This is not an application form.

All applications have to be filled through e-LORA only.

FINAL SAFETY ANALYSIS REPORT

B. TECHNICAL DESCRIPTION OF THE GAMMA RADIATION PROCESSING FACILITY (GRAPF)

1. Brief Description of the Facility

2. Design details : (design principles, defence in depth concept, redundancy. independence and diversity in the design, built-in-safety features provided in the design, statement declaring compliance with the AERB Safety Standard titled 'Land-Based Stationary Gamma Irradiators' [AERB/RF-IRRAD/SS-6 (Rev.1); 2007].

3. Site of installation of GRAPF: Geotechnical and geological information, field investigations, water table, weather, soil profile, laboratory investigations, allowable bearing pressure / safe bearing capacity, chemical analyses of water and soil

   Site lay out, Documentary evidence of the ownership of the site, regulatory Consent issued by AERB for site approval

   - Structural details – type and depth of foundation, seismic requirements and precautions against flooding
   - Buildings and residential complexes, occupancy, etc. within 50 m radius of the source location; give layout and height of the adjacent tallest building in the vicinity of 100 m)
   - Access roads to the facility: road strength and width to carry transport flasks (culvert/ bridge, if any, on the way - specify)
   - Any additional information

   Biological shield

   - Sketch giving details of shielding wall surrounding the source, wall thickness, labyrinth access, openings, voids, reinforcements, embedment etc. in the biological shield
   - Shield material, density, quality assurance during construction

- Maximum & minimum shield thickness, roof thickness

- Dose rate profiles anticipated at various locations: (Maximum & minimum values). Indicate them on a sketch of the facility - control room, roof, access doors, openings and where personnel are expected to be stationed for work or otherwise.

- Maximum dose rate anticipated

Locations : (Indicate also in a sketch)

4. Safety Systems / Interlocks

4.1 Water Pool

- Detailed sketch or drawing of water pool for source storage showing dimensions, water proofing, lining details, penetrations, piping, fittings, embedment, locations of level measuring devices, inlet-outlet water piping,

- Water control dimensions, volume, maximum, minimum water levels, normal level and abnormal levels.

- Overhead water storage tank details, provision of emergency water discharge into pool, provision of overflow/ drainage of water from the pool to any municipal sewerage lines.

- Municipal water supply quality - TSD, TSS, hardness and conductivity

- Rate of water supply in emergency

- Quantity of water maintained in pool, conductivity maximum/ minimum, method of assuring water quality

- Method of assuring water levels

- Leakage from pool - prevention and assessment

- Normal evaporation water losses from pool (with and without ventilation) related to humidity and temperature

- System to prevent water flooding in the cell

- Method of cleaning water pool

- Pool grill cover strength - prevention of accidental fall into the pool - during normal times, during source loading operations

- Pool bottom surface plan - loading conditions, anchoring of source rack, provision for transport container, intermediate source storage, if any.

- Corrosion - intermetallic / galvanic, specification of metals coming in contact with pool water prevention thereof.

- Maximum water height above source rack during normal operation and expected radiation profiles on the pool surface, both at normal and abnormal water levels.

- Underwater lights, location, voltage, use, prevention of shocks and electrocution.

- Prevention of syphoning action in pool

- Prevention of accidental entry into the cell when the water level in the pool is low and when the source is exposed or in storage position.

- DM water plant capacity and type (anion, cation, mixed bed etc.)

4.2. Source Drive System

- Details of mechanical arrangement (include drawing) source raise/ lower loop. Anchoring and supports of source rack, source locking in the rack, prevention of accidental fall of sources.

- Maximum/ minimum hydraulic pressure, cylinder type and their specifications

- Gravity/ accidental fall of rack into the pool

- Source getting stuck in the exposed position - possibilities of remedial action

- Tension adjustment (and monitoring) in the ropes

- Source movement control - limits/ overshoot

- Protection to source rack from product/ carrier/ conveyor interference

- Accidental fall of carrier, product, product box into the pool - protection thereof

- Material of construction of - source rack, wires, fittings, etc.

4.3 Source Raise Conditions

- Information should include - protection against human access to the cell when the source is in raised position, mechanical, electrical, hydraulic, radiation interlocks, trespass control through product entry door.

- Interference to interlocks and source safety & protection against exposure to radiation

- Power failure and protection against accidental entry

- Cautions, display, alarm against entry into the cell

Source operation disable situation:

Describe point by point conditions under which the source cannot be raised from safe storage position. Emergency termination of source raise operations

Automatic source lowering situations:

Describe point by point situations under which the exposed source will move to storage position. Methods to achieve fail safe situation and monitoring thereof

Preconditions to raise source:

List the preconditions to be satisfied before the source can raised

4.4 Ventilation System

- Volume of cell including & excluding labyrinth, ventilation rate provided, anticipated minimum air changes in the cell

- Location and routing of ventilated ducts, fans, duct size, etc. (give sketch)

- Methods of monitoring ventilation and action on ventilation failure

- Location of ventilation exhaust and the height above the cell roof. Prevention of water flooding through ventilation ducts from roof (sketch)

- Ozone concentration (maximum) anticipated in the cell with ventilation on and off. Time duration in minutes for safe concentration of ozone in the cell (0.1ppm) after the exhaust is switched off.

- Prevention of entry to the cell when unsafe limit of ozone concentration exists

- Details of interlocks to retract the source to safe storage position in case of ventilation failure

- Provision for standby ventilation exhaust fans, if any

- Electric power failure rate. The number of days the source is likely to remain in the pool without exhaust and ventilation.

4.5 Fire Detection System

- Detection methods of excessive temperature rise, smoke, fire, and interlock if any with the source movement. Type of detectors used and their sensitivity, location of detectors.

- Validity certification for detectors

- Direction escape route for fire - fire fighting system, fire hydrants, extinguishers, dry risers, etc.

4.6 Control System General

- Give control system description in brief

- Voltage and currents employed, emergency power standby power, battery backup if any,

- Control logic and flow of command

- Interlock systems for fail-safe operation

4.7 Audio-visual Alarms/ Anunciators

- Describe the list of audio-visual alarms provided, their location, purpose and effectiveness - against exposure to radiation, fire, smoke, toxic gases, etc.

4.8 Power Failure and Auxiliary Power

- Provisions made when power failure occurs, status of safety systems and source position indicators

4.9.1 Access Control

- Provisions made at personnel entry door & product entry door

5. Design Basis Accident Analysis

Abnormal events mentioned below shall be analysed and methods for achieving safety under these events shall be described.

(a) Accidental exposures
(b) Breaking of source hoist cable
(c) Fraying of source hoist cable inside the cell roof tube
(d) Source frame stuck in rest position due to
    (i) jamming of source raise wire rope in roof tube assembly
    (ii) jaming of source frame on guide wire ropes
(e) Failure of mooring of guide wire ropes of source frame
(f) Failure of PAD interlocks
(g) Fire in the irradiation cell
(h) Failure of ventilation system
(i) Damage to the sources
(j) Contamination of pool water
(k) Leakage of water from pool
(l) Earthquake at the irradiator site
(m) Flooding of irradiator cell with water

The designer / manufacturer shall carry out such safety analysis to demonstrate means provided to prevent and handle above situations safely

6. Design Basis Accident Analysis & Safety Povisions

(a) Breaking of source raised wire rope

(b) Fraying of source raised wire ropes

(c) Source frame stuck in rest position due to,

(i) jamming of source raise wire rope in roof tube assembly
(ii) jaming of source frame on guide wire ropes

(d) Failure of personal entry door interlocks
(e) Fire in the cell

(f) Contamination of pool water

(g) Breakage of pool lining

(h) Flooding of the cell

(i) Fall of person in the water pool
j) Product carrier interfering with source frame; dislodging of source in carriers and coming out of shield with it.

7. Acceptance Test Reports by Applicant

a.	Start-up sequence	:	Performance test
b.	Shut down sequence	:	Performance test
c.	Performance tests	:	Motors : Pumps :
d.	Performance of interlocks	:	Tripwire & other automatic source safe or fail safe systems
e.	High pressure lines	:	Test results - pressure gauge, valves, temperature cut off, etc.
f.	Electrical systems earthing	:	
g.	Leakage of pool water: evaporation test (with switch off ventilation)		(10 days: mean value mm/day)
h.	Ventilation	:	Air changes :

i. Dummy source load/ unload operations :

j. Source raise/ lower operational reliability (50 operations) without failure or interference

k. System operations for one day without failure

m. Location and functions of all radiation monitors

n. Proof tests for hoists and handling equipment

8. Radiation Source Details

a. Address of supplier :

b. Type and nature of radioactive source :

c. Chemical form :

d. Physical form :

e. Source encapsulation details :

f. Source pencil (ISU) assembly drawing & identification : (length, diameter, welding method, etc.)

g. Total number of ISU's

h. Quantity of activity (total) per ISU : -----PBq (------kCi)

i. Total activity : ------ PBq (-----kCi)

j. Performance certification (performance certificates as per (AERB/SS/3 (Rev. 1) /ISO 2919 (1980) with bend test requirements for L/D > 15) :

k. Source rack assembly details and location of the pencils in the rack (provide with sketch)

TABLE 1

POSITION OF SOURCES IN SOURCE RACK AFTER SOURCE LOADING

S. No.	ISU Identify--cation Number	Activity	Date	Position	Remarks
1					
2.					

9. Acceptance Test Reports after Source Loading Operations

a. Dose rate profile measurement in the entire facility, strength of radiation source.
b. Performance of radiation monitoring and control interlocks
c. Performance of personnel monitors
d. Dose concentration measurement with and without ventilation fan functioning
e. Assurance and effectiveness of control functions and interlocks

Sketch of the facility & location of dose rate monitoring points and maximum/minimum dose rate levels should include :

(i) Name of persons carrying out the measurement
(ii) Instrument used in the radiation survey
(iii) Confidence limits of radiation level measurements
(iv) Background radiation levels in each location of measurement.

10. List of Critical Safety Components

The manufacturer of radiation processing plant shall provide to the operating organisation a complete list of components as per following classification:

Group A: Replaceable by manufacturer or with his explicit Consent

Group B: Replaceable to exact specifications

Group C: Replaceable without restriction
