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Title:	**CAPPING PROCEDURE FOR THE CLOSING AND SEALING OF CaF2 POND 4**

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Revisions

This document has been revised according to the following schedule:

Revision	Date Approved	Nature of Revision	Prepared by
00	See title page	First Issue	LS Dlamini

Contents:

1.0 PURPOSE

The purpose of this document is to describe the capping procedure for CaF_2 sludge contained in pond 4 at Thabana in order to isolate the sludge from the environment.

2.0 SCOPE

The document specifies all the steps to be followed for the capping of CaF_2 pond 4.

3.0 REFERENCES

The following documents are referenced in this document:

[1]	SHEQ-INS-5300	Written safe work procedures, instruction, orientation and task training.
[2]	SHEQ-INS-8150	Access and Egress Control for Radiological Areas
[3]	SHEQ-INS-8120	Safe Work Procedures and Radiation Protection Work Permit System
[4]	NLM-PLN-00638	Waste Management Plan for the closing and sealing of CaF_2 Pond 4
[5]	NLM-REP-25/070	Radiation Survey Report for CaF_2 Pond 4
[6]	NLM-REP-25/070	SHEQ-INS-0800 Capping of CaF_2 Pans 3 and 4 at Thabana

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 DEFINITIONS:

Capping: A process of the closing and sealing a pond to isolate the contents of the pond from the environment.

Pond: A lined well used to evaporate effluent coming from different plants.

4.2 ABBREVIATIONS:

CaF_2:	Calcium Fluoride
DM:	Discipline Manager
EMG:	Environmental Management Group
EPD	Electronic Personal Dosimeter
HDPE:	High Density Polyethylene
Necsa	South African Nuclear Energy Corporation SOC Ltd

NNR:	Nuclear Energy Regulator
PDO:	Predisposal Operations, a Section of Waste Management department.
PPE:	Personal Protective Equipment
PVC:	Polyvinyl Chloride
QA:	Quality Assurance
RP:	Radiation Protection
RPO:	Radiation Protection Officer
SHEQ:	Safety, Health, Environment and Quality
TLD:	Thermo Luminescent Dosimeter
WM:	Waste Management Department

5.0 RESPONSIBILITY

1. It is the responsibility of the DM to ensure that all the regulatory requirements as specified in the 0800 safety case file [6], safety file from the supplier and prescribed Necsa SHEQ requirements are adhered to.

2. The responsible project manager shall coordinate the capping process in consultation with the DM (PDO) and the project team.

3. The Waste Management project leader and the responsible RPOs are responsible for ensuring compliance to this capping procedure by all personnel involved in the project.

4. It is the responsibility of the DM (PDO), as well as the project manager to ensure that the following training is received by all contractor personnel prior to the start of the construction [1].
    - Necsa induction (1 day)
    - Facility (PDO) induction (0.5 Day)
    - Radiation worker (1 day)
    - Chemical worker (1 day)
    - Half Face mask (0.5 day)
    - Noise worker (1 day)

6.0 FACILITY DESCRIPTION

CaF_2 pond 4 is an open-air evaporation pond that contains chemicals and uranium-contaminated effluent where the aqueous part of the effluent is evaporated by natural processes. However, the degradation of the lining of the pond (mainly due to prolonged exposure to sun and ultraviolet rays, wind and temperature differences) and the sporadic exposure of the top of the sludge during dry seasons has increased the risk of contamination to the environment from this pond. Apart from the existing liquid in the sludge, rainwater will continually add as transport medium for contamination to leak down into the geosphere if there is any damage to the pond liner. When the sludge is dried out in winter, the wind can also blow contaminated dust from the ponds to the surrounding environment.

7.0 BRIEF PROJECT DESCRIPTION

- The project will include the closing and sealing of the HDPE lined pond with new HDPE liners to isolate the sludge from the environment and rain water.
- The removal of the pump system that includes motor and pipes, from the sump structure platform.
- The removal of a steel bridge leading to a concrete sump structure inside the pond.
- Partial dismantling of the sump structure.
- The covering of the sludge and HDPE liners with sand on different intervals is prescribed in more detail in Paragraph 10.2.
- The installation of a drainage system to the outside of the pond.

8.0 DOSE RATE MEASUREMENTS

12 dose rate measurements were performed at the Pond [5], which indicate low levels of radiation.

9.0 RADIOLOGICAL PROTECTION REQUIREMENTS

9.1 RESPONSIBILITIES

9.1.1 Service Provider/Contractor

- Personnel involved in the project and working inside the pond shall be registered as Occupational Exposed Workers.
- EPDs to be issued to the personnel working inside the pond daily by RPOs.
- Urine samples to be taken prior and after completion of the project.
- Contractors need to undergo a whole-body count before and after the project.
- The RPOs will continuously monitor personnel for contamination upon exit.

9.2 PERSONAL PROTECTIVE CLOTHING

All personnel will wear the following PPE during the identified phases of the project:

9.2.1 Covering of sludge inside pond with sand

- Blue-collar overalls
- Plastic disposable overalls
- Water boots with steel cap
- Leather Gloves
- Eye protection
- Half Face Mask

9.2.2 Dismantling of sump structure and steel bridge

- Blue-collar overalls
- Steel cap safety shoes
- Leather Gloves
- Eye protection
- Ear protection
- Half Face Mask

9.2.3 Installation of drainage system

- Suitable overalls
- Steel cap safety shoes
- Leather Gloves
- Eye protection
- Dust mask

9.2.4 Installation of HDPE liner

- Blue-collar overalls
- Steel cap safety shoes
- Leather Gloves
- Eye protection (if needed)

9.3 DEMARCATION AND SIGN POSTING

- All entrances leading to the area surrounding pond 4, including temporary classified areas shall be sign-posted at the barrier or entrance.
- At all exits from the area leading to an uncontrolled area a sign indicating that personnel are entering an uncontrolled area shall be displayed.
- Sign posting shall be in accordance with the requirements specified in SHEQ-INS-8150 [2].

10.0 CAPPING PROCEDURE

The following events/steps, with associated responsibilities, shall be carried out as follows and in sequence of order of the activities that must take place:

10.1 PUMPING OF EXCESS WATER

- Necsa personnel will be responsible to ensure that all excess water on top of the sludge inside pond 4 is pumped over to pond 5 as much as possible. This shall include the water inside the sump pump structure.
- A suitable submersible pump will be used for any pump actions that must take place.
- Necsa personnel will ensure that the drain valve inside the sump is fully opened to ensure maximum drainage from the pond at all times.

10.2 COVERING OF THE SLUDGE INSIDE THE POND WITH SAND

- A layer of sand (minimum 150mm thick) to be poured on top of the sludge to enable a safe working area and reduce the possibility of contamination to workers.
- Some areas inside the pond will require more sand due to the unevenness of the sludge.
- This sand will be laid from the edges inwards to ensure that at all times they are working on the minimum thickness of 150mm required.
- Starting from the side where the sand is loaded into the pond, the sand must be levelled with appropriate and suitable equipment/tools and spread over the full area of the sludge inside the pond.
- A conveyor belt or similar material must be used/placed on top off the sand while progressing in laying the sand towards the centre and the opposite end of the pond.
- The slope from the south eastern corner, must be created to flow to the north western corner to channel the rain water to the exit point.

***Note**: There are no limitations to the amount/volume of sand to be used to achieve the required slope. The contractor should ensure that enough sand is used to fully cover the sludge inside the pond at a minimum depth of 150mm and more depth for the elevated parts of the pond for the first layer of sand. Everything (vegetation and rubble) in the pond will be covered with first layer of sand*.

10.3 DISMANTLING OF THE SUMP STRUCTURE AND STEEL BRIDGE (SEE FIGURE 1 FOR LAYOUT OF STEEL BRIDGE AND SUMP STRUCTURE).

10.3.1 Dismantling of the pump system, steel bridge and the platform inside the pond – safety precautions

- The motor shall be isolated before commencement of dismantling of the pump system.
- The steel bridge, including the walking platform, leading to the concrete sump structure inside the pond needs to be fully removed.
- The removal shall be done by a contractor (note: possible contamination to equipment used in removal process).

- Only qualified personnel, trained in the use of power machines (grinders, jack hammer etc.) and hand tools will be authorized in the process of the removal of the bridge.
- A dedicated area (quarantine area) for all waste associated with rubble and secondary waste generated in the process of dismantling of the steel bridge will be allocated by Necsa for temporary storage. See Waste Management Plan [4].

  The RPO shall monitor all equipment for possible contamination prior to or during the removal of any equipment from the sump structure.

10.3.2 Dismantling sequence for the pump system, steel bridge handrails and platform grids

- Uncouple the motor's electrical connections, the pump and pipes present on the platform.
- Ensure that all the water inside the sump structure is pumped out to Pond 5 prior to the removal of any equipment and if there is a small amount of water that could not been pumped out, fill the sump structure with soil until all the remaining water is absorbed.
- Ensure that the sand level inside the sump structure stay below the sand level on the outside of the sump structure.
- Remove all equipment from the platform and place them in the dedicated demarcated area for all the waste, (will be referred to as the Quarantine area going forward).
- Equipment with any possibility of contamination shall be placed inside a plastic liner/bag.
- By starting at the pond-end side of the bridge, remove the steel handrails by loosening/cutting the handrail bolts on the I-Beam and remove the loose grids on the platform, piece by piece and store in the quarantine area.

Figure 1: Pump System, Bridge and Platform

10.3.3 Removal of bridge support I-beams (See figure 2 for layout of support beams)

- Remove all bolts at the back of the support I-beams with an appropriate spanner/grinder.

- Standing on the first layer of sand inside the pond, remove all bolts at the front end of the support I-beams (See figure 2 for layout of bolts at the front end of the beam), with an appropriate spanner/grinder. If the height of the bolts is out of reach by standing on the sand, make use of wooden pallets to stand on.
  ***Note**: The pallet structure needs to be inspected by the dedicated safety officer for the pan project before use.*
- Place wood pallets next to the sump structure and underneath the I-beams to minimise the fall distance of the I-beams, ensure a distance of ± 300mm between the wood pallets and I-beam.
- Also place stacks of pallets next to the first stack of pallets towards the wall side with the top pallet at roughly the same height as the first stack pallets to drag the I-beams on towards the wall to prevent a big drop of the I-beam on the wall liner.
- Remove the I-beams from the pond by pulling them, using suitable slings and shackles, from the back off each beam until it is fully removed from the pond.
- Remove all the debris to the dedicated storage area, See Waste Management Plan [4] for more details.

Figure 2: Layout of bolts at the back of the support

10.3.4 Dismantling of the concrete sump structure

- The sump structure shall be dismantled down to the surrounding sand level inside the pond. The inside of the dismantled sump structure shall be covered with a layer of at least 200 mm soil/sand. The structure is hollow, with a thickness of 170mm on all four sides.
- The dismantling will be done by a contractor (Note: possible contamination to equipment used in dismantling process).
- Construct an elevated height with wooden pallets on one side of the sump structure. The height of this structure must be as such that the top of the sump area can easily be reached with an electrical jack hammer impact tool.
  ***Note:** The pallet structure needs to be inspected by the Necsa safety officer for the project before use.*

- Starting at the top of the side of the sump structure where the elevated height was constructed and by using the electrical jack hammer, dismantle the sump structure to the level of the sand.
- Move pallet structure to next side of the sump structure to be dismantled and repeat the previous step.
- Repeat previous step until the whole sump structure is dismantled to the maximum reachable height standing on the pallet structure.
- Remove pallet structure.
- Standing on the sand inside the pond and starting from one side of the sump structure, dismantle the remaining bottom of the structure to a level almost down to the surrounding sand inside the pond.
- Cover the inside of the dismantled sump structure with a layer of at least 200 mm soil/sand.
- The concrete debris shall be removed with suitable plastic buckets and placed inside the 200 litre steel drums at the quarantine area.
- Remove the reinforcing steel by cutting it into smaller pieces and place the reinforcing steel pieces inside the quarantine area.

10.4 CUTTING AND BACK FOLDING OF OLD POND LINER

- HDPE lining needs to be cut along the top edges and all around the pond.
- The cutting of the lining at the top edges must be 200mm from the top of the pond.
- Cut the HDPE liner inside the corners of the pond, to be folded back on top of the pond content to mimic an envelope.
- The contractor will fold the lining back over the sand, covering the pond contents, until the lining is in position to be glued or welded together on top of the covered sludge.
- All uncovered sand areas not covered with the old liners shall be covered with new HDPE liners and welded to the old liners.
- The contractor shall also dig out the old liners outside on top of the pond walls and around the pond area.
- The cut out pieces shall be monitored for any possible contamination by the RPO and placed inside the quarantine area.

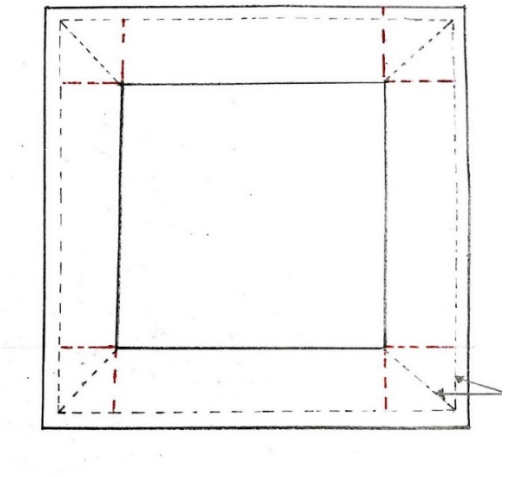

Figure 3: Cutting position of old liner

10.5 INSTALLATION OF THE NEW FIRST LINER

- Cover the old folded liner with a new 2 mm thick HDPE liner (possible welding together of new cover as needed) and tucked over the folded edges to cover the old lining.

10.6 COVERING OF THE NEW LINER WITH SECOND LAYER OF SAND

- This new layer of sand shall follow the exact profile and slope of the covered old liner to divert the rain water flow to the north western corner of the pond.
- The new layer of sand shall have a minimum 100mm thickness.

10.7 DRAINAGE SYSTEM DESCRIPTION

- The drainage on the pond is controlled by the slope of the sand, through gravity, the rain water will flow down the pond to the north western corner.
- This stream of water shall flow through a pre-cast culvert bridge, at least 1,2m wide span. See figure 5 below.
- The contractor should dig a trench from the edge of the pond that passes through the full length (± 8.7m) of the inspection road up to the exit point. See figure 4
- After completion of the drainage system, an investigation must be done on the stability of the wall on top of the drainage system.
- An investigation and final report needs to be compiled by the contractor to be reviewed by Necsa and then submitted to the NNR.

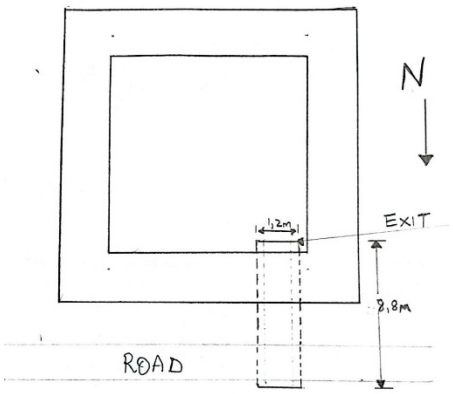

Figure 4: Culvert Bridge at Exit point

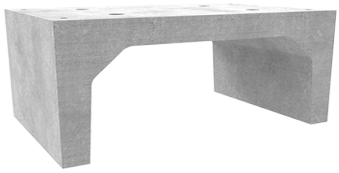

Figure 5: Pre-cast Culvert

10.8 INSTALLATION OF FINAL TOP LINER

- After the second layer of sand (which is the final layer) has been laid into the pond, a layer of 2 mm thick HDPE liner must be installed.
- The width of the liner does not cover the full surface of the pond and thus they must be joined. At the joints they must be welded together to ensure a leak tight surface.
- The length of the liner is required to cover the pond from the outer edges, walls and the inside.
- The liner on the outer edges will be placed in the groove that was created during the digging out of the old liners on top of the walls.
- The outer edge of the liner will be covered with the soil removed during the digging out of the old liners, this method will ensure that water from outside the pond does flow into the pond.
- The top liner must be installed in such a way that it enters the culvert channel.

- Sand bags shall be utilized to hold the liner down for the duration of the installation period to prevent the liner from being blown away.

11.0 FLOW CONTROLL OF WATER DRAINED FROM POND 4 TO THE SURROUNDING ENVIRONMENT

After completion of the capping process of pond 4, a water flow control system needs to be implemented to ensure that the flow of water drained from the pond via the culvert system is controlled in such a way that soil erosion as a result of the water flowing from the drain system is prevented. See Figure 6 for the layouts of the water control systems. At the exit side of the drainage system on the other side of the road a concrete channel shall be constructed with a slight slope to ensure the flow of water from the exit into the environment.

The concrete channel shall be at least 150 mm thick and the same width as the channel through the road.

Rocks from the area with a diameter of between 100 mm and 200 mm shall be placed inside the wet concrete at different positions (see Figure 6). The rocks shall be placed one third of its diameter into the concrete and the two thirds shall protrude upwards from the concrete. The length of the concrete channel shall be determined on site during the site visit.

Figure 6: Rocks imbedded in concrete

12.0 RADIOLOGICAL MONITORING OF THE WATER OUTLET POINT FROM THE DRAINAGE SYSTEM.

It is not foreseen that there will be a need for the monitoring of drained water from the pond (mainly rainwater) at the outlet point of the drainage system on a continuous basis. As the contaminated contents of the pond are completely enclosed/covered with non-contaminated material, the possibility of contaminated material seeping out of the pond, into the drainage system, is extremely low.

It is therefore suggested that:

- A sample is taken at the outlet of the drain system after the first rain storm (after capping of the pond).

- Depending on the results of the sample after it was analysed, the way forward for future sampling (frequency etc.) to be determined.

13.0 RECORDS

The documentation pertaining to the radioactive waste and the results of the tests, checks and inspections carried out shall be retained as quality & RP related records at PDO.