GUIDELINES NO. AERB/FE-FCF/SG-5

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GOVERNMENT OF INDIA

AERB SAFETY GUIDELINES

RADIOLOGICAL SAFETY IN HANDLING BEACH SAND MINERALS AND OTHER NATURALLY OCCURRING RADIOACTIVE MATERIALS

ATOMIC ENERGY REGULATORY BOARD

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RADIOLOGICAL SAFETY IN HANDLING BEACH SAND MINERALS AND OTHER NATURALLY OCCURRING RADIOACTIVE MATERIALS

Atomic Energy Regulatory Board
Mumbai-400 094
India

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Price:

Order for this Guidelines should be addressed to:

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FOREWORD

Activities concerning establishment and utilisation of nuclear facilities and use of radioactive sources are to be carried out in India in accordance with the provisions of the Atomic Energy Act, 1962. In pursuance of the objective of ensuring safety of members of the public and occupational workers as well as protection of environment, the Atomic Energy Regulatory Board (AERB) has been entrusted with the responsibility of laying down safety standards and enforcing rules and regulations for such activities. The Board has, therefore, undertaken a programme of developing safety standards, safety codes and related guides and manuals for the purpose. While some of the documents cover aspects such as siting, design, construction, commissioning, operation, quality assurance, decommissioning of nuclear and radiation facilities, the other documents cover regulatory aspects of these facilities.

Safety codes and safety standards are formulated on the basis of internationally accepted safety criteria for design, construction and operation of specific equipment, structures, systems and components of nuclear and radiation facilities. Safety codes establish the objectives and set requirements that shall be fulfilled to provide adequate assurance for safety. Safety guides and guidelines elaborate various requirements and furnish approaches for their implementation. Safety manuals deal with specific topics and contain detailed scientific and technical information on the subject. These documents are prepared by experts in the relevant fields and are extensively reviewed by advisory committees of the Board before they are published. The documents are revised, when necessary, in the light of the experience and feedback from users as well as new developments in the field.

A graded approach to regulation is one of the key principles embodied in the IAEA safety standards, which state that the application of the requirements for practices 'shall be commensurate with the characteristics of the practice or source and with the magnitude and likelihood of the exposures'. In line with this, this 'Guidelines' has been prepared to provide regulatory requirements and guidance with respect to radiological safety, waste management and transportation aspects relevant to facilities processing beach sand minerals, columbite tantalite ore, rock phosphate and phosphogypsum.

Consistent with the accepted practice, 'shall', 'should', and 'may' are used in the guidelines to distinguish between a firm requirement, a recommendation and a desirable option, respectively. Appendices are integral part of the document, whereas Annexures and bibliography are included to provide further information that might be helpful to the user. Approaches for implementation, different to those set out in the guidelines may be acceptable, if they provide comparable assurance against undue risk to the health and safety of the occupational workers and the general public, and protection of the environment.

For aspects not covered in this document, applicable national and international standards, codes and guides acceptable to AERB should be followed.

This 'Guidelines' has been prepared by a consultant. It has been reviewed in-house by the Industrial Plants Safety Division, AERB and the 'Advisory Committee on Safety Documents relating to Fuel Cycle Facilities other than Nuclear Reactors' (ACSD-FCF), consisting of experts from Atomic Energy Regulatory Board, Bhabha Atomic Research Centre and Heavy Water Board.

AERB wishes to thank all individuals and organisations who have prepared and reviewed the draft and helped in its finalisation. The list of persons, who have participated in this task, along with their affiliations, is included for information.

(S. S. Bajaj)
Chairman, AERB

DEFINITIONS

Accident

An unplanned event resulting in (or having the potential to result in) personal injury or damage to equipment which may or may not cause release of unacceptable quantities of radioactive material or toxic/hazardous chemicals.

ALARA

An acronym for 'As Low As Reasonably Achievable'. A concept meaning that the design and use of sources, and the practices associated therewith, should be such as to ensure that exposures are kept as low as reasonably practicable, with economic and social factors taken into account.

Approval

A type of regulatory consent issued by the regulatory body to a proposal.

Atomic Energy Regulatory Board (AERB)

A national authority designated by the Government of India having the legal authority for issuing regulatory consent for various activities related to the nuclear and radiation facility and to perform safety and regulatory functions, including their enforcement for the protection of site personnel, the public and the environment against undue radiation hazards.

Competent Authority

Any official or authority appointed, approved or recognised by the Government of India for the purpose of the Rules promulgated under the Atomic Energy Act, 1962.

Consent

A written permission issued to the "consentee" by the regulatory body to perform specified activities related to nuclear and radiation facilities. The types of consents are 'licence', 'authorisation', 'registration' and 'approval', and will apply according to the category of the facility, the particular activity and radiation source involved.

Dose

A measure of the radiation received or absorbed by a target. The quantities termed absorbed dose, organ dose, equivalent dose, effective dose, committed equivalent dose, or committed effective dose are used, depending on the context. The modifying terms are used when they are necessary for defining the quantity of interest.

Dose Limit

The value of the effective dose or the equivalent dose to individuals from controlled practices that shall not be exceeded.

Exposure

The act or condition of being subject to irradiation. Exposure can be either external (irradiation by sources outside the body) or internal (irradiation by sources inside the body). Exposure can be classified as either normal exposure or potential exposure; either occupational, medical or public exposure; and in intervention situations, either emergency exposure or chronic exposure. The term 'exposure' is also used in radiation dosimetry to express the amount of ions produced in air by ionising radiation.

Inspection

Quality control actions, which by means of examination, observation or measurement determine the conformance of materials, parts, components, systems, structures as well as processes and procedures with predetermined quality requirements.

Licence

A type of regulatory consent, granted by the regulatory body for all sources, practices and uses for nuclear facilities involving the nuclear fuel cycle and also certain categories of radiation facilities. It also means authority given by the regulatory body to a person to operate the above said facilities.

Normal Operation

Operation of a plant or equipment within specified operational limits and conditions.

Registration

The regulatory consent shall be the registration for sources and practices that include

(i) medical diagnostic X-ray equipment including computed tomography (CT) and therapy simulator;

(ii) analytical X-ray equipment used for research;

(iii) nucleonic gauges;

(iv) radio immuno assay laboratories;

(v) radioactive sources in tracer studies;

(vi) bio-medical application and research using radioactive materials; and

(vii) any other source and practice notified by the competent authority.

Regulatory Body

See 'Atomic Energy Regulatory Board'

SPECIAL DEFINITIONS

(Specific for the present 'Guidelines')

Beach Sand Washings Collection

The process of manual collection of beach sands enhanced with heavy mineral concentrates due to repeated wave action.

Heavy Minerals

Minerals occurring in the beach sands with density greater than that of quartz (density > 3000 kg/m^3).

CONTENTS

1. INTRODUCTION

1.1 General

This ‘safety guidelines’ on ‘Radiological Safety in Handling Beach Sand Minerals and Other Naturally Occurring Radioactive Materials’ is prepared under the programme of publishing codes and guides on various topics on nuclear and allied industries by the Atomic Energy Regulatory Board.

The predominant industrial processes which require handling of Naturally Occurring Radioactive Materials (NORM) are processing of Beach Sand Minerals (BSM), Columbite Tantalite Ore, Rock Phosphate and Phosphogypsum.

In India, heavy mineral sand deposits containing ilmenite, rutile, leucoxene, zircon, garnet, sillimanite and monazite occur mostly along the coastal areas of the peninsular regions and in the form of inland sand dunes near the coast. Mining and processing of these heavy Beach Sand Minerals (BSM) other than monazite is carried out in different parts of the country by many Private and Public Sector Industries. However, during preferential separation of BSM other than monazite, the tailings generated get enriched in monazite containing uranium and thorium. Similarly processing of Columbite Tantalite Ore and Rock Phosphate (for phosphoric acid production) results in generation of uranium and thorium bearing slag and radium bearing phosphogypsum respectively.

The presence of uranium, thorium and radium in these NORMs warrants the need to control exposures of workers and members of the public in accordance with the various regulatory and safety requirements.

Other NORMs such as oil and gas shales, fly ash, metal slag from processing of aluminium, zinc, tin, copper etc are not dealt specifically in this guidelines. However, radiation protection aspects in facilities handling these NORMs will have to be assessed on a case to case basis.

AERB has already published a Safety Guidelines on ‘Thorium Mining and Milling’ (AERB/NF/SG/IS-6) which deals with the mining and separation of monazite and its chemical processing and therefore, this aspect is not included in the present guidelines.

This document outlines the various radiological safety aspects related to the processing of beach sand minerals and handling/disposal of the NORM residues.

1.2 Objective

The objectives of this ‘guidelines’ are:

(i) To lay down guidelines for safety procedures and systems to be followed at various stages of design and operation with the overall objective of protecting workers, public and the environment from the harmful effects of radiation associated with the operations.

(ii) To provide guidelines for adopting monitoring and control techniques/procedures.

(iii) To provide detailed information on implementing a graded regulatory approach for the protection of workers and members of the public against radiation exposure.

1.3 Scope

The ‘guidelines’ presents the radiological safety aspects related to mining and processing of beach sand minerals, columbite tantalite ore, rock phosphate and phosphogypsum and handling/ disposal of NORM residues by private and public sector industries. Radiological safety and waste management aspects to be considered during the mineral separation of BSM, processing of columbite tantalite ore, processing of rock phosphate and use of phosphogypsum in commercial applications in order to minimize the radiation exposure to occupational workers and members of the public are described along with the monitoring and control measures required for achieving the objective.

2. PROCESS DESCRIPTION

2.1 Processing of Beach Sand Minerals (BSM)

Heavy-mineral sand deposits occur underwater or may form part of sea beaches or coastal dunes created by wind action over long periods of time. They may also occur inland in coastal strips up to a few kilometers wide. These deposits are richest during periods of intense wave action (eg. south west monsoon), following which, if left un-recovered, they are likely to become wholly or partly washed away.

The composition of heavy-mineral sand deposits varies according to location of their occurrence. The total heavy-mineral content of raw sand is typically in the range of 5-50%. Table 1 gives typical composition of beach sand minerals. Ilmenite constitutes the bulk of the raw sand followed by zircon, rutile, garnet and sillimanite. Monazite and leucoxene are minor constituents. All of these minerals have densities greater than 3000 kg/m^3, hence their designation as heavy minerals. The composition, properties and uses are given in Table 2.

TABLE 1 : TYPICAL COMPOSITION OF BEACH SAND MINERALS

MINERALS	PERCENT CONTENT		
	West Coast	South West Coast	East Coast
ILMENITE	61	46	8 - 9
RUTILE	4 - 7	2 - 27	0.3 - 0.4
ZIRCON	5 - 8	4 - 6	0.3 - 0.5
SILLIMANITE	4 - 8	2 - 3	3 - 4
GARNET	---	7 - 14	6 - 7
MONAZITE	0.5 - 1	3 - 4	0.1 - 0.5
LEUCOXENE	1 - 1.5	0.5 - 1	---

TABLE 2 : THE COMPOSITION, PROPERTIES AND USES OF VARIOUS BSM

Mineral	Chemical Composition	Sp.Gravity	Properties	Typical Uses
Ilmenite	TiO_2 FeO	4.5 - 5.0	Conducting and strongly magnetic	Manufacture of titanium dioxide pigment, synthetic rutile and titanium sponge
Rutile	TiO_2	4.1 - 4.25	Conducting and non magnetic	Manufacture of titanium dioxide pigment, titanium sponge and welding electrode fluxes
Zircon	$ZrSiO_4$	4.6 - 4.7	Non conducting and non magnetic	In ceramics, refractories, foundries and nuclear reactors
Sillimanite	Al_2SiO_5	3.2 - 3.25	Non conducting and non magnetic	Refractories
Garnet	$Fe_3(SiO_4)_3$	3.1 - 4.3	Non conducting and moderately magnetic	Abrasive for sand blasting, in water –jet cutting and glass polishing
Monazite	(Ce,La,Th,Nd,Y) PO_4	4.6 - 5.7	Non conducting and weakly magnetic	As raw material for production of rare earth, uranium and thorium
Leucoxene	Fe-Ti oxide mixture (Granular alternation product of titanium minerals)	4.3 - 4.6	Conducting and strongly magnetic	Raw material for titanium dioxide pigment and welding rod flux

The Beach Sand Mineral Facilities are primarily involved in:

(a) Mining and mineral separation of beach sands to produce one or more of the following minerals : titanium minerals (ilmenite, rutile, leucoxene), garnet, sillimanite, zircon and monazite.

(b) Procurement of ilmenite or garnet rich tailings with enhanced monazite content for further recovery of ilmenite or garnet.

(c) Purification, Chemical processing and value addition of titanium minerals.

(d) Chemical processing of zircon for the production of Zirconium compounds and value addition.

2.1.1 Mining and Mineral Separation

Extraction of beach sand deposits is carried out either by beach washings collection or by using a suction dredge in a planned and pre-determined path. Beach sands at certain locations with favourable topography have higher concentration of heavy minerals due to repeated washings by wave action. 'Beach sand washings collection' involves collection of these beach sands and transporting it to concentration up-gradation units. The dredge unit is used for mining inland placers.

Dredge: a dredge unit usually has a cutter on its cutter ladder which cuts the sand, loosens it and keeps the sand grains in suspension enabling the suction pump to lift it. The dredge breaks the face of the sand deposits which collapses into the dredge pond as the dredge unit advances forward in its cutting path.

Head Feed Bin: the dredged out slurry is pumped in the head feed bin unit, which consists of a surge bin and a rotating trommel. The trommel screens the over sized pebbles, grass roots etc and the screened underflow is collected in the surge bin.

Wet Concentrator : the slurry from the surge bin is pumped at a specified pulp density to a wet concentrator unit for pre concentration of minerals. The wet concentrator unit consists of series of spirals. The tailings is normally used to backfill the mined out areas. The pre-concentrated slurry is subjected to further concentration in heavy minerals up-gradation units, which consist of several circuits of spirals and wet tables for further up-gradation of heavy minerals to 95 to 97%.

The heavy mineral concentrate from heavy mineral up-gradation units is subjected for separation of individual minerals. The separation of individual minerals is done based upon their physical properties listed in Table 2.

Equipment normally used for the separation of magnetic and non magnetic minerals are induced roll magnetic separators, high intensity roll magnetic separators, semi lift magnetic separators, rare earth drum separators, cross belt magnetic separators, etc. Equipment normally used for separation of conducting and non conducting minerals are high tension separators, electrostatic plate separators, electro-screen separators etc. In addition, a number of dryers are needed to eliminate moisture in the feed concentrate and products from wet separators and also to heat dry solids prior to high tension separation. Fig. 1 gives a simplified general flow sheet of the mining and mineral separation processes.

Based on the raw material input and monazite enriched tailings generated, the BSM facilities can be classified into the following four major types.

Type I. Facilities carrying out mining and mineral separation of beach sands and producing ilmenite and/or garnet. Such facilities generate large quantities of monazite enriched tailings and the monazite content in these tailings is generally <5%.

Type ll. Facilities carrying out mining and mineral separation of beach sands and producing all the major constituent minerals such as ilmenite, rutile, garnet, zircon and silimanite. Such facilities generate relatively less quantities of monazite enriched tailings and the monazite content in these tailings is generally 20-70%.

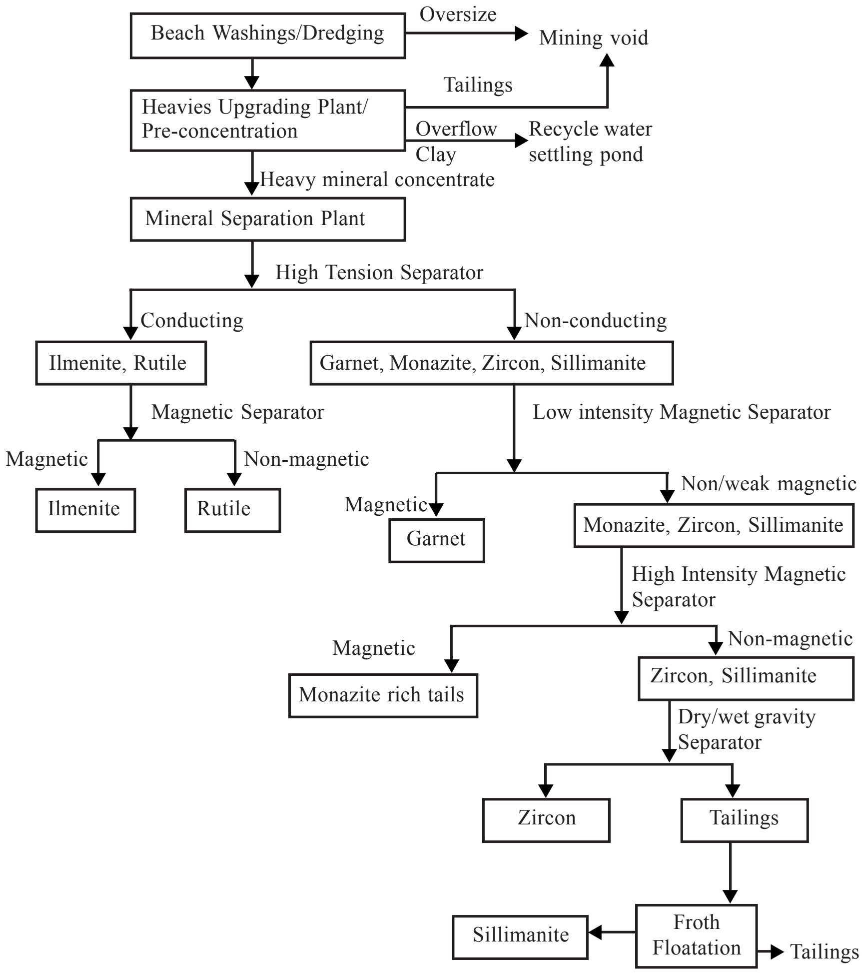

FIG.1 : TYPICAL FLOW CHART SHOWING SEPARATION OF HEAVY MINERALS

Type III. There are certain facilities procuring ilmenite for value addition. Such facilities prior to chemical processing of ilmenite subject it to further physical separation for purification and in the process generate small quantities of monazite enriched tailings and the monazite content in these tailings is generally about 5%.

Type IV. Finally, there are facilities which procure the monazite enriched tailings for recovery of the other heavy minerals. Such facilities generate small quantities of monazite enriched tailings and the monazite content in these tailings is generally 20-70%.

2.2 Processing of Columbite -Tantalite Ore

Columbite is an ore of niobium (also called columbium) and Tantalite is an ore of tantalum. In view of similar atomic size (lanthanide contraction) and other chemical and physical properties, these two metals remain invariably associated with each other in nature. However, columbite/tantalite also contains small but recoverable amount of uranium and traces of thorium. The ore is chemically processed to obtain salts of niobium and tantalum and also for obtaining niobium and tantalum metal.

The process in general involves grinding of ore, dissolution in hydrofluoric acid, solvent extraction with Tributyl Phosphate (TBP)/kerosene to separate niobium and tantalum stream and subsequent recovery of the products .The residue obtained after dissolution of the ore contains enhanced concentration of uranium, thorium and radium-226.

2.3 Processing of Rock Phosphate and Use of Phosphogypsum

The fertilizer plants in India are presently processing rock phosphates imported from countries like Jordan, Morocco, Egypt, Senegal, Togo, China and others for production of phosphoric acid/fertilizers. Rock phosphates are known to contain enhanced concentrations of naturally occurring radionuclides especially uranium and its daughter products like Radium-226.

During wet processing of Rock Phosphate, it is reacted with dilute sulpuric acid to produce phosphoric acid and phosphogypsum is obtained as by product as shown in the following reaction.

$$Ca_3(PO_4)_2 + 3H_2SO_4 + 6H_2O \longrightarrow 3CaSO_4.2H_2O + 2H_3PO_4$$

In the chemical processing of rock phosphates, the radionuclides get selectively separated into the phosphoric acid and solid waste. About 86% of uranium goes into the phosphoric acid and 80% of Ra-226 goes into the phosphogypsum. Phosphogypsum is used in various commercial applications such as in manufacture of cement, fly ash brick, plaster of paris, plaster board, glass fibre reinforced gypsum panels (GFRGP) and also in agriculture.

3. RADIOLOGICAL SAFETY

3.1 General

Monazite, columbite tantalite ore and rock phosphate contain thorium and uranium chain radionuclides in secular equilibrium and do not exhibit any appreciable change in activity with respect to time. Figures 2 (A) and 2 (B) give the U- 238 and Th- 232 decay series respectively. In the decay scheme of naturally occurring thorium, one atom of ^{232}Th emits six alpha particles, 4 beta rays and several gamma rays before becoming the stable end- product, ^{208}Pb. The alpha energies range from 4.0 MeV to 8.78 MeV. The chain also shows high-energy beta and gamma rays of 2.26 MeV and 2.61 MeV respectively. Each atom of ^{238}U in natural uranium decays to stable lead

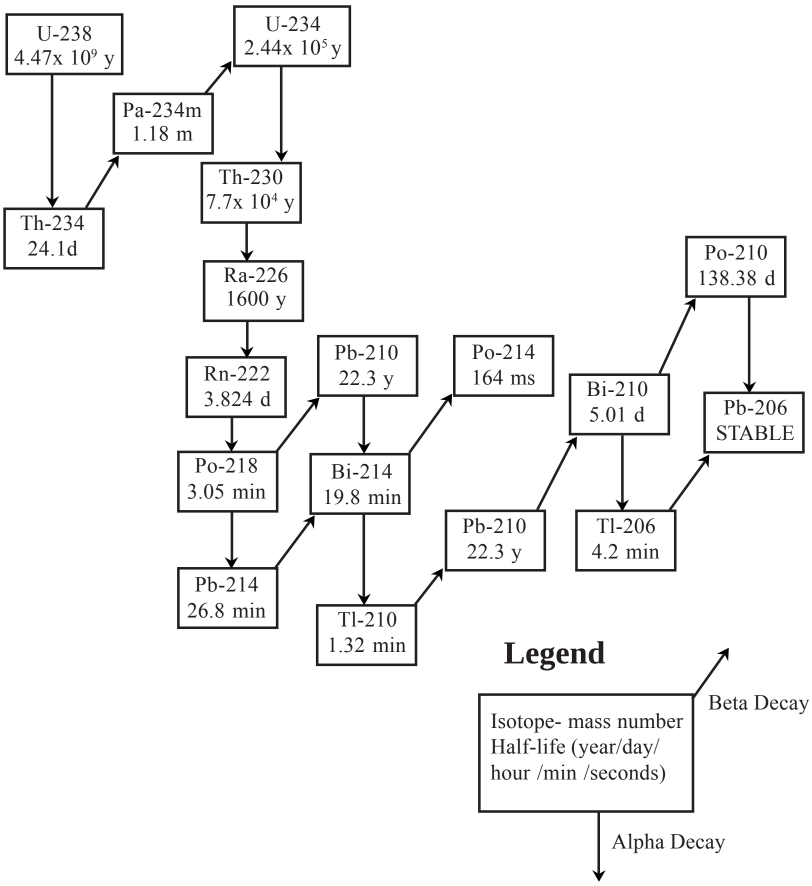

FIG. 2(A) : URANIUM DECAY SERIES

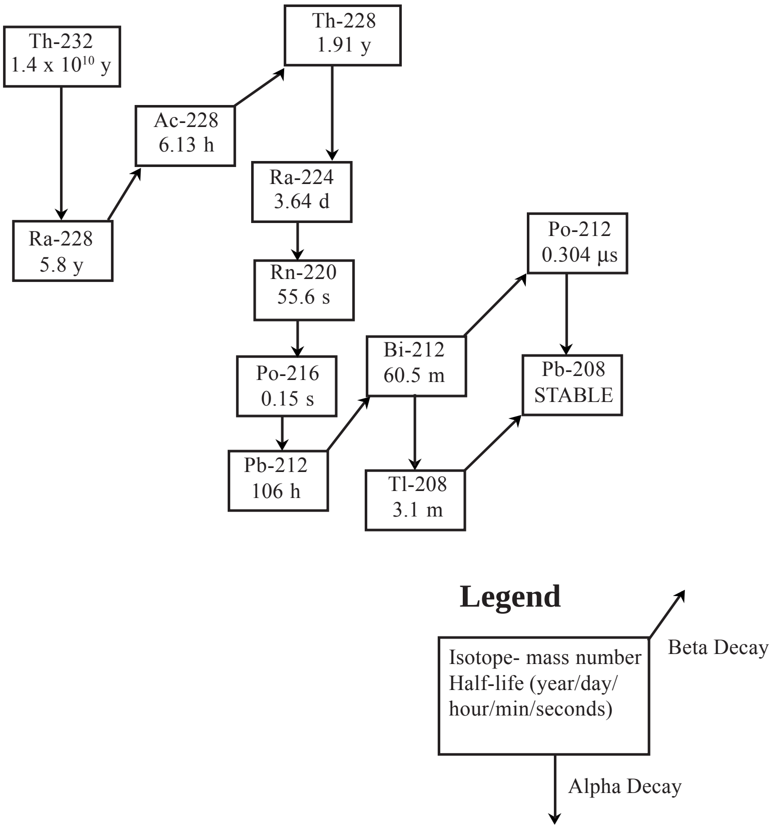

FIG. 2(B) : THORIUM DECAY SERIES

(^{206}Pb) through the emission of 8 alpha particles and 6 beta rays along with accompanying gammas. The maximum energies of emissions are 7.69 MeV, 3.26 MeV and 1.76 MeV for alpha, beta and gamma respectively. The daughter radionuclides equilibrium gets disturbed during chemical processing of these minerals.

3.2 Processing of Beach Sand Minerals

The mineral monazite found in beach sands is the principal ore of Rare Earths and Thorium. Monazite contains around 0.35% uranium as U_3O_8 and 9 % thorium as ThO_2 with Th-232 series activity concentration in the range 40 – 600 Bq/g. Zircon also contains uranium and thorium in the crystal lattice. Their current levels, for most commercial zircons, would be about 250–350 ppm uranium and about 100–200 ppm thorium. Therefore, the radiological hazards associated in the BSM facilities are due to the presence of thorium, uranium and their decay products in the mineral constituents of the feed, process streams, products and the tailings.

The hazards in BSM facilities can be both from external and internal sources. External hazards are due to high energy beta and gamma rays of thorium series and internal hazards are mainly due to alpha emitting radionuclides deposited inside the body. Internal hazard is mainly by way of inhalation of air borne thorium bearing mineral sand particles. Uranium concentrations encountered in the BSM facilities are insignificant to constitute any external or internal exposure problems. Radon/thoron concentrations observed in mineral processing are also too low to be of any radiological safety concern. Thorium is almost always associated with its immediate daughter product ^{228}Ra which is chemically much more mobile than thorium. Radium can easily get leached out from the site of deposition and is trans-located to different organs. Ingestion by way of food and drinking water is another possible route of entry of thorium and daughter products into the human body. However internal exposure via ingestion is unlikely to require consideration under normal operational circumstances.

3.2.1 Mining and Mineral Separation

The mineral separation plants are situated at the natural high background areas and the background radiation level in these areas is generally in the range of 1 to 3 μGyh^{-1}. Radiation fields in the plant area are dependent upon the inventory of monazite in each process stream. The fields buildup through different stages of mineral separation and show direct proportionality to the monazite content in each stream. The external radiation may come from the emission of gamma radiation from the feed storage area, machinery containing sand of higher monazite content, spillages of monazite enriched tailings or intermediate stockpiles of monazite enriched tailings. Most of the external radiation exposures in mineral sand processing plants occur from being in close proximity to the tailings such as during sun drying of intermediate sand concentrate.

In Type I and Type III BSM facilities (described in section 2.1.1), the monazite throughput in the plant is relatively less and the tailings contain monazite less than 5%. The radiation field varies from background to 10 μGyh^{-1}. The annual individual external dose in such facilities is within 2mSv. However, in Type II and IV facilities (described in section 2.1.1), the monazite throughput in the plant is quite significant and the monazite content in the tailings may vary in the range 20-70%. The radiation fields on contact with the tailings can be of the order 50 - 150 μGyh^{-1}. The annual individual external dose in such facilities could be as high as 6 mSv.

Internal exposure at BSM facilities is mainly due to fine air borne particulates of monazite and silica bearing dust. In the minerals separation plants nearly 75% of the airborne dust is non-respirable. Some specific sources of air-borne dust and air activity are:

(i) Conveying of sand using open belt conveyors and elevators.

(ii) Re-suspension of dust settled on surfaces of equipment, floor, window sills etc by movement of men and vehicles.

(iii) Fall of sand from blocked conveyors and elevators and during power failures.

(iv) Receiving chutes of conveyors, elevators and dryers.

(v) Carryover of slime from the raw sand feed.

The air activity levels due to thorium encountered in these plants are of the order of less than 1/20 of the corresponding Derived Air Concentration. Internal dose attributable to thoron and thoron daughters is not significant in the mineral separation plants as the emanation of thoron from the mineral is very low.

3.3 Processing of Columbite - Tantalite Ore

The uranium and thorium concentration in columbite tantalite ore varies significantly with the geographical locations. Indian ore contains uranium in the range 1000 - 2500 ppm as (U_3O_8) and thorium in the range 400 - 600 ppm. However, U-238 content in imported columbite tantalite ore may range upto 1300 ppm and Th-232 may range upto 5500 ppm.

Exposure to direct gamma and inhalation of airborne dust containing uranium and thorium nuclides are the two routes of radiation exposure to occupational workers in these industries. The exposure of a worker during the processing of columbite tantalite is not likely to exceed 3mSv/y. Exposure due to radon and thoron progeny to workers is insignificant in these plants. Processing of columbite and tantalite ores for the extraction of niobium and tantalum leaves residues containing significant concentrations of U-238 (~ 300 Bq/g), Th-232 (~ 100 Bq/g) and Ra -226 (~ 500 Bq/g).

3.4 Processing of Rock Phosphate and Use of Phosphogypsum

Rock phosphate imported in India contains U-238 typically in the range of 0.8 - 1.85 Bq/g and Ra-226 in the range of 0.5-1.7 Bq/g. The phosphogypsum obtained as byproduct during wet processing of these imported rock phosphates contains U-238 typically in the range of 0.1-0.2 Bq/g and Ra-226 typically in the range 0.5-1.3 Bq/g. The exposure of a worker during the processing of rockphosphate is likely to be in the range of 1- 2 mSv/y. Disposal of phosphogypsum should be in engineered storage yards located away from public residences and water bodies.

Use of phosphogypsum in commercial applications resulting in annual dose in the range 0.3 - 1 mSv to the public is permitted. This is in line with AERB directive No. 01/09 on Phosphogypsum disposal.

4. RADIATION SURVEILLANCE

4.1 Radiation Monitoring

Physical measurement of the parameters relevant for radiation protection, provides information necessary for ensuring radiation safety and helps in estimating the occupational exposures and public exposure. This is required to be carried out in BSM and Columbite Tantalite Processing facilities. In view of extremely low radiation hazard in rockphosphate processing facilities, the requirement of radiation monitoring may not be warranted.

To meet the requirements for limiting radiological risks, the licensee should prepare plant specific radiation protection procedures which *inter alia* will include programme for individual assessment of occupational exposures and doses. The dose assessment programme should demonstrate compliance with the radiation dose limits for individuals; it should also demonstrate that doses are as low as reasonably achievable, economic and social factors being taken into account, and provide information for individual dose records.

Two approaches - individual monitoring and workplace monitoring - may be used (either as alternatives or in combination where appropriate) to determine exposure levels for the purposes of individual dose assessment.

4.1.1 Personnel Monitoring (Individual Monitoring)

Personnel exposures comprise of two components, viz. external exposure arising from external sources of radiation and internal exposure arising mainly from inhalation of airborne dust/gases containing radioactivity. However, in most of the NORM industries the internal exposure is insignificant and only external exposure needs to be considered for dose estimation.

Individual exposures are (i) based on personal radiation dosimeter records which give the cumulative radiation dose or (ii) estimated based on plant area monitoring for radiation fields and occupancy periods at the work place. Personal radiation dosimeter should be provided if the dose rates are likely to give rise to annual individual external doses of 6 mSv or above, such as in Type II and Type IV BSM facilities.

Thermo Luminescent Dosimeters (TLD) should be issued to the workers on a quarterly basis. TLD racks should be provided preferably near the entrance in a low background area where each radiation worker is allotted a marked slot for keeping the TLD when off duty. Compliance of TLD use should be ensured by spot checks and checking of the TLD racks. After the end of the quarter the TLDs should be changed and the used TLDs should be monitored for surface contamination. The dosimeters should be collected and sent to the Head, PMS/RPAD of the Bhabha Atomic Research Centre or any other duly authorized agency for dose evaluation. The details of the TLD service are maintained in TLD form and TLD issue Register.

For other cases such as Type I and Type III BSM facilities and Columbite Tantalite Processing facilities, estimates of individual doses based on Ambient Dosimetry should be sufficient which are calculated based on workers' occupancy and the prevailing radiation level in that area.

4.1.2 Workplace monitoring (Plant/Area Monitoring)

Plant/area monitoring surveys should include:

(i) levels of external radiation in all occupied areas of the plant and tailings/slag disposal area;

(ii) concentration of airborne radionuclides.

4.1.2.1 Measurement of External Radiation

(a) Radiation monitoring at the place of work should be carried out with dose rate measuring instruments, which are count rate meters based on GM counters/scintillometers. Instruments based on ionization chambers duly protected from moisture can also be used for beta-gamma dose rate measurements.

(b) The frequency of measurements should be normally once in a month and should be specified in the radiation protection procedures of the plant.

(c) Each working area should be surveyed, with particular attention paid to fixed working locations and to other areas where workers may remain for a large part of their work. Pipelines carrying radioactive material/slurry or having potential of sludge deposition (such as iron oxide carrying pipelines in ilmenite processing facilities) should be surveyed to assess any build up of activity.

(d) Details of the workplaces surveyed and the dose rates determined should be recorded.

(e) Instruments used to measure dose rates should be calibrated (once in a year) and maintained regularly under a quality assurance programme as specified in the radiation protection procedures of the plant.

The requirements of Radiation Monitoring Equipment are given in Table 3.

TABLE 3 : REQUIREMENTS OF RADIATION MONITORING EQUIPMENT

S.No.	Type of Facility	Type of Instrument in working condition	Minimum No.
1	Columbite Tantalite and Type I & III BSM Facilities	G.M. Survey meter (0 - 20 mR/h)	1
2	Type II & IV BSM Facilities	G.M. Survey meter (0 - 20 mR/h)	1
		Scintillometer (low range) - desirable	-
		Thermo Luminescent Dosimeters	Workers having potential to exceed dose of 6 mSv/y.

4.1.2.2 Measurements of Radioactive Dust, Radon/Thoron and Radon/Thoron Progeny Concentrations

Concentrations of radioactive dust, radon/thoron and radon/thoron progeny should normally be got monitored by approved agencies once in a year. Open face filter paper air sampling with a suction head, tubing and attached suction pump with flow measuring facility should be used for air monitoring for dust and particulate activity in the working environment. Long duration air samples are analyzed for gross radioactivity (alpha/beta) and the concentrations per unit volume are arrived at for internal dose estimates. For radon/ thoron measurements in the working atmosphere short duration filter paper air sampling with programmed alpha activity measurements or dedicated radon/ thoron detection devices may be used. The ambient conditions of humidity, temperature and ventilation should be monitored so as to be able to estimate their influence on the radon/thoron assessment.

The locations at which workplace monitors are deployed for measuring contaminant concentrations in air should be selected to be representative of the air breathed by workers, particularly where workers move through areas with differing contaminant concentration. Instrumentation used to measure contaminant concentrations should be calibrated and maintained regularly under a quality assurance programme. Where grab sampling is used, it should be demonstrated that the samples are representative of average ambient conditions. As a method, it is only appropriate in environments for which conditions are known to be generally stable.

The monitoring programme and frequency should be described in the radiation protection procedures of the plant.

4.1.3 Environmental Monitoring

A suitable environmental monitoring programme appropriate to the level of operations and in line with the classification cited earlier should be established to assess the impact of the facility on the environment. The programme should include radiation monitoring in the vicinity of the plant for assessment of variation, if any, in the background radiation levels. This may be carried out by using calibrated dose rate measuring instruments, which are count rate meters based on GM counters, ionization chambers or scintillators. The environmental monitoring programme should comply with the regulatory requirements prescribed on a case to case basis.

4.1.3.1 Beach Sand Minerals Facilities

(i) Mining and monazite enriched tailings disposal sites (trenches/ backfilled areas) should be monitored for the background radiation level.

(ii) Integrity of the topping of the trenches should be ensured by quarterly monitoring.

The mined and refilled areas are to be preferably replanted and rehabilitated. There should be a continuous programme for restoring the ecological balance to the maximum extent possible.

4.1.3.2 Columbite - Tantalite Processing Facilities

Monitoring of water bodies such as river, stream, or lake into which the liquid effluent may be discharged should be carried out once in a quarter.

4.2 Monitoring Records

All the monitoring data of individuals, workplace and environment should be recorded and maintained. Dose records should be preserved during the working life of each worker, and afterwards until the worker attains or would have attained the age of seventy five years, or not less than thirty years after the termination of the work involving occupational exposure whichever is later.

5. CONTAINMENT OF RADIOACTIVE MATERIAL AND CONTROL OF RADIATION EXPOSURES

Engineered, operational and administrative control measures are adopted for keeping the exposures As Low As Reasonably Achievable (ALARA).

5.1 External Exposure Control

Control measures to protect the health of workers are basically achieved by confinement/containment of radioactive material within the process equipment. The processes should largely be automated, thus minimizing direct contact with the material. The processes, equipments and working practices should be so designed as to reduce the exposure of personnel to radioactive material both during operations and maintenance.

5.1.1 Engineered Control

5.1.1.1 Beach Sand Minerals Facilities

(i) Sand bins containing sand concentrates and fractions enriched in monazite should be properly shielded, if needed, to control the radiation exposure to personnel working in their vicinity.

(ii) Overhead sand conveyors (especially passing above passage and worker occupied areas) should be provided with suitable covers to prevent spillage of mineral.

(iii) All packaging and handling of zircon powder should be mechanized to avoid direct handling.

(iv) Mechanised methods should be adopted for segregation, collection, transport and storage of tailings to storage sites.

(v) Iron oxide slurry during ilmenite processing should be transported in pipelines.

5.1.1.2 Columbite - Tantalite Processing Facilities

(i) Uranium and thorium bearing slag should be contained in high integrity structures.

(ii) Dykes should be provided for all process tanks

(iii) Mechanised methods should be adopted for collection and bagging of slag.

5.1.1.3 Rock Phosphate Processing Facilities

(i) Phosphogypsum slurry should be transported in closed pipelines.

(ii) Phosphogypsum should be stored in engineered disposal facilities having water proof lining to prevent migration of radionuclides into ground water and there should also be a proper leachate collection system.

5.1.2 Operational Control Measures

(i) Raw materials should be stored in controlled locations (sheds/ storages) where the occupancy should be limited based on the radiation fields. Storage areas and other high radiation areas should be properly identified by suitable methods and caution boards should be prominently displayed with radiation monitoring details.

(ii) Structures and process equipment such as pipelines, conduits, conveyors, tanks with elevated radiation field (due to enhancement of radionuclide concentration during process operation) should be identified for necessary control.

(iii) Monazite enriched tailings/uranium thorium bearing slag/ phosphogypsum should be stored away from areas normally occupied by workers.

(iv) Good working practices and house keeping such as prevention of spillage of radioactive material (raw material/intermediate/slag/ residue) and prompt removal of spillage if any from working areas should be adopted.

(v) Pipelines carrying radioactive material in the form of liquid/slurry should be tested periodically.

5.1.3 Administrative Control

The control measures to be implemented are:

(i) Access control to prohibit unnecessary occupancy in high radiation areas.

(ii) Exposure control by Radiological Work Permits (RWP) in situations of anticipated high exposures (such as in monazite tailings stockyard).

(iii) Job rotation of the individual to limit individual exposures.

5.2 Internal Exposure Control

Normally no forced ventilation is required in NORM industries for internal exposure control. However, radial exhausts may be provided on the roofs to ensure enough air movement to reduce the levels of air borne radio activity and dust. Provision of master roofs adds to the air circulation. Other control measures that may be adopted are:

5.2.1 Engineered Control

The belt conveyers and bucket elevators and especially the transfer point should be provided with appropriate enclosures. The gap between the discharge end of conveyors and the receiving chutes should be kept minimum and hoods with local exhausts should be provided to prevent the release of dust.

The dust generating equipment such as grinders should be housed in engineered enclosures at small negative pressure to prevent escape of fine dust to occupied areas.

5.2.2 Operational Control Measures

(i) Wet methods of mining and processing should be adopted wherever possible.

(ii) Spillages and dust deposited on surfaces should be promptly removed by vacuum cleaning/wet mopping.

(iii) Dust generating machineries like Electrostatic and magnetic separators, grinders, air tables etc should always be kept enclosed to prevent escape of dust to workplace.

(iv) Sufficient settling time should be provided for the recycled water used for pre-concentration and wet processing to reduce the dust load carried into the process stream. Settling ponds should be regularly de-silted.

5.2.3 Administrative Control

(i) Appropriate respirators/Personnel Protective Equipments (PPE) should be used to prevent inhalation of airborne dust and activity.

(ii) Access controls, barriers, restricted/no entry areas should be enforced in dust generating areas.

6. WASTE MANAGEMENT

6.1 Processing of Beach Sand Minerals

6.1.1 Mining and Mineral Separation

Beach washing collection and dredge mining of inland placers generate large volume of overburden which include topsoil, clay, silica sand, slime, peat, organic waste (vegetation, trees, roots. etc.), screen - overs and shells. Solid tailings containing shells and organic waste (shreds of roots etc) and screen overs are generated from trommel operations. This can be preserved at mine site for topping the refilled areas to facilitate eco-restoration.

Silica waste is generated during the pre-concentration and concentrate up-gradation operations. The volume of silica waste generated depends on the heavy mineral concentration in the mined raw sand and the recovery effected in the processes. The silica waste, which contain around 80% quartz, is depleted of monazite (field of 0.1 - 0.3 μGy/h) and need not be subjected to any regulatory control and can be used for backfilling the mined out sites.

Separation of individual minerals namely ilmenite, rutile, leucoxene, garnet, zircon and sillimanite leads to generation of monazite enriched tailings, upto 5 % and in extreme cases it may go up to 70 %. The disposal of such tailings, having radiation level upto 150 μGy/h, on the land or in sea has radiological implications. Disposal of these tailings on land will create radiation 'hot-spots' that will lead to higher public exposure. The area along with radioactive tailings may be abandoned by the operators after the lease period. It is difficult to have effective post control/ surveillance over such waste disposal. The practice of sea disposal of these tailings results in ultimate re-concentration of monazite and re-deposition of the same on the beaches. In this way the natural background radiation level on the beach may get enhanced over a period of time resulting in increased population exposure.

The tail water released after mining , pre-concentration and separation of minerals does not carry any enhanced radioactivity levels and hence may be pumped /drained to the settling ponds and re-circulated and/or disposed to water bodies (canal, sea) after settling. The airborne releases from mining and mineral separation are insignificant.

6.1.1.1 Disposal of Monazite Enriched Tailings

The radiological criteria for disposal of the tailings should be mainly governed by the external radiation field which is contributed by the monazite present in the tailings. The criteria for tailings disposal in an area should be on the basis of minimum external radiation field as measured during pre operational monitoring. For example, if the radiation fields in the mining areas range from 1 to 3 μGy/h on pre operational monitoring the post operational limit should be fixed at 1 μGy/h. In this manner it is ensured that the practice does not result in additional exposure to members of public at the Naturally High Background Radiation Areas (NHBRA). The different methods for disposal of monazite enriched tailings are as follows:

(i) Recycling

As much as possible the tailings should be recycled in the process along with fresh feed with a view to reduce the total quantity generated to the minimum.

(ii) Disposal in Trenches

Disposal of the tailings in earthen trenches (earthen pits or brick lined pits) located within the plant premises and topping with silica rich sand should be adopted by facilities when the monazite content in the tailings is high (more than 5 %) and the quantity of tailings generated is comparatively less as encountered in Type II and Type IV facilities. Trenches should be periodically topped with silica tailings to reduce the radiation fields to natural levels encountered in the area.

The trenches should not be filled up to the surface with monazite enriched tailings. Sufficient free board space (preferably one metre) should be left in the trenches for topping with silica rich tailings so as to prevent the topping from getting eroded by wind action and exposing the monazite enriched tailings. The surface of the trenches after filling should be leveled with the surface topography and the boundary of the pits should be demarcated with proper identification.

The design of the earthen trenches should take into consideration the prevailing water table in the area. The monazite enriched tailings should be transported by mechanized means such as pumping, conveyors, and covered trucks and dump trucks/bins to the disposal site.

These trenches should be under the institutional control of the facilities. Institutional control consists of those actions, mechanisms, and arrangements implemented to maintain control of a waste management site after closure, as required by the AERB. This control should be active (for example, monitoring, surveillance, remedial work) or/and passive (for example, land use control).

(iii) Disposal by Mixing with Inactive Silica Tailings and Backfilling

The option is advisable for Type I BSM facilities where the quantity of tailings generated is large and the monazite content in the tailings is relatively low (less than 5%). The monazite enriched tailings should be homogenously mixed with silica tailings and then used for backfilling the mined out areas so that radiation level in the backfilled area is close to background. Since the concentration of monazite varies from place to place, the exact specification for dilution has to be given on a case-by-case basis based on the lower range of the observed monazite concentration in raw sand.

(iv) Sale to Other Facilities/Returning Back to Suppliers

The monazite enriched tailings containing other minerals may also be sold to other facilities having valid AERB licence under the Atomic Energy (Radiation Protection) Rules, 2004 for further recovery of other associated mineral values or may be returned back to the supplier (from whom raw material was procured).

6.2 Processing of Columbite - Tantalite Ore

The radioactivity content in the liquid and gaseous effluents released during processing of columbite tantalite is generally insignificant. Depending on the uranium/thorium content in the slag, it should either be handed over to facilities for further recovery of uranium/thorium values as per the direction of Department of Atomic Energy or stored in secured near surface disposal facilities as per the guidelines of regulatory body.

6.3 Processing of Rock Phosphate and Use of Phosphogypsum

The radioactivity content in the liquid and gaseous effluents released during processing of rockphosphate is generally insignificant. Phosphogypsum should be stored in engineered storage ponds as per the regulatory guidelines.

6.4 Waste Management Records

6.4.1 Processing of Beach Sand Minerals

Records should be maintained of the amount of monazite enriched tailings generated, monazite content (%) in the tailings, amount of silica tailings mixed with monazite enriched tailings, final content of the monazite in the tailings after mixing, location of disposal site/backfilled area and radiation level in the backfilled area/over the trenches. Any other records related to measurement of radioactivity in gaseous/liquid streams as directed by AERB should also be maintained.

6.4.2 Processing of Columbite - Tantalite Ore

Records of quantity of slag along with uranium, thorium and radium content in the slag should be maintained. Any other records related to measurement of radioactivity in gaseous/liquid streams as directed by AERB should also be maintained.

6.4.3 Processing of Rock Phosphate and Use of Phosphogypsum

Analysis report of every consignment of rock phosphate processed and the resultant phosphogypsum produced w.r.t U-238 and Ra-226 content along with amount of phosphogypsum stored /sold for commercial applications should be maintained. Any other records related to measurement of radioactivity in gaseous/liquid streams as directed by AERB should also be maintained.

7. TRANSPORTATION OF NORMS

Transport regulations do not apply to natural materials and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides provided the activity concentration of the material does not exceed 10 times the values specified in the regulations ie 10 Bq/g.

7.1 Monazite Enriched Tailings

Monazite enriched tailings should be transported in such a manner that under routine conditions of transport there is no escape of the radioactive contents from the conveyance nor there is any loss of shielding. However, when the monazite content in the tailings is more than 10 Bq/g (approximately 25%) necessary approval from AERB should be obtained.

7.2 Uranium and Thorium Bearing Slag

Uranium and thorium bearing slag generated during the processing of columbite-tantalite ore should be transported as industrial package with prior approval from AERB. The main purpose of these packages is to carry bulk quantity of radioactive material for economical transport.

7.3 Rock Phosphate and Phosphogypsum

As the activity of rock phosphate and phosphogypsum is less than 10 Bq/g, transportation of these materials do not warrant any regulation from AERB.

8. GRADED APPROACH TO REGULATION OF NORMS

The graded approach applies to all sources of radiation subject to regulation. However, it is particularly relevant to operations involving exposure to natural sources, because the exposures are generally (but not always) moderate with little or no likelihood of approaching or exceeding the dose limit (Appendix A), little or no likelihood of extreme radiological consequences from accidents and because occupational health and safety measures already in place to control other (non-radiological) hazards in the workplace may well provide some protection against radiological hazards as well.

The values of activity concentration for radionuclides of natural origin, derived using the exclusion concept and based on AERB Safety Directive No. 01/2010 on "Exclusion, Exemption and Clearance of Radionuclides in Solid Materials", are given in Table 4.

TABLE 4 : VALUES OF ACTIVITY CONCENTRATION FOR RADIONUCLIDES OF NATURAL ORIGIN

Radionuclide	Activity concentration (Bq/g)
K-40	10
All other radionuclides of natural origin	1

8.1 Regulatory Requirements for Different Types of Facilities

All BSM processing facilities are required to apply for licence under Rule 3 of the Atomic Energy (Radiation Protection) Rules, 2004 as per the gazette notification S.O. 1210 dated April 24, 2009 given in Appendix B.

(i) Approval: Where the regulatory body has determined that exemption is not the optimum option, the minimum requirement is to formally obtain an *approval* from the regulatory body for the intention to carry out the practice. Though the annual effective dose is a small fraction of the applicable dose limit, it provides the added reassurance that the regulatory body remains informed of all such practices. (Eg. rock phosphate by fertilizer plants). Such facilities need not have a Radiological Safety Officer and periodical radiological monitoring is also not mandatory. Periodic regulatory inspection of such facilities by regulatory body is not required. However, if desired, regulatory body may carry out special inspection of these facilities. The application format for approval/renewal of approval is given in Annexure I. Use of Phosphogypsum in Building Materials and Agriculture shall be as per the guidelines specified in the safety directive given in Appendix C.

(ii) Registration: Where the level of exposure to NORM is such that neither exemption nor the minimum regulatory requirement of approval is the optimum regulatory option, the facility operator has to meet additional (but limited) obligations to ensure that exposed individuals are adequately protected. These obligations would typically involve measures to keep exposures under review and to ensure that the working conditions are such that exposures remain moderate, with little likelihood of doses approaching or exceeding the dose limit. The mechanism for imposing such obligations on the applicant is the granting of consent in the form of a *registration*. Based on this approach, facilities processing Columbite Tantalite, Type I and III BSM facilities should obtain registration. Availability of Radiological Safety Officer is mandatory with periodical radiological monitoring of the facility and regulatory inspections by regulatory body will be carried out once in five years. The application format for registration/renewal of registration is given in Annexure II.

(iii) Licence: Where an acceptable level of protection can only be ensured through the enforcement of more stringent exposure control measures, consent in the form of a licence may be required. Type II and IV facilities processing beach sand minerals should be issued *licences*. Availability of Radiological Safety Officer is mandatory with periodical radiological monitoring of the facility and regulatory inspections by regulatory body will normally be carried out once in a year. The application format for licence/renewal of licence is given in Annexure III.

(iv) Exemption: However, based on graded approach, the following facilities are *exempted* from regulation:

- (a) Chemical processing of ilmenite and zircon.
- (b) Value addition of separated beach sand minerals other than monazite.
- (c) Facilities engaged only in mining of beach sand minerals and no further processing.
- (d) Trading of separated beach sand minerals other than monazite.

Along with the application form for obtaining registration/licence, radiation protection procedures and application for approval of radiological safety officer should be submitted, the formats for which are given in Annexure IV & V respectively.

8.2 Submission of Reports to Regulatory Body

Beach sand minerals and columbite tantalite ore processing facilities should submit quarterly and annual health physics reports covering the monitoring results of workers, workplace, waste and environment as per the format given in the Annexure VI and Annexure VII respectively. In addition, any radiological safety related significant event should be intimated to AERB within 24 hrs of the occurrence of the event.

Rock phosphate processing facilities should submit quarterly analysis report giving the activity concentration of U-238 and Ra-226 in every consignment of rockphosphate imported and the resultant phosphogypsum generated as per the format given in the Annexure VIII.

APPENDIX - A

DOSE LIMITS FOR EXPOSURES FROM IONISING RADIATION FOR WORKERS AND THE MEMBERS OF THE PUBLIC

In exercise of Rule 15 of the Atomic Energy (Radiation Protection) Rules, 2004, the Chairman, Atomic Energy Regulatory Board, being the Competent Authority under the said rules, hereby issues an order prescribing the dose limits for exposures from ionising radiations for workers and the members of the public, which shall be adhered to.

Dose Limits

General

(i) The limits on effective dose apply to the sum of effective doses from external as well as internal sources. The limits exclude the exposures due to natural background radiation and medical exposures.

(ii) Calendar year shall be used for all prescribed dose limits.

A1. Occupational Dose Limits

A1.1 Occupational Workers

The occupational exposures of any worker shall be so controlled that the following limits are not exceeded:

(a) an effective dose of 20 mSv/year averaged over five consecutive years (calculated on a sliding scale of five years);

(b) an effective dose of 30 mSv in any year;

(c) an equivalent dose to the lens of the eye of 150 mSv in a year;

(d) an equivalent dose to the extremities (hands and feet) of 500 mSv in a year and

(e) an equivalent dose to the skin of 500 mSv in a year;

(f) limits given above apply to female workers also. However, once pregnancy is declared the equivalent dose limit to embryo/fetus shall be 1 mSv for the remainder of the pregnancy.

A1.2 Apprentices and Trainees

The occupational exposure of apprentices and trainees between 16 and 18 years of age shall be so controlled that the following limits are not exceeded:

(a) An effective dose of 6 mSv in a year

(b) An equivalent dose to the lens of the eye of 50 mSv in a year

(c) An equivalent dose to the extremities (hands and feet) of 150 mSv in a year

(d) An equivalent dose to the skin of 150 mSv in a year.

A2. Dose Limits for Members of the Public

The estimated average doses to the relevant members of the public shall not exceed the following limits:

(a) An effective dose of 1 mSv in a year

(b) An equivalent dose to the lens of the eye of 15 mSv in a year

(c) An equivalent dose to the skin of 50 mSv in a year.

APPENDIX - B

GAZETTE NOTIFICATION FOR LICENSING REQUIREMENT OF BSM FACILITIES

EXTRACT FROM THE GAZETTE OF INDIA : PART II, SEC. 3, SUB-SEC. (ii)

Appearing on Page No. 2315

Dated 9-5-2009

परमाणु ऊर्जा नियाम परिषद

ATOMIC ENERGY REGULATORY BOARD

अधिसूचना

नई दिल्ली, 24 अप्रैल, 2009

का. आ. 1210.- परमाणु ऊर्जा (विकिरण संरक्षण) नियम, 2004 के नियम 3(3) (X) तथा परमाणु ऊर्जा विभाग अधिसूचना (भारत सरकार के दिनांक 12-10-2006 के राजपत्र में प्रकाशित का. आ. सं. 4072) के अनुसार प्रदत्त शक्तियों का प्रयोग करते हुए यह अधिसूचित किया जाता है कि बीच सैन्ड मिनरल्स (BSM) प्रोसेसिंग फैसिलिटिज, जो इल्मेनाईट, रूटाईल, ल्यूकोजीन, ज़कान, सिलिमेनाईट, गार्नेट तथा मोनाजाईट के उत्पादन हेतु खनन एवं खनिजों का पृथक्करण करती है तथा इन बीच सैन्ड खनिजों का भौतिकीय अथवा रासायनिक प्रक्रिया संसाधन करती हैं, उन्हें परमाणु ऊर्जा (विकिरण संरक्षण) नियम, 2004 के नियम 3 के तहत अनुज्ञप्ति प्राप्त करने के लिए आवेदन प्रस्तुत करना आवश्यक है ।

[संदर्भ: एईए/16(1)/2008-ईआर/1120]
सुरेन्द्र कुमार शर्मा, अध्यक्ष
परमाणु ऊर्जा नियामक परिषद्, सक्षम प्राधिकारी

NOTIFICATION

New Delhi, the 24th April, 2009

S.O. 1210.- In exercise of the powers conferred by Rule 3 (3) (x) of the Atomic Energy (Radiation Protection) Rules, 2004 and the Department of Atomic Energy Notification (S. O. No. 4072 published in the Gazette of India dated 12-10-2006), it is hereby notified that Beach Sand Minerals (BSM) processing facilities carrying out mining and mineral separation for production of ilmenite, rutile, leucoxene, zircon, sillimanite, garnet & monazite and physical or chemical processing of these BSM are required to apply for licence under Rule 3 of the Atomic Energy (Radiation Protection) Rules, 2004.

[Ref. AEA/16(1)/2008-ER/1120]
S.K. SHARMA, Chairman
Atomic Energy Regulatory Board
Competent Authority

APPENDIX - C

USE OF PHOSPHOGYPSUM IN BUILDING AND CONSTRUCTION MATERIALS AND IN AGRICULTURE

Rockphosphates imported in India by the fertilizer plants for production of phosphoric acid contain small concentrations of radioactive nuclides, viz., Uranium-238 and Radium-226. Phosphogypsum produced as byproduct during wet processing of these rockphosphates contains activity concentration of U-238 typically in the range 0.1-0.2 Bq/g and Ra-226 typically in the range 0.5-1.3 Bq/g.

The subject of processing of imported rockphosphates and the use of phosphogypsum so produced in commercial applications like Building and Construction Materials and in Agriculture has been examined in the Atomic Energy Regulatory Board (AERB) from the radiological safety considerations and the following directives are issued.

(i) Analysis of RockPhosphate and Phosphogypsum: All rockphosphate processing industries shall carry out analysis to determine U-238 and Ra-226 content in each imported consignment of rockphosphate as well as in the phosphogypsum produced from its processing and shall report the results to AERB on quarterly basis. This data will be reviewed in AERB for a period of about two years for deciding on the frequency of such analysis in future.

(ii) Sale of Phosphogypsum by Fertilizer Plants: AERB approval is not required for selling phosphogypsum for its use in building and construction materials provided the activity concentration of Ra-226 in it is less than or equal to 1 Bq/g. [If Ra-226 concentration in phosphogypsum is more than 1Bq/g, it is to be mixed with other ingredients such that the Ra-226 activity concentration in bulk material is less than or equal to 1.0 Bq/g.]

(iii) Manufacturing and Use of Phosphogypsum Panels and Blocks: AERB approval is not required for manufacturing and use of phosphogypsum panels or blocks provided they have Ra-226 activity less than 40 kBq/square metre area of any surface of the panels/blocks.

(iv) Use in Agriculture: There is no restriction for use of phosphogypsum in agricultural applications from the radiological safety considerations.

ANNEXURE - I

Form ID: AERB/IPSD/ RP/APP

Government of India
Atomic Energy Regulatory Board

Niyamak Bhavan,
Anushaktinagar,
Mumbai - 400 094

APPLICATION FOR APPROVAL/RENEWAL OF APPROVAL FOR OPERATION OF FACILITIES PROCESSING ROCK PHOSPHATE

(a) *This application would be considered by the competent authority for issuance of licence, under the Atomic Energy (Radiation Protection) Rules, 2004. (AERPR-2004)*

(b) *The duly filled-in form should be sent to Head/Director, Industrial Plants Safety Division, (IPSD) AERB, Niyamak Bhavan, Anushaktinagar, Mumbai-400094 with the necessary documents.*

(c) *Incomplete applications and those without all relevant documents are liable to be rejected.*

(d) *All the forms pertaining to BSM facilities can be downloaded from the website www.aerb.gov.in*

(e) *Attach extra sheets wherever required*

PART A

GENERAL PARTICULARS

A.1 Name and address (with PIN Code) of the facility:
Telephone No. (LandLine)
Fax No.
Email

A.2 Name and designation of the applicant#:
Telephone No. (LandLine)
Fax No.
Email
Mobile No.

A.3 Name of the Head of the Facility$:
Telephone No. (LandLine)
Fax No.
Email
Mobile No.

A.4 Application for

	Ref. No	Date	Validity of existing approval
New Approval/renewal (strike out whichever are not applicable)			

\# *Applicant is the person in whose name the consent may be issued, under AERPR-2004, and who would have the responsibilities of "licencee" prescribed in AERPR-2004 and should be a full time employee of the institution.*

$ *The head of the institution is the person who would have the responsibilities of "employer" prescribed in AERPR-2004.*

PART B

PARTICULARS OF THE FACILITY

B.1 Facility Details:

(Facilities yet to start operation are required to provide the estimated figures & facilities already in operation are required to provide actual figures)

Source Location and Country from where Rock Phosphate is Imported	Quantity of Rock Phosphate to be Imported in a year	Analysis Result of Rock Phosphate Imported		Quantity of Corresponding Phosphogypsum Produced in a year from Processing of Rock Phosphate	Analysed/Anticipated Result of Corresponding Phosphogypsum Produced from Processing of Rock Phosphate	
		U-238 (Bq/g)	Ra-226 (Bq/g)		U-238 (Bq/g)	Ra-226 (Bq/g)

B.2 End use Details of the Phosphogypsum

1. End Use of Phosphogypsum (by the fertilizer plants):
   End Use: ______________________________

2. If Phosphogypsum is sold, please provide *(attach separate sheet if necessary)*
   (i) the complete address, telephone no. fax, email of the buyers
   (ii) quantity of phosphogypsum sold in a year
   (iii) its end use by the buyers

3. For phosphogypsum panels/blocks manufacturers

   (i) Indicate the surface density of the panels: _________ kg/sq.metre

   (ii) Ra-226 concentration in the phosphogypsum used for manufacturing panels/blocks _______ Bq/g

4. If phosphogypsum is stored / disposed by the fertilizer plants, please indicate

   (i) The quantity stored/disposed in this quarter__________________

   (ii) Distance of nearest residence from the storage/disposal yard _______

   (iii) Distance of nearest surface water body from the storage/disposal yard (river, lake etc) ________

   (iv) If any protection measures to prevent air borne activity/seepage to groundwater have been provided (for example covering of phosphogypsum heaps with polythene sheets, lining of the storage/ disposal yard etc) __________

PART C

UNDERTAKING

I/We hereby certify that

(a) all the statements made above are correct to the best of my/our knowledge and belief;

(b) no activity shall be carried out for purposes other than those specified in this form;

(c) the operation of the facility shall not be commenced without approval from AERB;

(d) all provisions of the Atomic Energy (Radiation Protection) Rules, 2004 shall be strictly complied with;

(e) the facility shall not be transferred/sold/ rented by me/us to another without the prior permission of the competent authority;

(f) full facilities will be accorded by me/us to any authorised representatives of the competent authority to inspect this installation at any time;

(g) all recommendations made from time to time by the competent authority in respect of radiation safety measures will be duly implemented;

(h) keep AERB informed about any changes in the information furnished above.

In case, it is found, at any stage, that the information provided by me/us is false and/or not authentic, then I/we hereby accept that appropriate regulatory actions may be initiated against me/us and our institution, in accordance with the applicable Rules.

ANNEXURE - II

Form ID: AERB/IPSD/CT/REG

Government of India
Atomic Energy Regulatory Board

Niyamak Bhavan,
Anushaktinagar,
Mumbai - 400 094

APPLICATION FOR REGISTRATION/RENEWAL OF REGISTRATION FOR OPERATION OF FACILITIES PROCESSING COLUMBITE - TANTALITE ORE

(a) *This application would be considered by the competent authority for issuance of licence, under the Atomic Energy (Radiation Protection) Rules, 2004. (AERPR-2004)*

(b) *The duly filled-in form should be sent to Head/Director, Industrial Plants Safety Division, (IPSD) AERB, Niyamak Bhavan, Anushaktinagar, Mumbai-400094 with the necessary documents.*

(c) *Incomplete applications and those without all relevant documents are liable to be rejected.*

(d) *All the forms pertaining to BSM facilities can be downloaded from the website www.aerb.gov.in*

(e) *Attach extra sheets wherever required*

PART A

GENERAL PARTICULARS

A.1 Name and address (with PIN Code) of the facility:
Telephone No. (LandLine)
Fax No.
Email

A.2 Name and designation of the applicant[#]:
Telephone No. (LandLine)
Fax No.
Email
Mobile No.

A.3 Name of the Head of the Facility[$]:
Telephone No. (LandLine)
Fax No.
Email
Mobile No.

A.4 Application for

	Ref. No	Date	Validity of existing registration (not required if application is for new licence)
New Registration/Modification/ renewal (strike out whichever are not applicable)			

\# *Applicant is the person in whose name the consent may be issued, under AERPR-2004, and who would have the responsibilities of "licencee" prescribed in AERPR-2004 and should be a full time employee of the institution.*

$ *The head of the institution is the person who would have the responsibilities of "employer" prescribed in AERPR-2004.*

PART B

PARTICULARS OF THE FACILITY

B.1 Facility Details:

1.1 Operational status of the facility
(strike out whichever is not applicable): operating/ yet to start operation

1.2 Design capacity of the plant__________

1.3 Does the facility carry out/plan to carry out mining of columbite - tantalite ore ☐ Yes ☐ No

If Yes, provide the following information

(i) Mining lease (Ref. No.)________________________________

(ii) Date of grant of mining lease____________________________

(iii) Validity of the mining lease ______________________________

(iv) Location of mining area ________________________________

1.4 Details of material to be processed

(i) Raw material description (strike out whichever are not applicable)
Raw columbite - tantalite ore/ ore concentrates/metal rejects/scraps/ others (please specify) _________________

(ii) Source of the raw material (if procured/imported, give the details from where it is procured) ______________

B.2 Process Details

2.1 Details of raw materials, products and slag
(Facilities yet to start operation are required to provide the estimated figures & facilities already in operation are required to provide actual figures)

	Raw material used			Final product(s)	Uranium/ thorium bearing slag	Other solid waste
	Raw ore	Ore concentrates	metal rejects/ scraps	Niobium/ tantalum or their compounds		
Quantity/annum (tons)						
Uranium (Bq/g)						
Thorium (Bq/g)						
Radium (Bq/g)						

B.3 Radiological Safety Details:

3.1 Radiological Safety Officer (if available for the facility):

(i) Name ____________________

(ii) Reference No. of AERB approval ________________________

(iii) Validity of AERB approval ______________________________

Else, apply for approval for RSO in prescribed format along with this application.

3.2 Radiation monitoring instruments

Name of the instrument	Detector type	Quantity	Range	Accuracy	Make

3.3 Workplace monitoring: (applicable for operating facilities)

Location (all locations of the plant including storage area of ore and slag should be covered)	Radiation level (microGray/hour)

3.4 Radiation worker and dose details: (facilities yet to start operation are required to provide the estimated figures & facilities in operation are required to provide actual figures)

(i) Number of Permanent employees__________

(ii) Number of Contractor's Workers __________________________

(iii) Average Individual Dose _________________________________

(iv) Maximum Individual Dose ______________________________

B.4 Radioactive Waste Management Details:
(Facilities yet to start operation are required to provide the estimated figures & facilities in operation are required to provide actual figures)

4.1 Method of disposal of radioactive slag (tick whichever is applicable)

(i) Disposed in secured landfill ☐

(ii) Sold to other facilities ☐

(iii) Others (please specify) ☐ _____________________

4.2 If radioactive slag disposed/to be disposed in landfill, provide the following information.

(i) Quantity to be disposed in a year___________________________

(ii) Location of landfill site__________________________________

4.3 If radioactive slag disposed/to be disposed by sale, provide the following information.

(i) Copy of agreement of the facility with the buyer
(ii) Name and address of the buyer of the radioactive slag
(iii) Quantity of radioactive slag sold/to be sold per year

4.4 Disposal of liquid effluent (If discharged to the environment)

(i) Volume of liquid effluent discharged in a year_________________

(ii) Analysis of liquid effluent (gross alpha and gross beta)___________

B.5 Environmental Safety Details:

5.1 Background radiation level of the

(i) Mining area (if applicable): __________

(ii) Plant premises: ____________________

5.2 Radiation level at slag disposal area:
(facilities yet to start operation are required to provide the estimated figures & facilities already in operation are required to provide actual figures)
On top of landfill: ___________

5.3 Measures proposed to prevent spread of radioactivity by water/wind to nearby areas during normal operation and emergency conditions.

____

5.4 Distance of the nearest population centre from the plant ____________

5.5 Population of the area nearest to plant__________

B.6 Enclosures:

(1) Approved Mine Plan: if applicable.

(2) Site Plan: showing the Plant and the landfill site (if applicable): information on site condition for external events such as seismicity, flood, cyclone, tsunami etc.

(3) Process Details: Write up of the process, flow sheet indicating generation of slag, disposal method for slag, treatment of liquid effluent, material balance.

(4) Lay out: plant and equipment layout

(5) Design Details: Codes/standards used for plant and equipment design, details of instrumentation and control system, design for containment for radioactive material and ventilation system for controlling radiation exposures, design of landfill (if applicable) for disposal of slag.

(6) Quality assurance: For structures containing radioactive material

(7) Radiation Protection Procedures

(8) Application for approval of RSO (if RSO not available)

(9) Other statutory clearances of the plant.

PART C

UNDERTAKING

I/We hereby certify that

(a) all the statements made above are correct to the best of my/our knowledge and belief;

(b) no activity shall be carried out for purposes other than those specified in this form;

(c) the operation of the facility shall not be commenced without Registration from AERB;

(d) all provisions of the Atomic Energy (Radiation Protection) Rules, 2004 shall be strictly complied with;

(e) the facility shall not be transferred/sold/ rented by me/us to another without the prior permission of the competent authority;

(f) full facilities will be accorded by me/us to any authorised representatives of the competent authority to inspect this installation at any time;

(g) radiation surveillance of all persons engaged in radiation work as required by the competent authority will be duly carried out at my/ our expense;

(h) radioactive slag will be disposed off in a safe manner as per the regulations and the radioactive slag shall not be used for surfacing operations or any other purposes;

(i) transport of radioactive materials shall be in accordance with relevant safety regulations;

(j) all recommendations made from time to time by the competent authority in respect of radiation safety measures will be duly implemented;

(k) duly qualified/experienced radiological safety officer(s) will be appointed before the commencement of operation of the facility;

(l) the requirements laid down by competent authority regarding closure and reuse of the site will be strictly complied with;

(m) keep AERB informed about any changes in the information furnished above.

In case, it is found, at any stage, that the information provided by me/us is false and/ or not authentic, then I/we hereby accept that appropriate regulatory actions may be initiated against me/us and our institution, in accordance with the applicable Rules.

Place: Signature:

Date: Name of the Applicant:

Designation:

Signature:

Name of Head of the Institution:

Designation:

(Seal of the institution)

ANNEXURE - III

Form ID: AERB/IPSD/ BSM/LIC

Government of India
Atomic Energy Regulatory Board

Niyamak Bhavan,
Anushaktinagar,
Mumbai - 400 094

APPLICATION FOR LICENCE/REGISTRATION OR ITS RENEWAL FOR OPERATION OF BEACH SAND MINERALS (BSM) FACILITIES CARRYING OUT PHYSICAL MINERAL SEPARATION (OTHER THAN MONAZITE)

(a) *This application would be considered by the competent authority for issuance of licence, under the Atomic Energy (Radiation Protection) Rules, 2004. (AERPR-2004)*

(b) *The duly filled-in form should be sent to Head, Industrial Plants Safety Division, (IPSD) AERB, Niyamak Bhavan, Anushaktinagar, Mumbai-400094 with the necessary documents.*

(c) *Incomplete applications and those without all relevant documents are liable to be rejected.*

(d) *All the forms pertaining to BSM facilities can be downloaded from the website www.aerb.gov.in*

(e) *Attach extra sheets wherever required*

PART A

GENERAL PARTICULARS

A.1 Name and address (with PIN Code) of the facility:
Telephone No. (LandLine)
Fax No.
Email

A.2 Name and designation of the applicant#:
Telephone No. (LandLine)
Fax No.
Email
Mobile No.

A.3 Name of the Head of the Facility$:
Telephone No. (LandLine)
Fax No.
Email
Mobile No.

A.4 Licence Application for

	Ref. No	Date	Validity of existing licence (not required if application is for new licence)
New Licence/Licence Modification/Licence renewal (strike out whichever are not applicable)			

Applicant is the person in whose name the consent may be issued, under AERPR-2004, and who would have the responsibilities of "licencee" prescribed in AERPR-2004 and should be a full time employee of the institution.

$ *The head of the institution is the person who would have the responsibilities of "employer" prescribed in AERPR-2004.*

PART B

PARTICULARS OF THE FACILITY

B.1 Facility Details:

1.1 Operational status of the facility (strike out whichever is not applicable): operating/ yet to start operation

1.2 Does the BSM facility carry out/plan to carry out mining as well as Physical Separation of minerals ☐ Yes ☐ No
If Yes, provide the following information

(i) Mining Lease (Ref. No.)________________________________

(ii) Date of grant of mining lease_____________________________

(iii) Validity of the mining lease ______________________________

(iv) Location of mining area _________________________________

1.3 Details of Material to be processed

(i) Raw Material Description (strike out whichever are not applicable)

Raw Beach Sand/ Pre Concentration Plant output/Mineral Separation Plant rejects/Mineral Separation Plant products (processed BSM)/ Others (please specify) ____________

(ii) Source of the raw material (if procured, give the address from where it is procured) ______________

B.2 Process Details

2.1 Details of raw materials, products and tailings
(BSM facilities yet to start operation are required to provide the estimated figures & BSM facilities already in operation are required to provide actual figures)

	Raw material used			Final product(s)							Tailings generated	
	Mined out sand	Pre Con plant output	Pro-cured raw mate-rial	Ilme-nite Rutile	Leuco-xene	zircon	garnet	silli-ma nite	mona zite	Mined out sand	Silica rich tailings	Monazite enriched tailings
Quantity/ annum (tons)												
Monazite (%)												

B.3 Radiological Safety Details:

3.1 Radiological Safety Officer (applicable for operating BSM facilities):

(i) Name ____________________

(ii) Educational qualifications______________________________

(iii) Type of training (including place and duration) _____________

(iv) Experience in BSM facility _____________________________

(v) Reference No. of AERB approval _______________________

(vi) Validity of AERB approval _____________________________

3.2 Radiation monitoring instruments available (applicable for operating BSM facilities):

Name of the instrument	Detector type	Quantity	Range	Accuracy	Make

3.3 Workplace monitoring: (applicable for operating BSM facilities)

Location	Radiation level (microGray/hour)
Pre-Concentration Plant (if applicable) Mineral Separation Plant (give break up location wise)	

3.4 Radiation worker and Dose details: (BSM facilities yet to start operation are required to provide the estimated figures & BSM facilities in operation are required to provide actual figures)

(i) Number of Permanent employees_______________

(ii) Number of Contractor's Workers _______________

(iii) Average Individual Dose _____________________

(iv) Maximum Individual Dose ___________________

B.4 Radioactive Waste Management Details:
(BSM facilities yet to start operation are required to provide the estimated figures & BSM facilities in operation are required to provide actual figures)

4.1 Method of disposal of monazite enriched tailings (tick whichever is applicable)

(i) disposed by backfilling of mined out sites: ☐

(ii) disposed in trenches ☐

(iii) sold to other BSM facilities ☐

(iv) Others (please specify) ☐ _______________

4.1.1 If monazite enriched tailings is disposed/to be disposed by backfilling of mined out sites, provide the following information.

(i) Quantity of monazite enriched tailings mixed with silica rich sand in a year to reduce the radiation level to background _______________

(ii) Quantity of silica rich sand mixed with monazite enriched tailings in a year________________

(iii) Monazite (%) after mixing_______________________________

(iv) Location of backfilled sites ______________________________

4.1.2 If monazite enriched tailings disposed/to be disposed in trenches, provide the following information.

(i) Quantity of monazite enriched tailings disposed in a year__________

(ii) Location of backfilled sites________________________

(iii) Material used for topping of trenches to reduce the radiation level
____

(iv) Thickness of topping of trenches _________________

(v) Location of trenches ____________________________

4.1.3 If monazite enriched tailings disposed/to be disposed by sale, provide the following information.

(i) Quantity of monazite enriched tailings sold/to be sold per year

(ii) Name and address of the buyer of the tailings

(iii) Does the buyer have a valid AERB licence____________________

If Yes, provide the licence number and validity ________________________

B.5 Environmental Safety Details:

5.1 Background radiation level of the

(i) Mining area (if applicable):___________

(ii) Plant premises: ____________________

5.2 Radiation level at monazite enriched tailings disposal area:
(BSM facilities yet to start operation are required to provide the estimated figures & BSM facilities already in operation are required to provide actual figures)

(i) At backfilled site after mixing with silica rich sand:_____________

(ii) On top of trenches after topping: ____________

5.3 Measures proposed to prevent spread of radioactivity by water/wind to nearby areas during normal operations and emergency conditions.

____

5.4 Distance of the nearest population centre from the tailings disposal site ______________

5.5 Population of the area nearest to tailings disposal site___________________

B.6 Enclosures:

(1) Approved Mine Plan: showing the mining area and tailings disposal site (backfilled areas/trenches) if applicable.

(2) Site Plan: showing Mineral Separation Plant and the tailings disposal site (trenches): information on site condition for external events such as seismicity, flood, cyclone, tsunami etc.

(3) Process Details: Write up of the process including, mining, preconcentration and mineral separation, disposal method for tailings, block diagrams with details of generation of tailings with their monazite content (%) at each stage and material balance.

(4) Lay out: plant and equipment layout

(5) Design Details: Codes/standards used for plant and equipment design, details of instrumentation and control system, design for containment for radioactive materiel and ventilation system for controlling radiation exposures, design of trenches (if applicable) for disposal of monazite enriched tailings.

(6) Quality assurance: For structures conveying/containing radioactive material

(7) Radiation Protection Procedures

(8) Application for approval of RSO (if RSO not available)

(9) Other statutory clearances of the plant.

PART C

UNDERTAKING

I/We hereby certify that

(a) all the statements made above are correct to the best of my/our knowledge and belief;

(b) no activity shall be carried out for purposes other than those specified in this form;

(c) the operation of the facility shall not be commenced without Licence from AERB;

(d) all provisions of the Atomic Energy (Radiation Protection) Rules, 2004 shall be strictly complied with;

(e) the facility shall not be transferred/sold/rented by me/us to another without the prior permission of the competent authority;

(f) full facilities will be accorded by me/us to any authorised representatives of the competent authority to inspect this installation at any time;

(g) radiation surveillance and medical surveillance of all persons engaged in radiation work as required by the competent authority will be duly carried out at my/our expense;

(h) radioactive tailings will be disposed off in a safe manner as per the regulations and the radioactive tailings shall not be used for surfacing operations or any other purposes;

(i) transport of radioactive materials shall be in accordance with relevant safety regulations;

(j) all recommendations made from time to time by the competent authority in respect of radiation safety measures will be duly implemented;

(k) duly qualified/experienced radiological safety officer(s) will be appointed before the commencement of operation of the facility;

(l) the requirements laid down by competent authority regarding decommissioning and reuse of the site of the decommissioned facility will be strictly complied with;

(m) keep AERB informed about any changes in the information furnished above.

In case, it is found, at any stage, that the information provided by me/us is false and/or not authentic, then I/we hereby accept that appropriate regulatory actions may be initiated against me/us and our institution, in accordance with the applicable Rules.

Place: Signature:

Date: Name of the Applicant:

Designation:

Signature:

Name of Head of the Institution:

Designation:

(Seal of the institution)

ANNEXURE - IV

CONTENTS FOR RADIATION PROTECTION PROCEDURES FOR BSM-NORM INDUSTRIES

1. Brief description of the plant
2. Measures to control radiation exposure
3. Work place monitoring - external radiation, airborne contamination
   - (a) The quantities to be measured
   - (b) The location and frequency
   - (c) Measurement methods
4. Individual monitoring
   - (a) External exposure
   - (b) Dose estimation methodology
   - (c) TLD issue procedure (where applicable)
5. Radioactive waste disposal
   - (a) Solid waste monitoring, disposal
6. Environmental monitoring - external radiation measurement location and frequency
7. Syllabus on radiation protection training
8. Responsibilities of Plant Management and RSO

ANNEXURE - V

APPLICATION FOR APPROVAL OF NOMINATION OF RADIOLOGICAL SAFETY OFFICER FOR BSM-NORM FACILITIES

(To be submitted to the Industrial Plants Safety Division, AERB, Niyamak Bhavan, Anushaktinagar, Mumbai 400 094)

PART - 1 : PARTICULARS OF THE INSTITUTION

1. Name and address of the institution:

2. Name, designation and address of the person-in-charge of the institution :

   Telegraphic address :

   FAX No. :

   Telex No. :

   Telephone No. (Office) :

   Telephone No. (Residence) :

   e-mail address :

PART - II : PARTICULARS OF THE RSO DESIGNATE

Please affix here a passport size photograph of the RSO designate

1. Name of the person to be designated as RSO :

2. Address of the nominee with tel.no.

   Office:

   Residence:

3. Academic qualification

Degree/Diploma	University/Board of examination	Year of passing	Subjects of study

4. (a) Experience in radiation work

Year(s) of work	Name of the institution	Type of radiation work handled	Radiation source & activity (Bq/Ci) handled, if any	Personal monitoring number, if personal monitoring service is being/ was availed

4. (b) Particulars of radiation safety training and year of passing:

5. Additional responsibilities assigned to the RSO Designate, if any:

6. (a) I hereby certify that the information furnished above is correct to the best of my knowledge and belief.

   (b) I undertake to abide by the conditions stipulated by the competent authority from time to time and follow guidelines in discharging the duties and responsibilities as Radiological Safety Officer.

   (c) I further undertake to inform the Industrial Plants Safety Division, AERB immediately, in case I am relieved of my service as RSO.

   (d) I undertake to maintain radiation safety in the institution and submit a radiation safety status report in the prescribed format quarterly and annually to IPSD, AERB every year.

   (e) I undertake to abide by the conditions stipulated in the RSO approval certificate issued by the competent authority.

Signature of RSO Designate

Place:

Date:

7. (a) I hereby certify that all the statements made in the application are correct to the best of my knowledge and belief

   (b) I hereby undertake to provide all necessary facilities to the RSO for discharge his duties and functions effectively.

   (c) I further undertake to inform IPSD, AERB immediately in case the RSO leaves this institution and or is relieved of his duties.

Signature and seal of the office
of the employer

Place:

Date:

ANNEXURE - VI

QUARTERLY/ANNUAL HEALTH PHYSICS REPORT FOR BEACH SAND MINERALS (BSM) FACILITY

Name of the facility :

Location of the facility :

Period of Reporting : _______ to _________

1.0 Dose Statistics

		No. of persons monitored	Collective dose (person-mSv)	Average individual dose (mSv) Individual	Maximum dose (mSv)
Quarter	Regular				
	Temporary				
Cumulative in the year	Regular				
	Temporary				

1.1 Individual Dose Statistics (cumulative in the year)

Dose range	Number of persons in year		
(mSv)	Regular	Temporary	Total
Less than 2			
2 - 6			
> 6 - 20			
> 20 - 30			
> 30			
TOTAL			

2.0 Monazite Enriched Tailings Details

		Raw Material Used (whichever is applicable)			Final Product(s) (whichever is applicable)						Tailings Generated	
		Mined out sand	Pre Con plant output	Procured raw material	Ilmenite	Rutile	Leucoxene	Zircon	garnet	Sillimanite	Silica rich tailings	Monazite enriched
Quarter	Quantity (tons)											
	Monazite (%)											
Cumulative in the year	Quantity (tons)											
	Monazite (%)											

2.1 Method of disposal of monazite enriched tailings (tick whichever is applicable)

(i) Disposed by backfilling of mined out sites ☐

(ii) Disposed in trenches within the plant boundary ☐

(iii) Sold to other BSM facilities ☐

3.0 Radiation Monitoring Results* (whichever is applicable)

Location	Radiation level (microGray/hour)
Mining area	
Backfilled area (with monazite enriched tailings mixed with silica rich sand)	
Pre concentration plant	
➤ General background	
➤ Raw material storage	
➤ Pre concentration plant output	
➤ Pre concentration plant tailings	
Mineral processing plant (physical mineral separation and/or chemical processing)	

Location	Radiation level (microGray/hour)
➤ General background of plant premises	
➤ Raw material storage	
➤ Inside mineral separation plant (e.g magnetic separators, high tension separators etc)	
➤ Monazite Enriched Tailings storage area	
➤ On top of trenches filled with monazite enriched tailings and topped with silica rich sand	
➤ Inside chemical processing plant having mineral separation unit (roaster, calciner, digester, effluent pipelines like iron oxide slurry pipelines etc)	

* The table is indicative in nature. If necessary, facility may include other areas also.

(Signature of Radiological Safety Officer)

(Signature of the Employer with Official Seal & Date)

Director, Industrial Plants Safety Division
Atomic Energy Regulator Board
Niyamak Bhavan-A
Anushaktinagar, Mumbai-400 094
Maharashtra

ANNEXURE - VII

QUARTERLY/ANNUAL HEALTH PHYSICS REPORT FOR COLUMBITE - TANTALITE (CT) PROCESSING FACILITY

Name of the facility :

Location of the facility :

Period of Reporting : _______ to _______

1.0 Dose Statistics

		No. of persons monitored	Collective dose (person-mSv)	Average individual dose (mSv) Individual	Maximum dose (mSv)
Quarter	Regular				
	Temporary				
Cumulative in the year	Regular				
	Temporary				

1.1 Individual Dose Statistics (cumulative in the year)

Dose range (mSv)	Number of persons in year		
	Regular	Temporary	Total
Less than 2			
2 - 6			
> 6 - 20			
> 20 - 30			
> 30			
TOTAL			

2.0 Analysis Results

Consignment of CT ore imported with date of import in a quarter	Source location and Country from where ore is imported	Quantity of CT ore imported in each consignment	Analysis result of CT ore imported in each consignment			Quantity of slag produced from processing of CT ore in each consignment	Analysis result of corresponding slag produced from processing of CT in each consignment		
			U-238 (Bq/g)	Th-232 (Bq/g)	Ra-226 (Bq/g)		U-238 (Bq/g)	Th-232 (Bq/g)	Ra-226 (Bq/g)
1									
2									
3									

2.1 Total quantity of CT ore processed in a year ________________________

2.2 Total quantity of slag produced from processing of CT ore in a year _____

3.0 Radiation Monitoring Results*

Location	Radiation level (microGray/hour)
inside plant	
plant premises	

* The table is indicative in nature. If necessary, facility may include other areas also.

4.0 End Use Details of the Uranium Bearing Slag

(i) End use of slag (by the CT processing facilities plants):

End Use: ____

Quantity used in a quarter: ___________________________

(ii) If slag is sold, please provide *(attach separate sheet if necessary)*

(a) the complete address, telephone no. fax, email of the buyers

(b) quantity of slag sold in a quarter

(c) its end use by the buyers

(iii) If slag is stored/disposed by the CT processing facility, please indicate

(a) The quantity stored/disposed in this quarter____________

(b) Distance of nearest residence from the storage/disposal yard _______

(c) Distance of nearest surface water body from the storage/ disposal yard______

(d) If any protection measures to prevent air borne activity/ seepage to groundwater has been provided (for example covering of slag with polythene sheets, lining of the storage/ disposal yard etc) __________

Date: _______________ _______________________

Signature of Head of the Unit
with Official Seal

(Signature of Radiological Safety Officer)

(Signature of the Employer with Official Seal & Date)

Director, Industrial Plants Safety Division
Atomic Energy Regulator Board
Niyamak Bhavan-A
Anushaktinagar, Mumbai-400 094
Maharashtra

ANNEXURE - VIII

QUARTERLY ANALYSIS REPORT FOR ROCKPHOSPHATE PROCESSING FACILITIES

Name of the plant : ____________________________________

Address : ____________________________________

____

____

Telephone and Fax : ____________________________________

Email : ____________________________________

Quarter : _________ (Jan-March/April - Jun/Jul - Sep/Oct -Dec)

Year : _________

Consign-ment of rock phosphate imported with date of import	Source location and Country from where rock phosphate is imported	Quantity of rock phosphate imported in each consign-ment	Analysis Result of rock phosphate imported in each consignment		Quantity of correspon-ding phos-phogypsum produced from proce-ssing of rockphos-phate in each consignment	Analysis Result of corresponding phosphogypsum produced from processing of rock phosphate in each consignment		
			U-238 (Bq/g)	Ra-226 (Bq/g)		U-238 (Bq/g)	Th-232 (Bq/g)	Ra-226 (Bq/g)
1								
2								
3								

If any phosphogypsum sample has Ra-226 greater than 1 Bq/g, indicate the quantity of other ingredients and the phosphogypsum mixed together to bring down the Ra-226 content in the bulk material to 1Bq/g ________________

End Use Details of the Phosphogypsum

1. End use of phosphogypsum (by the fertilizer plants):

   End use: ____

   Quantity used in a quarter: ____________________________

2. If Phosphogypsum is sold, please provide *(attach separate sheet if necessary)*

   (i) The complete address, telephone no. fax, email of the buyers

   (ii) Quantity of phosphogypsum sold in a quarter

   (iii) Its end use by the buyers

3. For phosphogypsum panels/blocks manufacturers

   (i) Indicate the surface density of the panels: ____________ kg/sq.metre

   (ii) Ra-226 concentration in the phosphogypsum used for manufacturing panels/blocks _______ Bq/g

4. If phosphogypsum is stored/disposed by the fertilizer plants, please indicate

   (i) The quantity stored/disposed in this quarter__________________

   (ii) Distance of nearest residence from the storage/disposal yard _______

   (iii) Distance of nearest surface water body from the storage/disposal yard (river, lake etc) ________

   (iv) If any protection measures to prevent air borne activity/seepage to groundwater has been provided (for example covering of phosphogypsum heaps with polythene sheets, lining of the storage/ disposal yard etc) __________

Date:___________

____

Signature of Head of the Unit
with Official Seal

BIBLIOGRAPHY

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ADVISORY COMMITTEE ON SAFETY DOCUMENTS RELATED TO FUEL CYCLE FACILITIES OTHER THAN NUCLEAR REACTORS (ACSD-FCF)

Dates of meeting	:	March 29, 2012 October 1, 2012

Members and Invitees of the Committee:

Members:

Shri S. Vasant Kumar (Chairman)	:	AERB (Former)
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LIST OF REGULATORY DOCUMENTS FOR FRONT END FUEL CYCLE FACILITES

Reference No.	Title	Year of Publication
AERB/NF/SG/IS-6	Safety in Thorium Mining and Milling	2006
AERB/FE-FCF/ SG-2	Radiological Safety in Uranium Mining and Milling	2007
AERB/FE-FCF/ SG-3	Uranium Oxide Fuel Fabrication Facilities	2009
AERB/FE-FCF/ SG-4	Safety Guidelines on Siting, Design, Construction, Commissioning, Operation, Closure and Monitoring of Tailings Management Facilities for Uranium Ore Processing	2013
AERB/FE-FCF/ SG-5	Radiological Safety in Handling Beach Sand Minerals and Other Naturally Occurring Radioactive Materials	2013
AERB/FE&BE-FCF/SG-1	Renewal of Licence for Operation of Nuclear Fuel Cycle Facilities other than Nuclear Power Plants and Research Reactors	2010
AERB/NF/SS/FPS (Rev.1)	Fire Protection Systems for Nuclear Facilities	2010
AERB/NRF/SG/ IS-1 (Rev.1)	Control of Works	2011
AERB/SG/IS-2	Preparation of Safety Report of Industrial Plants other than Nuclear Power Plants in the Department of Atomic Energy	2001
AERB/SG/IS-3	Personal Protective Equipment	2004
AERB/SG/IS-4	Guidelines for Pre-employment Medical Examination and Fitness for Special Assignments	2005
AERB/SG/EP-3	Preparation of Site Emergency Preparedness Plans for Non-Nuclear Installations	2000

LIST OF REGULATORY DOCUMENTS FOR FRONT END FUEL CYCLE FACILITES (CONTD.)

Reference No.	Title	Year of Publication
AERB/SG/EP-4	Preparation of Off-site Emergency Preparedness Plans for Non-Nuclear Installations	2000
AERB/NF/SG/G-2	Consenting process for Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors	2006
AERB/NF/SG/ RW-5	Management of Radioactive Waste from Mining and Milling of Uranium and Thorium	2007
AERB/SM/IS-1	Safety Manual on Data Base Management for Accidents/Diseases Happening due to Occupation and Implementation of the same in the Department of Atomic Energy	1991
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