BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL, NEW DELHI

In Re:-ORIGINAL APPLICATION NO. 439 OF 2025

In the Matter of:

News Item titled "Radioactive contamination affects habitations in Punjab, parliamentary panel urges urgent action" appearing in The Times of India" on 14.08.2025

NGT ON ITS SUO MOTU NOTICE

Versus

POLLUTION CONTROL BOARD AND OTHERS

---Respondents

INDEX

SR. NO.	PARTICULARS	DATE	PAGE(S)
1.	"**Report on Guidance on Management of Uranium Containing Exhausted Media**" shared by O/o Head, Safety, Security & Safeguard Division Nuclear Controls and Planning Wing, Department of Atomic Energy, Mumbai, vide Letter No. DAE/NCPW/ICSD/2023/16480 dated 11-12-2025		1-28

Place: SAS NAGAR

Dated: 17-12-2025

Er. Jagatjot Goel

Chief Engineer (South)-cum, Advisor, Water Quality, Department of Water Supply and Sanitation, Mohali, Punjab on behalf of Respondent No. 2.

भारत सरकार Government of India
परमाणु ऊर्जा विभाग Department of Atomic Energy
Nuclear Controls and Planning Wing

2nd Floor, OYC Building,
C.S.M. Marg,
Mumbai – 400 001
Phone: 022-2286 2675
Email: us_ncpw@dae.gov.in

No.DAE/NCPW/ICSD/2023/03/16480 December 11 , 2025

To,
Additional Secretary-cum-Head,
Department of Water Supply & Sanitation (DWSS),
Water Works Complex,
Phase-2, Sahibzada Ajit Singh Nagar-160055.
Punjab.

Subject:- Original application (OA) 439 of 2025 of Hon'ble National Green Tribunal (NGT) court: Request for BARC study for the safe disposal of Uranium-loaded media.

Reference : 1. Letter No. 5539 dated 27.10.2025
2. Letter No. 1361 dated 13.11.2025

Respected Sir,

Kind reference is invited to above referred letters and to email dated 09.12.2025 from Executive Engineer(WQ), DWSS on the above cited subject.

2. In this regard, the requisite "Report on Guidance on Management of Uranium Containing Exhaust Media" is forwarded herewith for further necessary action please.

3. This has the approval of competent authority in the Department.

Thanking you,

Yours faithfully,

Abhilash Kidave

Encl.: As above.

(Abhilash Kidave)
Under Secretary to the Government of India

: 2 :

Copy to: Executive Engineer(Water Quality),
Department of Water Supply & Sanitation (DWSS),
Water Works Complex,
Phase-2, Sahibzada Ajit Singh Nagar-160055.
Punjab.

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Report of Internal Committee

on

Guidance on Management of Uranium Containing

Exhausted Media

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आज़ादी का अमृत महोत्सव

सत्यमेव जयते

राष्ट्र की सेवा में परमाणु
प ऊ वि DAE
ATOMS IN THE SERVICE OF THE NATION

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GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY

Ref. No. : DAE/NCPW/R-1/2023 Date: 27.3.2023

Sub: Report of Internal Committee on Guidance on Management of Uranium Containing Exhausted Media

[Ref: Office Order No.42/2022; Dated: December 13, 2022]

The report of the internal committee along with guidelines for evolving SOP for management of uranium containing exhausted media is enclosed herewith. A joint meeting between DAE, NJJM and CPCB needs to be coordinated by NJJM for formulation and adoption of final SOP by CPCB.

This for your kind consideration & advice for further necessary actions.

(S. K. Agrawal)
Convener, Internal Committee

Director, BARC

Copy To:
Office of Secretary, DAE
ED, AERB
Head, NCPW
Director, ChEG
Director, NRG
Director, HS&EG
Members of the Committee

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Report of Internal Committee on
Guidance on Management of Uranium Containing Exhausted Media

[Ref: Office Order No. 42/2022; Dated: December 13, 2022 issued by Director, BARC]

Background

National Jal Jeevan Mission (NJJM) has sought the guidance of Department of Atomic Energy (DAE) for handling and safe disposal of uranium loaded media generated during treatment of ground water containing uranium, while providing safe drinking water to the affected habitations in the State of Punjab.

Based on this, a three-membered team from BARC visited Badla village, Hoshiarpur district of Punjab in May, 2022 and interacted with officials from Drinking Water Supply and Sanitation (DWSS) Department, Government of Punjab. The team noted that resin-based uranium removal plant (capacity: 1 m^3/hr) set up in this village by M/s Ion-exchange India Limited (IEL) has been operational since 2019. The unit is reported to have a serviceable life of ~3 years. It is given to understand that Government of Punjab is also piloting another technology developed by M/s Hydromaterials Pvt. Ltd. (An IIT-Madras incubated firm) at domestic scale (capacity: 20-30 LPD), which is based on nano-adsorbent (iron-aluminum oxy-hydroxide composite) cartridges (58 mm dia; 100 mm height) along with terafil pre-filter (for iron and turbidity removal). Life of the cartridge is reported to be ~3 years, after which the candle requires safe disposal. Representative of this technology informed that elution and reuse of this nanocomposite cartridge may not be possible. Based on the discussions with DWSS, Punjab, it emerged that Standard Operating Procedure (SOP) for disposal of the spent resin/cartridges needs to be formulated.

Subsequently, another meeting was held with all stakeholders in Ministry of Jal Shakti in the month of June, 2022 and the need of a task force to meet the requirement was discussed.

Director, BARC constituted an internal committee vide office order no. 42/2022 dated December 13, 2022. Office order is attached as **Annexure-I**.

After several round of discussions, the internal committee has prepared a report on management of the loaded media as elaborated below.

1. Management aspects of uranium loaded media

Addressing the safe disposal of spent/exhausted uranium bearing media, a guideline is developed to ensure public and environmental safety.

2. Estimation of uranium in the exhausted media

The pilot plant operated by IEL in Badla village comprises of two columns of 60 L each in series loaded with U selective media. After about 3 years of operation, the

media is exhausted. Some portion of the loaded media was taken out and submitted to BARC for quantitative estimation of U in the loaded media.

The exhausted media sample was completely solubilized by silver mediated electrolytic dissolution process. In this process, the generated Ag^{++} was used to complete the conversion of the polymeric media into CO_2 and the loaded U is solubilized as $UO_2(NO_3)_2$. The uranium concentration in solution was estimated by radiometry technique, i.e., high-resolution photonic emission spectrometry based on high-purity germanium (HPGe) detector. In this radiometric metrology, gamma radiation emitted from decay of ^{238}U (49.5 KeV), ^{235}U (143.8, 163.4, 185.7 and 205.3keV) and ^{234}U (53.2 and 120.9KeV) are used to identify and quantify the U concentration in the samples. All the analyses were carried out at Health Physics Division (HPD), BARC Hospital, Anushaktinagar. Results of the analysis showed that ~70 mg of U was loaded per gram of dried media. This corresponds to about 2.1 kg of U loading onto the 60 L column (assuming 30 kg of media in the column and homogeneous distribution of U in the column).

3. Experimental studies on recovery of uranium

3.1 Elution of uranium from exhausted media

Initial desorption study was carried out by IEL and samples were submitted to BARC for U analysis. In this study, feasibility of using both strong mineral acid (sulphuric acid) and alkali (sodium carbonate) were examined and only about 70% elution was achieved.

In the second attempt, elution was carried out as per directive of BARC officials. In this case, the extent of elution was improved to about 94% using sodium bi-carbonate followed by sodium carbonate solution (about 12x volumes of media).

The U lean media, left after the elution, can be disposed off as exempt waste without further regulatory considerations if U activity concentration is less than 1 Bg/g (1g U = 25kBq). This is possible only if the extent of elution is >99.95%. However, in the present scenario, the maximum attainable elution is 94%. Therefore, due to poor desorption performance, the lean media won't qualify as exempt waste.

3.2 Precipitation of the eluted uranium

With regard to U recovery from eluted solution, i.e., to convert the soluble U to yellow cake, a brief outline of the process involved is shown below. Based on the elution data, it is estimated that about 720 L (12 bed vol.) of the eluate will be generated from elution of 1 column (bed volume of 60 L). The uranium present in the eluate can be separated out as solid ammonium diuranate (ADU) cake. This involves processes such as acidification of the eluate (for removal of carbonate) followed by precipitation of ADU using NH_4OH solution. In place of ADU, sodium diuranate precipitation can also be carried out by using sodium hydroxide (in place of NH_4OH) for precipitation. The total U which can be recovered in this process is ~2.0 kg from operation of one column for a period of 3 years. Here, the resulting supernatant will have ~1 ppm of U and its disposal is to be carried out as per applicable regulatory approval. In view of the above, it can be stated that the recovery of the small amount of U has to undergo through multiple complex processes and involves regulatory and security aspects and overall, it will be highly uneconomical.

4. Options for management of the eluate

Now, there are two options for management of the eluate, i.e., either the eluate is transported to DAE unit for uranium recovery or it is further treated at the water treatment facility to precipitate it in the form of solid residue, which can then be transported. In the former case, transportation of radioactivity in liquid form is to be carried out with necessary regulatory approvals. Since liquid transportation is cumbersome with greater potential of spillages during transportation, this option is not preferred. In the latter case, the water treatment facility will be generating concentrated uranium bearing yellow cake, which warrants imposition of additional stringent regulatory requirements from safety and security considerations during its generation, storage and transportation.

5. Departmental views on recovery of uranium

In view of the above, recovery of uranium from small batches of exhausted media is not economical and also cost-benefit of the facility will offset the objective. Moreover, the chemical toxicity of naturally occurring U supersedes its radiological toxicity which is reflected in promulgating and adopting the permissible limit of uranium in drinking water across the world. Therefore, such uranium bearing wastes/exhausted media laced with naturally occurring uranium can be dealt in accordance with hazardous waste regulations.

In this regard, DAE previously had a meeting with representatives of Central Pollution Control Board (CPCB) on disposal of naturally occurring radioactive material bearing residues, including the spent media generated from water treatment plants. It has been agreed in the meeting that such residues, once it is declared as waste by the department, is to be disposed off as per the guidelines issued by CPCB [in accordance with the provision of Hazardous and other Waste (Management & Transboundary Movement) Rules, 2016 framed under the Environment Protection Act, 1986]. It was also recorded that additional considerations from radioactivity, if any, shall be communicated to CPCB by AERB/DAE. (Copy of the minutes is enclosed herewith in **Annexure-II**).

Accordingly, DAE suggests that the exhausted media should be disposed off after immobilization in cement (as a short-term measure) as indicated in Figure 1. However, as a long-term strategy, the development and implementation of an alternate strategy for appreciable volume reduction needs to be explored. Incineration of the loaded media is one of the promising routes that can be looked into for management of U loaded media along with other hazardous waste.

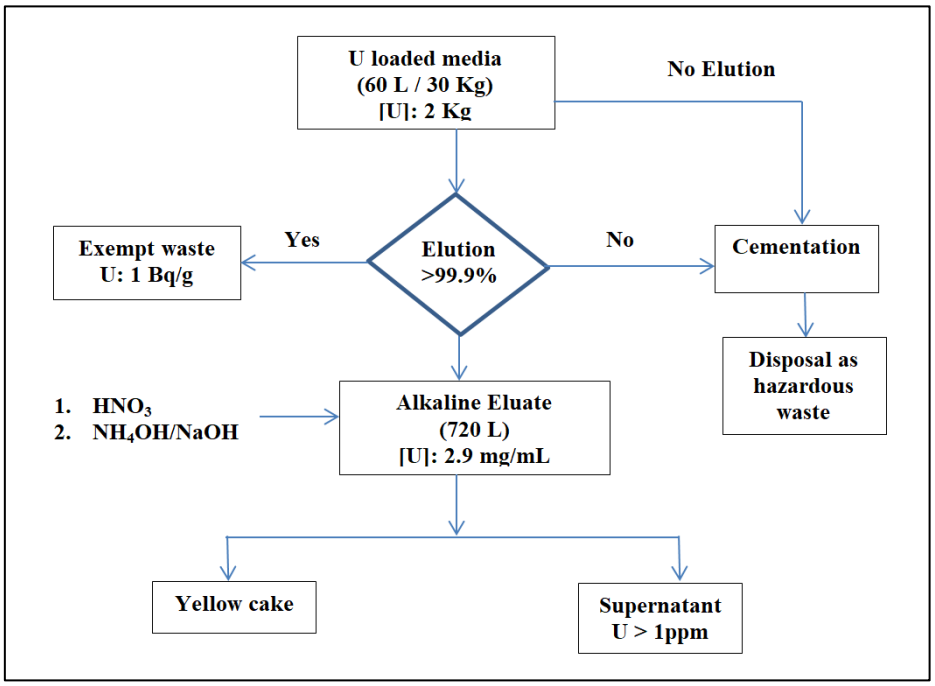


Figure 1: Disposal options for the U bearing media.

Cementation of the media is considered in order to make it environmentally safe and proliferation resistant (to avoid U retrieval by unauthorized means). The monolith cement block, like other hazardous waste, can qualify for disposal if it is meeting the following criteria:

a. The leaching of U from cement block should be reasonably low and should be lower than the U concentration in drinking water even under adverse environmental conditions such as whole matrix is deluged.
b. The impact of leached U and its migration through soil should not have any environmental impact.

6. Leaching studies of uranium loaded media

Studies have been carried out to determine the U leaching from the exhausted media, as discussed below.

6.1 Bare uranium loaded media

U leaching from spent media has been determined by batch equilibration method. The media (1 g) was equilibrated with 100 mL water for a period of 24 hrs and U concentration in the solution was analysed. Result shows that U concentration in solution is ~10 ppb. The data is used for evaluation of environmental impact of U leaching from media matrix, as discussed below.

6.2 Uranium loaded media immobilised in cement matrix

Experiments were also conducted for the fixation of U loaded media in cement matrix. The actual U loaded media received from IEL was used in the study. After cementation, the block was cured for 28 days and thereafter leaching of U in distilled

water was carried out for a period of 28 days. During the leaching studies, the leachant was replenished every week and the leachant samples were analysed for U concentration and pH. The U analysis in leachant was done using LED induced fluorimetry. Based on the measured U concentration in leachant, the average U leaching was calculated and found to be 0.6 % ($1x10^{-5}$ g/cm^2/d). The very low leaching of U from cement block can be attributed to strong interaction between U and the media. Results of the study show that disposal of the Ion exchange media, upon cementation, can be done with added advantages such as lower risk of proliferation and practically insignificant impact to environment.

7. Environmental impact on disposal of exhausted media in hazardous waste landfills

Theoretical simulation studies were carried out to trace the concentration of uranium in groundwater at different distances and time using conservative generic hydro-geological parameters for most conservative scenario. It is proposed to dispose off the spent media in the form of monolith cement block in standard MS drum/ barrel (Volume: 210-220 litre, 16 gauge thick, Dia: 572-580 mm, H:Clear height of 850-860 mm). Anticipated number of drums to be generated in a year is 35 to accommodate 1 tonne of spent media (assumption). An annual national average rainfall rate of 1180 mm is considered with the variation in the range of 500 to 4000 mm. A groundwater recharge rate of 10% is used in the study. Being a critical parameter, two typical groundwater velocities of 10 cm/day and 100 cm/day are used in the study corresponding to slow and fast groundwater speeds respectively. K_d values for U are taken as 500 l/kg and 200 l/kg for cement block and soil matrix, respectively, considering worst case scenario. Model input parameters were considered in such a way that the simulated output is highly conservative and in any real scenario, it is highly unlikely to breach the predicted concentration. All the radionuclides which leach out through the disposal facilities are assumed to reach the groundwater table without any attenuation or capture in the vadose zone. In addition, no credit is given to the barriers used to contain the waste.

The concentration of Uranium and its daughter products in the groundwater and the annual radiological doses are evaluated at two monitoring points namely, at 300 m and 500 m downstream distances from the disposal site. Two exposure pathways have been considered for dose evaluation namely, drinking water pathway and agriculture (crop consumption) pathway. Based on the theoretical simulation study, it was found that 0.08 µg/l and 0.05 µg/l are the maximum concentration of uranium in groundwater which will appear after 8000 years and 12,500 years, respectively, at 300 m and 500 m downstream distances from the disposal site, considering the groundwater velocity of 10 cm/day. When the groundwater velocity is 100 cm/day, the maximum uranium concentration in groundwater at the monitoring points will appear after 3000 years with a peak concentration of ~0.01 µg/l. At both the distances, in all cases, the concentration of uranium in groundwater is well within 30 µg/l (BIS stipulated permissible level and WHO provisional guideline value).

Radiological ingestion dose to the public due to consumption of this groundwater through drinking and crop consumption pathway is estimated to be around 1

µSv/year (see table). The predicted dose at different distance and groundwater water velocity are given below.

The predicted dose at different distance and groundwater water velocity are given below.

Downstream distance from the disposal site	**Groundwater velocity**	
	10 cm/day	**100 cm/day**
300 meter downstream	1.12 µSv/y after 8000 yrs	0.04 µSv/y after 3000 yrs
500 meter downstream	1.22 µSv/y after 12500 yrs	0.035 µSv/y after 3000 yrs

These values were arrived without giving any credit to the barriers.

8. Procedure for immobilization of exhausted media in cement matrix

Based on the above studies, the following guidelines for immobilization of uranium loaded media are suggested as an immediate or short-term measure.

Basis:

- Batch Size: 60 L loaded resin (~30 kg) or 60 nos. of pre-filters & cartridges (total).

[a] For cementation of resin

Option-I (In-drum mixing)

- A typical vertical drum/container for in-drum mixing of loaded resin: Drum total capacity: ~ 220 L (Dia: ~575 mm, H: Clear height of ~855 mm).
- The drum can have in-built type stirrer and cement mixing position can have a detachable motor. An adequate mixing system is to be provided with detachable motor arrangement for mixing of the media with cement and water.

  OR

  Drum can be put on standard vibro-rotation table for mixing of materials inside the drum. The vibro-rotation table of adequate capacity is to be used for mixing of the drum content with protection against drum toppling.

Option-II (Outside drum mixing)

A standard cement mixer tumbler can be used for mixing of cement, water and resin media. The mixture can then be poured inside the drum. The tumble mixer should have adequate capacity to mix powder media, water and cement content with protection against content spillage outside the mixer.

[b] For cementation of pre-filters & cartridges

- A typical vertical drum/container: Drum total capacity: ~ 220 L (Dia: ~575 mm, H: Clear height of ~855 mm).

- A standard cement mixer tumbler of adequate capacity can be used to prepare cement-water slurry and pour inside the drum having cartridges.

8.1 Sequential steps for cementation of resin media

Option-I (for in-drum mixing)

- ✓ Check the empty drum/container for water leak tightness.
- ✓ If in-built stirrer type drum/container is used, check free rotation of inbuilt agitator.
- ✓ Standard drum/container to be filled with 100 kg cement.
- ✓ Put the drum/container at the mixing position on firm platform.
- ✓ Align the motor with stirrer so that it is in same axis Or align the drum with vibration platform.
- ✓ Pour the loaded media (60 L) into the drum/container.
- ✓ Pour 70-75 L water into the drum/container gradually and then close the lid.
- ✓ Start mixing (either by agitator-motor Or by vibrating platform arrangement).
- ✓ Note current and rpm Or vibrating platform parameters.
- ✓ Stop mixing operation after 20 min.
- ✓ Allow the cemented product to set for 4 h.
- ✓ Pour cement slurry (5 L water + 5 kg Cement) on top of the cemented product after opening the lid.
- ✓ Close the lid of the drum/container.
- ✓ Keep the product to cure for 7 days.
- ✓ Shift the cemented product to the designated hazardous waste disposal facility for final disposal as per the guidelines of CPCB.

Option-II (Preparation of cement and media mixer outside drum)

- ✓ Fill tumbler mixer with 100 kg cement and pour the loaded media (60 L)
- ✓ Start mixing operation.
- ✓ Pour 70-75 L water into it gradually.
- ✓ Care should be taken so that mixture does not spill outside the tumbler.
- ✓ Put the drum/container below the tumbler mixer.
- ✓ After adequate mixing for pour the content in the standard drum.
- ✓ Allow the cemented product to set for 4 h.
- ✓ Pour 5 L water and add 5 kg cement in the tumbler mixer and mix well.
- ✓ Pour the cement slurry on top of the cemented product.
- ✓ Close the lid of the drum/container.
- ✓ Keep the product to cure for 7days.
- ✓ Shift the cemented product to the designated hazardous waste disposal facility for final disposal under guidance of CPCB.

8.2 Sequential steps for cementation of pre-filters & cartridges

- ✓ Check the empty drum/container for water leak tightness.
- ✓ Stack 60 nos. of filters/cartridges into the empty drum so that the mid portion and surrounding of each filter/cartridge is accessible to cement slurry.

- ✓ Fill with 100 kg cement and pour 70-75 L water into the commercial tumbler cement mixer.
- ✓ Mix well to make consistent cement slurry.
- ✓ Put the drum/container below the tumbler mixer.
- ✓ Pour the cement slurry into the drum filled with filters/cartridges.
- ✓ Allow the cemented product to set for 4 h.
- ✓ Pour 5 L water and add 5 kg cement in the tumbler mixer and mix well.
- ✓ Pour the cement slurry on top of the cemented product.
- ✓ Close the lid.
- ✓ Keep the product to cure for 7 days.
- ✓ Shift the cemented product to the designated Hazardous waste disposal facility for final disposal as per the guidelines of CPCB.

8.3 Protection during U media handling and cementation

- Personal protective equipment (PPE) like boiler suits, chemical goggles, full-face shield or a full-face respirator, impervious gloves of chemically resistant material (rubber or neoprene), safety shoes etc. need to be used. (Ref: Standard Operating Procedure and Checklist of Minimal Requisite Facilities for utilization of hazardous waste under Rule 9 of the Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016.
- Work to be carried out by trained personnel.
- No rotating equipment shall be energized until ensuring worker is away from the equipment and hand or any body part of the worker is not aligned or entered in the mixing system.
- After completion of the work all PPEs shall be washed thoroughly and dried before next usage. Dust filter of the respirator shall be disposed off after each use as hazardous chemical waste.

Note:

As an immediate measure, cementation options are evaluated and suggested. For long-term measure, plasma-based hazardous waste incineration can be used to manage loaded media along with other hazardous industrial wastes as per CPCB guidelines. Plasma being a high temperature environment will suppress formation of toxic gases, like dioxin and furans, during polymeric waste incineration. The end product, slag form, can give better leach resistance for long-term disposal. The loaded media, to be incinerated in plasma-based system, needs to be blended with other common and voluminous hazardous wastes to achieve appropriate distribution of U and other hazardous elements in the slag matrix.

9. Regulatory position

9.1 Regulatory requirements w.r.t. handling of uranium

As per DAE's notification S.O. 1592(E), dated April 28, 2016, Natural Uranium with concentration exceeding 300 ppm is a prescribed substance under the Atomic Energy Act, 1962. Currently, as per Rule 3 of Atomic Energy (Mining, Milling and

Handling of Prescribed Substance) Rules, 1984 framed under Section 14 of the Atomic Energy Act, 1962, handling of any ore mineral or other material from which any one or more of the prescribed substances can be extracted requires licence from DAE. Hence, a licence shall be obtained from DAE as per Rule 3 of Atomic Energy (Mining, Milling and Handling of Prescribed Substance) Rules, 1984. Additionally, handling of radioactive substance under Atomic Energy (Radiation Protection) Rules, 2004 framed under Section 16 and Section 17 of the Atomic Energy Act, 1962 requires licence from AERB. Further, DAE vide notification S.O.503 (E), dated February 2, 2021 has empowered Chairman, AERB to specify radioactivity levels in substance or material exceeding which such substance or material shall be deemed to be a 'radioactive substance or radioactive material' under Atomic Energy Act, 1962. Accordingly, AERB through its Safety Directive No.01/2021, has specified that any substance or material with activity concentration of any naturally occurring radionuclides of ^{238}U or ^{232}Th decay series greater than 1 Bq/g shall be considered as radioactive substance within the meaning of the Atomic Energy Act, provided that for radionuclides of natural origin specific exemption of bulk amounts of material shall necessarily be considered on a **case to case basis** by using an effective dose criterion of the order of 1 mSv in a year, commensurate with typical doses due to natural background levels of radiation.

Presence of uranium in ground water (intended for drinking) falls under existing exposure situation, for which guidance values have been specified by WHO. In case of India, the guidance value adopted by BIS for uranium is 30 ppb considering the chemical toxicity of uranium which predominates the radiological exposure concerns. The treatment of water with levels exceeding the BIS specified value is a protective/remedial action. However, owing to concentration of the uranium in the resin/treatment media during the course of ground water treatment, the protective actions needs to be justified by the concerned Government (Ministry of Jal Shakti), i.e., intended protective actions yield more good than harm. Once it is justified, review of the safety assessment of the protective action is to be carried out on case to case basis to ascertain the need of any regulatory approvals and optimisation of the protective actions. Such safety assessment also needs to take into account the strategy for radioactive waste management to deal with any waste arising from the protective actions such that any subsequent public exposure associated with its disposal are addressed (please refer 9.2).

Uranium being a long-lived alpha emitter with low specific activity, the external exposure from separated uranium isotopes is not much of concern. Further, since the uranium in water is getting trapped in the media, potential of it getting air borne and resulting in internal exposure is also remote. As per the theoretical estimation carried out by HPD, BARC, the estimated dose rate even on the surface of drum containing exhausted resin is insignificantly low (9.34E-06 mR/hr) and radiological dose during operation, storage, handling and transportation of the resin is expected to remain well within1 mSv/year and hence may be considered for specific exemption on a case to case basis. It is therefore suggested that prior to issuance of licence under Atomic Minerals (Working of Mines, Minerals and Handling of Prescribed Substance) Rules, 1984, DAE may obtain views of AERB in this regard.

9.2 Regulatory requirements with respect to disposal of uranium

As per Section 6 of the Atomic Energy Act, disposal of mineral or concentrates and other materials which contain uranium in its natural state in excess of 0.005% U_3O_8 can be disposed only with the previous permission in writing from DAE and in accordance with such terms and conditions as it may impose.

Hence, in accordance with Section 6 of Atomic Energy Act, a written permission is to be issued by DAE directing the water treatment plants to dispose off the uranium bearing loaded media as per the guidelines of CPCB (as mentioned in 5.0), with a rider that, if at any point of time, DAE feels it is beneficial to recover the uranium, it shall issue necessary directives to acquire the loaded media, as per Section 15 of the Atomic Energy Act, 1962. DAE may also impose a condition of providing periodic information to DAE on the details of quantity of uranium disposed off in the landfills.

As seen from the studies conducted at BARC, the estimated dose to public from disposal of uranium loaded media in landfill, in accordance with guidelines of CPCB, is well within the limit for specific exemption. Hence, such disposal does not warrant any further regulatory control from radiological safety considerations. However, as an abundant caution, the monitoring wells surrounding the landfill should be monitored prior to disposal of the uranium loaded media (for base line results as per environment protection norms) and thereafter periodically monitored (frequency as per CPCB norms) for uranium content and results submitted to DAE and AERB.

Both, AERB and DAE reserve the right to carry out inspection at any time in the premises of such facilities and landfill siteto ascertain/verify that the stipulations provided in these guidelines are adhered to.

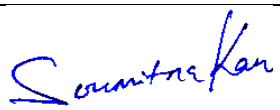
If at any stage, DAE or AERB feels the need to specify any additional regulatory requirement or impose any restriction, they shall have the liberty to do so and the water treatment facility shall comply with the same.

Environmental Clearance from MoEF&CC, Consent to establish and operate from respective State PCBs and other statutory clearances may be obtained, as warranted, under applicable laws.

10. Action points

A joint meeting of BARC, DAE, AERB, MoEF&CC and CPCB is to be coordinated by NJJM for formulation and adoption of guidelines by CPCB. These guidelines will provide the Operating Procedure listed above for immobilisation of the uranium loaded media and also address the regulatory requirements to be complied by water treatment plants.

The Operating Procedure to be communicated to NJJM is enclosed as **Annexure-III**.

 **(Soumitra Kar) Member Secretary**	 **(S. K. Sahoo) Member**	 **(Soumen Sinha) Member**
 **(K. C. Pancholi) Member**	 **(D. Banerjee) Member**	 **(S. K. Agrawal) Convener**

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Annexure-I

RESTRICTED

Government of India
Bhabha Atomic Research Centre

Central Complex, Trombay
Mumbai – 400 085

December 13 , 2022

OFFICE ORDER No. 42 /2022

Sub : Constitution of an Internal Committee to review and provide guidance on treatment of drinking water

National Jal Jeevan Mission (NJJM), Department of Drinking Water and Sanitation, Ministry of Jal Shakti has a mandate to provide safe drinking water across all households in the country. There is prevalence of uranium concentration above Bureau of Indian Standards (BIS) specified permissible limit of 30 ppb in some of the localised pockets of few States/UTs in the country. To render the water suitable for drinking, couple of technology developers under guidance of Drinking Water Supply and Sanitation have established drinking water treatment facilities. In this regard, NJJM has sought the guidance of the Department of Atomic Energy for handling and safe disposal of uranium loaded media.

Accordingly, an Internal Committee is hereby constituted with the following members:

1.	Shri S.K. Agrawal, SO/H, NCPW, DAE	:	Convener
2.	Dr. D. Banerjee, SO/G, PSDD, NRG, BARC	:	Member
3.	Shri Keyur C. Pancholi, SO/G, WMD, NRG, BARC	:	Member
4.	Shri Soumen Sinha, SO/G, AERB	:	Member
5.	Shri S.K. Sahoo, SO/E, HPD, HS&EG, BARC	:	Member
6.	Dr. Soumitra Kar, SO/G, DMTD, ChEG, BARC	:	Member Secretary

The Terms of Reference (ToR) of the Committee are as follows :

a) To provide guidance on management of uranium containing exhausted media (spent resin, equipment etc.) and its safe disposal.

b) To develop a framework document covering the above aspects to support NJJM.

The Committee shall submit the framework document to Director, BARC within two months of issue of this order.

Ajit Kumar Mohanty

(Ajit Kumar Mohanty)
Director

Convener and Members of the above Committee

Copy to :
1. Office of Chairman, AEC
2. Chairman, AERB
3. Director, ChEG, BARC
4. Director, NRG, BARC
5. Director, HS&EG, BARC
6. Head, NCPW, DAE

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Annexure-II

Government of India
Department of Atomic Energy
Nuclear Controls and Planning Wing

Anushakti Bhavan
CSM Marg,
Mumabi-400001

No. DAE/HNCPW/A-7.2.2/2021/12386 14th October, 2021

Subject: Minutes of Meeting of the Committee Constituted to Examine the Proposed Handling of NORM Waste by CPCB/SPCB

Meeting through Video Conferencing

Date: 30th Sept 2021

Members attended the meeting:

1. Sh. S.K. Agrawal, Scientific Officer H, NCPW, DAE	Convener
2. Sh. Ved Prakash Mishra, Director, HSMD, MoEF&CC	Member
3. Dr.Vinod Kumar Singh, Scientist-E, HSMD, MoEF&CC	Member
4. Sh. B. Vinod Babu, CPCB	Member
5. Sh. K. Venkat Ramana, Scientific Officer H, NPCIL	Member
6. Dr. P Vijayan, Scientific Officer G, AERB	Member
7. Sh. Darshit Mehta, Scientific Officer G, BARC	Member
8. Sh. Soumen Sinha, Head NCRAS, DRA&C, AERB	Member
9. Dr. Garima Sharma, Scientific Officer G, NCPW, DAE	Member-Secretary

This meeting was convened to discuss the disposal of NORM (Naturally Occurring Radioactive Material) waste which has radioactivity levels marginally exceeding the levels specified for the exempt waste under the Atomic Energy (Radiation Protection) Rules, 2004.

2. Sh. S.K. Agrawal, Convener of the Committee, extended welcome to all the members followed by brief round of introduction. He mentioned that Department of Atomic Energy (DAE) is committed for the safe management of the radioactive waste under the provisions of the Atomic Energy Act, 1962 and the Rules made thereunder.

He also mentioned that a robust legal, regulatory and institutional framework is already in place for the management of all types of radioactive waste in the Country.

Committee was informed that the DAE has recently formulated a Policy and Strategy for the safe management of radioactive waste which has been approved by the Atomic Energy Commission (AEC). With regard to NORMS wastes, Strategy proposes that such wastes may be handled in a similar way as hazardous waste under the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended from time to time framed under the Environment (Protection) Act, 1986, for further management as per guidelines of Central Pollution Control Board/State Pollution Control Board (CPCB/SPCB). He informed that the Committee is constituted to examine the above proposal holistically considering legal, regulatory and other requirements and explained the terms of reference of the Committee.

3. Sh. Soumen Sinha, AERB, made a presentation on the proposed handling of the NORM waste. He informed members that the NORM wastes are generated in various industrial operations which are not connected with atomic energy programme. These wastes are generated in large volumes and predominantly contain conventional pollutants due the use to various inorganic reagents in the process and also toxic heavy metals. Also, these wastes contain traces of naturally occurring radionuclides such as uranium, thorium, mostly within or at times, marginally higher than the exemption levels specified under the Atomic Energy (Radiation Protection) Rules, 2004. Moreover, the chemical toxicity of the radionuclides such as Uranium predominates the radiological safety. Few such industrial operations which generate NORM wastes are mining and milling of metalliferous and non-metallic ores, production of coal, oil and gas, extraction and purification of water, generation of geothermal energy, and production of industrial minerals, including phosphate, clay and building materials.

He further emphasised that the control measures specified for management of such wastes from conventional pollutants are found to be generally adequate from radiological safety considerations as well. Sh. Sinha, also informed that the provisions exist in Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 for handling such waste and CPCB has already issued guidelines for

management of Phosphogypsum generated from processing of rock phosphate and MoEF&CC has issued notifications on use of Fly ash.

4. Members noted that the slag generated from the pyrometallurgical process of metallic ores such as Sn, Cu, Al, Fe, Zn, Pb, Ti, etc. also falls under NORM has radioactivity levels comparable to the exemption levels and for Niobium and Tantalum, the radioactivity levels are normally few orders higher than exemption level.

5. It was further brought to the information of the members that the waste generated from Oil and Gas production has Radioactivity levels comparable to exemption level. In cases where the pipeline scales / sludge exceed exemption levels, they can be disposed of in the exhausted bore holes/or incinerated and ash disposed in landfills, or discharged in sea in line with existing domestic and international norms and practices. Such practices are already there under the provisions of sludge containing oil and drilling mud containing oil are regarded as hazardous waste under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Therefore, in the interest of public safety and national interest, guidelines for management of such wastes can be specified by CPCB under the existing legal framework. If the radioactivity levels in these wastes are below the exemption levels, then these wastes can be handled just like any other conventional wastes without any further consideration from radiological safety. However, If the radioactivity levels are higher than exemption levels, then the guidelines for environmental protection from conventional pollutants and heavy metals considerations, which are normally found to be adequate from radiological safety considerations as well, can be made applicable to such wastes such as disposal in secured landfills. However, before issuance of such guidelines, acceptability from radiological considerations may be obtained from AERB (as was done earlier for Phospogypsum).

6. Sh. Ved Prakash Mishra agreed that the NORM waste can be handled under the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 by adopting the concept of dilute and disperse in landfills. However, Sh. Mishra also agreed to the proposal and suggested that where radioactivity levels exceed the exemption levels, the adequacy of the guidelines may need to be confirmed by experts from AERB/DAE considering long term impact.

7. In this regard, Sh. Vinod Babu, CPCB expressed that these guidelines should be developed in close coordination with experts from AERB/DAE and through mutual consultations. He further stressed that a synergy should be established and maintained in the guidelines issued from CPCB and AERB for management of NORM wastes.

8. Committee deliberated the NORM waste management and disposal strategies at length. The committee agreed that, in case of NORM industries, the radiological impact associated with NORM waste is negligible and the control measures specified for conventional pollutants for environmental protection are generally adequate for radiological safety considerations also. The committee was of the view that the proposal for handling of NORM waste by CPCB/SPCB may be formulated in consultation with MoEF&CC, CPCB and AERB/DAE and guideline/SoP in this regards be issued by CPCB.

9.The meeting concluded with thanks to all the participants.

for Member Secretary

To:
Convener and all the Members (through email)
Head, NCPW, DAE

Annexure-III

Guidelines for Operating Procedures for Safe Disposal of Uranium Loaded Exhausted Media

National Jal Jeevan Mission (NJJM) has sought the guidance of Department of Atomic Energy (DAE) for handling and safe disposal of uranium loaded media generated during treatment of ground water containing uranium.

Based on experimental and theoretical studies conducted at BARC, it is decided to immobilize the uranium loaded spent media in a cement matrix which can be disposed off in a landfill used for hazardous waste in accordance with the guidelines to be issued by Central Pollution Control Board (CPCB).

The guidelines for operating procedures for cementation of uranium loaded media of different types is provided in Part-A as an immediate/ short-term measure; Part-A1 deals with media in resin form, Part A2 deals with media in cartridge form. Guidelines for long-term measures are highlighted in Part B. Further, the regulatory requirements to be complied are provided in part-C and the identified action points for NJJM and CPCB is provided in part-D.

Part-A

Immobilization in cement matrix as an immediate measure

Basis:

- Batch Size: 60 L loaded resin (~30 kg) or 60 nos. of pre-filters & cartridges (total).

[a] For cementation of resin

Option-I (In-drum mixing)

- A typical vertical drum/container for in-drum mixing of loaded resin: Drum total capacity: ~ 220 L (Dia: ~575 mm, H: Clear height of ~855 mm).
- The drum can have in-built type stirrer and cement mixing position can have a detachable motor. An adequate mixing system is to be provided with detachable motor arrangement for mixing of the media with cement and water.

OR

Drum can be put on standard vibro-rotation table for mixing of materials inside the drum. The vibro-rotation table of adequate capacity is to be used for mixing of the drum content with protection against drum toppling.

Option-II (Outside drum mixing)

A standard cement mixer tumbler can be used for mixing of cement, water and resin media. The mixture can then be poured inside the drum. The tumble mixer should have adequate capacity to mix powder media, water and cement content with protection against content spillage outside the mixer.

[b] For cementation of pre-filters & cartridges

- A typical vertical drum/container: Drum total capacity: ~ 220 L (Dia: ~575 mm, H: Clear height of ~855 mm).
- A standard cement mixer tumbler of adequate capacity can be used to prepare cement-water slurry and pour inside the drum having cartridges.

A1: Sequential steps for cementation of resin

Option-I (for in-drum mixing)

- ✓ Check the empty drum/container for water leak tightness.
- ✓ If in-built stirrer type drum/container is used, check free rotation of inbuilt agitator.
- ✓ Standard drum/container to be filled with 100 kg cement.
- ✓ Put the drum/container at the mixing position on firm platform.
- ✓ Align the motor with stirrer so that it is in same axis Or align the drum with vibration platform.
- ✓ Pour the loaded media (60 L) into the drum/container.
- ✓ Pour 70-75 L water into the drum/container gradually and then close the lid.
- ✓ Start mixing (either by agitator-motor Or by vibrating platform arrangement).
- ✓ Note current and rpm Or vibrating platform parameters.
- ✓ Stop mixing operation after 20 min.
- ✓ Allow the cemented product to set for 4 h.
- ✓ Pour cement slurry (5 L water + 5 kg Cement) on top of the cemented product after opening the lid.
- ✓ Close the lid of the drum/container.
- ✓ Keep the product to cure for 7 days.
- ✓ Shift the cemented product to the designated hazardous waste disposal facility for final disposal as per the guidelines of CPCB.

Option-II (Preparation of cement and media mixer outside drum)

- ✓ Fill tumbler mixer with 100 kg cement and pour the loaded media (60 L).
- ✓ Start mixing operation.
- ✓ Pour 70-75 L water into it gradually.
- ✓ Care should be taken so that mixture does not spill outside the tumbler.
- ✓ Put the drum/container below the tumbler mixer.
- ✓ After adequate mixing for pour the content in the standard drum.
- ✓ Allow the cemented product to set for 4 h.
- ✓ Pour 5 L water and add 5 kg cement in the tumbler mixer and mix well.
- ✓ Pour the cement slurry on top of the cemented product.
- ✓ Close the lid of the drum/container.
- ✓ Keep the product to cure for 7days.
- ✓ Shift the cemented product to the designated hazardous waste disposal facility for final disposal under guidance of CPCB.

A2: Sequential steps for cementation of pre-filters & cartridges

- ✓ Check the empty drum/container for water leak tightness.
- ✓ Stack 60 nos. of filters/cartridges into the empty drum so that the mid portion and surrounding of each filter/cartridge is accessible to cement slurry.
- ✓ Fill with 100 kg cement and pour 70-75 L water into the commercial tumbler cement mixer.
- ✓ Mix well to make consistent cement slurry.
- ✓ Put the drum/container below the tumbler mixer.
- ✓ Pour the cement slurry into the drum filled with filters/cartridges.
- ✓ Allow the cemented product to set for 4 h.
- ✓ Pour 5 L water and add 5 kg cement in the tumbler mixer and mix well.
- ✓ Pour the cement slurry on top of the cemented product.
- ✓ Close the lid.
- ✓ Keep the product to cure for 7 days.
- ✓ Shift the cemented product to the designated Hazardous waste disposal facility for final disposal as per the guidelines of CPCB.

A3: Protection during U media handling and cementation

- Personal protective equipment (PPE) like boiler suits, chemical goggles, full-face shield or a full-face respirator, impervious gloves of chemically resistant material (rubber or neoprene), safety shoes etc. need to be used. (Ref: Standard Operating Procedure and Checklist of Minimal Requisite Facilities for utilization of hazardous waste under Rule 9 of the Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016.
- Work to be carried out by trained personnel.
- No rotating equipment shall be energized until ensuring worker is away from the equipment and hand or any body part of the worker is not aligned or entered in the mixing system.
- After completion of the work all PPEs shall be washed thoroughly and dried before next usage. Dust filter of the respirator shall be disposed off after each use as hazardous chemical waste.

Part-B

Plasma-based incineration as long-term measure

For long-term measure, plasma based hazardous waste incineration can be used to manage loaded media along with other hazardous industrial wastes as per CPCB guidelines. Plasma being a high temperature environment will suppress formation of toxic gases, like dioxin and furans, during polymeric waste incineration. The end product, slag form, can give better leach resistance for long-term disposal. The loaded media, to be incinerated in plasma-based system, needs to be blended with other common and voluminous hazardous wastes to achieve appropriate distribution of U and other hazardous elements in the slag matrix.

Part-C

Regulatory requirements

- A licence shall be obtained from DAE as per Rule 3 of Atomic Energy (Mining, Milling and Handling of Prescribed Substance) Rules, 1984.
- In accordance with Section 6 of Atomic Energy Act, a written permission from DAE to be applied for disposal of uranium loaded media in the landfills (for which guidelines will be issued by CPCB).
- Baseline and periodic monitoring of the groundwater with respect to uranium content to be carried out (as per the guidelines to be developed by CPCB) and results to be intimated to DAE and AERB.
- Providing periodic information to DAE on the details of quantity of uranium bearing exhausted media/waste disposed off in the landfills.
- Providing access to AERB and DAE to carry out inspection at any time in their premises and landfill site.
- If at any point of time, DAE feels it is beneficial to recover the uranium, it shall issue necessary directives to acquire the loaded media, as per Section 15 of the Atomic Energy Act, 1962.
- If at any stage, DAE or AERB feels the need to specify any additional regulatory requirement or impose any restriction, they shall have the liberty to do so and the water treatment facility shall comply with the same. Environmental Clearance from MoEF&CC, Consent to establish and operate from respective State PCBs and other statutory clearances may be obtained, as warranted, under applicable laws.

Part-D

Action points for NJJM

A joint meeting of BARC, DAE, AERB, MoEF&CC and CPCB is to be coordinated by NJJM for formulation and adoption of guidelines by CPCB.