3 yrs.). There is no potable use of ground water in the vicinity. The superficial water also is not potable up to about 20 kms. The hydrologic studies show that it is highly improbable that radionuclides could arrive to man in harmful concentrations through the aquatic pathway.

The safety margins (even not including absorption on area soils) via aquatic pathway are quite high. The site is under frequent environmental monitoring and has various ground water monitoring wells in and around it.

Introduction

Like any industry, nuclear industry also generates a bye product which after treatment is liberated in the environment in such a way that surrounding public or population in general does not receive any harmful effects. When we have definite benefits from nuclear energy why cannot we accept a safe amount of radioactivity in our environment?

The primary nuclear fuel (U,Th) is already dilutely deposited on the earth's crust, we only concentrate it and use in the nuclear reactors. As a bye product, some solid wastes of low level radioactivity are naturally generated which are returned to environment in a technically safe manner, using the common philosophy of concentration/immobilization and storage, similarly some volumes of low level liquid radioactive effluentes are discharged to water bodies using the principle of dilution and dispersion. These discharges are practised while obeying well thought, deliberated norms. The norms and limits of releases of radioactive pollutants in air, water or ground are much more stringent than for conventional pollutnats. Methodologies, criterias in case of radioactive pollution are much more advanced than those for conventional pollution and serve as examples for chemical pollutants control also.

The safe limits in case of nuclear industry have long been established by International Commission of Radiological Protection (ICRP) and have been implemented strictly by all the nuclear countries, many using even additional safety factors to take care of 'unknown'uncertainties about environmental process, linear or threshold effects.

Regarding disposal of radioactive wastes many national and international criterias and norms have been built up so far, namely among them are criteria of International Atomic Energy Agency (IAEA) for site selection (1) and criteria of Nuclear Regulatory Commission (NRC) of USA for site evaluation (2).

Analysing the criterias of site evaluation and site selection, it should be said that suitability of a particular site established by steps of final selection need not eliminate the useful sites but discriminate not-useful sites. Further, detailed site characterization should be done in the final fase of selection, only in characterization fase appear conditions of suitability and unsuitability and this characterization should be done for more than one site.

A study of site selection/evaluation involves area examination, preliminary selection, site confirmation and deciding factors are supported by minimum requirements, related to geohydrology, ecology, socio-economic, political factors. These technical requirements need study of detailed characterization, modelling, safety/risk analysis and monitoring (pre and post).

In the present study, national guidelines of Comissão Nacional de Energia Nuclear adopted from international guidelines, have been used to evaluate the site for temporary storage of low level solid radioactive wastes generated in IPEN.

The site has been analyzed in detail with respect to its geographical, meteorological, geological and hydrological characteristics. The investigations were carried out as part of studies required to license the site which in turn form part of the regulations of CNEN.

The vital parameters of the unsaturated zone, i.e., rate of infiltration of rain/soil moisture at the site of IPEN was studied by the newly adopted technique of labelling the soil moisture by tritium, while the determination of flow of ground water and is direction in and around the site were made by using radioactive tracers like bromine-82, iodine-131, chromium-51, through single well techniques (3,4,5,6,7). It is woth mentioning that the first applications of these techniques for practical studies of disposal site and water resources evaluation were made in IPEN and by IPEN. They were used in IPEN-USP campus (3,4,5) in north east of Brazil (6) and in Araxá (7).

In this work only some results (Table-1 & 2) are presented while the focus is on the evaluation of the site based on the large volume of data obtained during the last few years.

Table-1 Ground Water Velocity, V^f data, cm/d

Ground water monitoring well (4" int. dia)						
IPT	IB	℄C	AC	DC	CE	IP-PU
4.61	20.8	46.1	8.6	6.9	9.38*	17.73*
iodine-131	(2/82)	(2/82)	(6/83)	(6/83)	(3/85)	(3/85)
4.65	9.3	15.9	31.4*			
bromine-82	(6/83)	(5/83)	(12/84)			
(10/80)	31.7*	20.0				
	(12/84)	(6/83)				

Obs. Variations of Vf values, where noted, is due to, variation in depth of injection; seasonal variations and different (months)/(years) of measurements. Equipment malfunctioning not considered to be contributing seriously to relative count rate situation.

* Internal reports of TE/IPEN to NP/IPEN, Dec. 84 and April 85

Table-2 Data of Soil Moisture Movement

Date of Sampling	Centre of Gravity of ^3H profile* cm	Displacement of Soil moisture cm	Avarage Moisture content (pt. of injection to centre of gravity % wt	Soil bulk density g/cm^3	Recharge cm
(A) Measurements 300 away from the site. Date of injection 24.5.79					
24.08.79	75	5	21.0	1.73	2
28.11.79	112	42	19.3	1.70	12
25.02.80	135	65	20.4	1.76	19
28.05.80	140	70	19.1	1.68	19
(B) Measurements within the site. Date of injection 26.8.81**					
30.11.81	135	65	28.7	1.42	21
03.03.82	241	171	23.6	1.78	58
08.07.82	233	163	22.8	1.78	54
27.08.82	297	227	18.7	1.78	64

* Profile for centre of gravity considered from the point of injection but depth of C.G. referenced to ground level.

** Report of TE/IPEN to NP/IPEN, Feb. 82

The local direction of ground water flow measured by $^{51}CrCl_3$ is towards north and appears towards NP, reactor and finally towards the main entry of IPEN.

Results and Discussion

Site is well located topographically, has low permeability; water table is not too shallow, it is well protected, population of 200.000 habitants within 3 km radius is not large. Sub-surface water finally flows to Pinheiros river 1860 m away. River discharge itself is 70 m^3/s. Annual precipitation is almost equal to evapotranspiration. Soil moisture penetrates only 297cm/y. Apparent recharge is less than 64 cm/y. The site has more than 20 m of clay fine sand. The maximum Vf of 46.1 cm/d amounting to a stage speed of 153.8 cm/d yields the most early ground water arrival time of 1209 days (3.3 years to river. There is no potable use of ground water. Surface water in the vicinity (20 km) also has no potable use. As per safety and operational procedures adopted at the site, it is highly improbable that radionuclides could arrive in river water in concentration harmful to man. These preliminary hydrologic calculations itself show that safety margin via aquatic pathway are quite high. The absorption in the area soils also has not been considered. Site is under frequent radiological supervision, fiscalization and has ground water monitoring piezometers in and around it.

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Acknowledgements

Most of the data discussed are from thesis. Part of the data (*Table 1, ** Table 2) discussed are from routine reports of TE to NP. Collaboration of the colleagues of TE for furnishing some of the data is thankfully acknowledged. This work deals with evaluation of disposal site and not with isotope techniques routinely used for obtaining hydrological parameters.