# FUEL TRANSFER CASK; PROCEDURE OPTION AND RADIATION PROTECTION DURING TRANSFERRING THE SPENT FUEL

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**Abstract**

*Reactor TRIGA PUSPATI (RTP) has been operating almost 30 years. Many components are ageing. Nuclear Malaysia has taken an initiative to manage this ageing problem to prolong the life of the reactor. Hence, reactor upgrading project already commence started with the reactor console. To upgrade the core, all the fuel must be taken out from the core. A conceptual design of fuel transfer cask already done. This paper will discuss about the option of safe working procedure for transferring the fuel to the spent fuel pool for temporary. Hence, radiation protection for operator should be considered during the process.*

## 1. INTRODUCTION

Reactor TRIGA PUSPATI (RTP) has been operated safely since 1982. It is almost 29 years and many of the component need to replace due to ageing problem. The ageing management should be carried out to prolong the life of the reactor. The upgrading initiative was commenced due to these problems. The main intentions of the upgrading are to enhance the capability of this reactor. The scope of the upgrading divided into three which is RTP proper, beam utilization, instruments, and facilities, and supporting infrastructure.

One of the main tasks to support this upgrading project is to transfer out all the fuel inside the core to spent fuel pool. A transfer cask has been design to transfer the fuel. The transfer cask still in conceptual design and the safe working procedure must be establish before commence the task.

### 1.1 Fuel Transfer Cask

The fuel transfer cask design concept is based on Morocco design. Morocco Research Reactor is a 2 Megawatts capacity but the fuel specs are the same as RTP. Overall cask has 41 cm diameter and 163 cm height. The cask is filled with lead and the outer layer is enclosed with stainless steel. Drainage system is available at the top and the bottom of the cask to allow coolant to be drained out. On the top of the cask is the cap that shields radiation on the top side. At the bottom is the sliding drawer to prevent the fuel from drop.

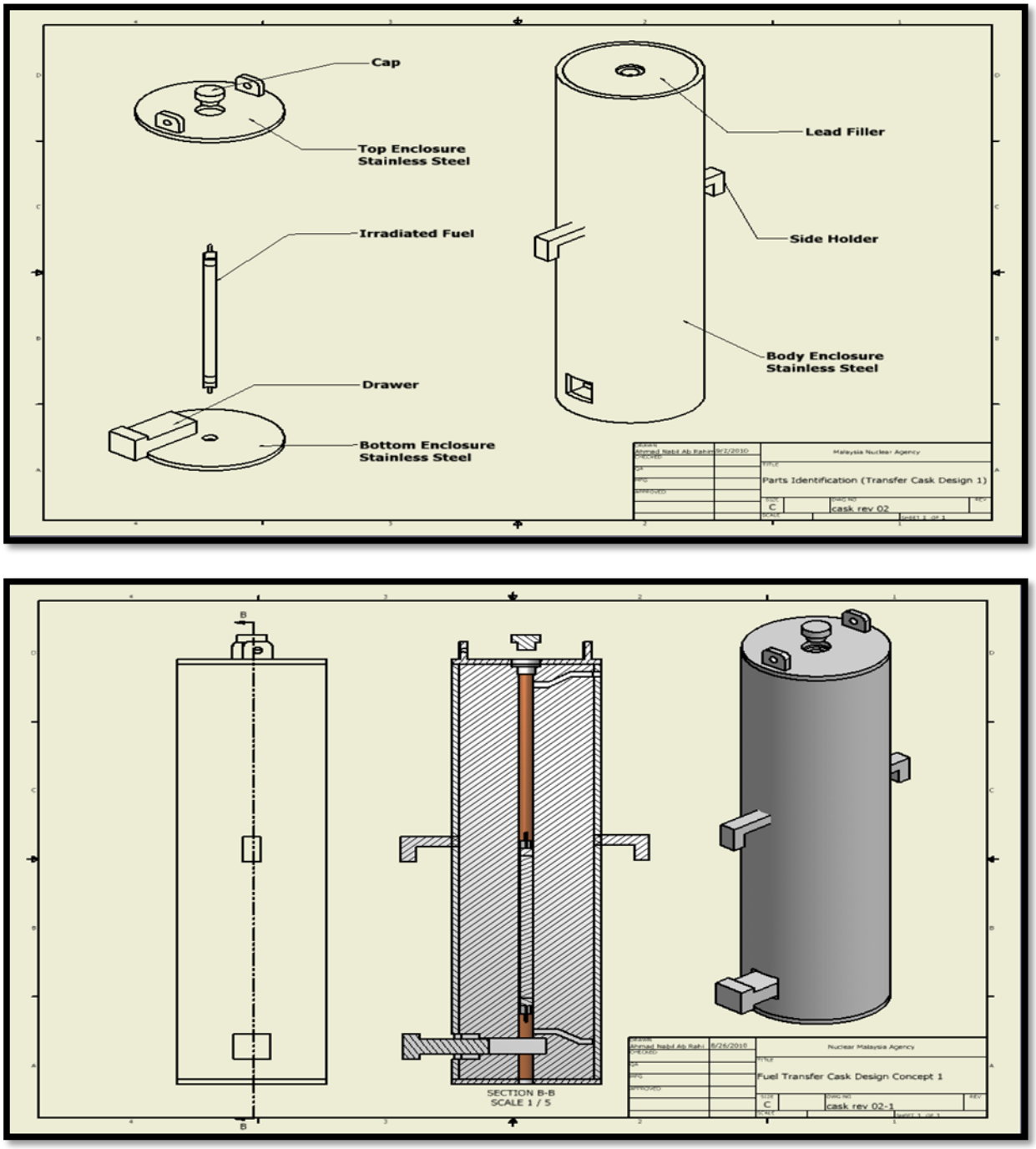
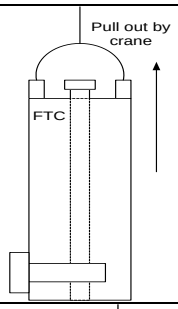
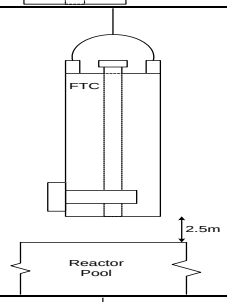
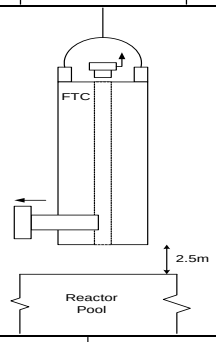
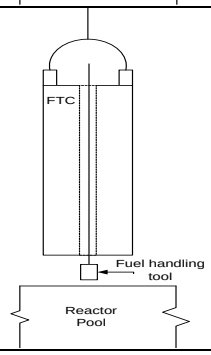


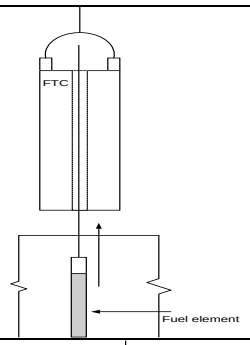
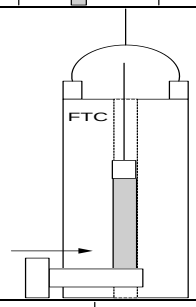
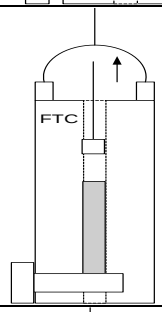
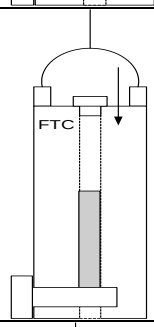
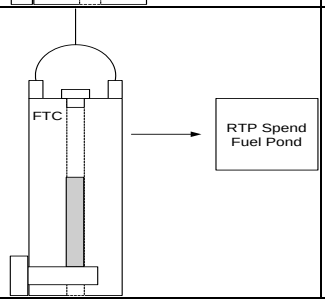

Figure 1 : Conceptual design of fuel transfer cask

To ensure the safety during the transferring the fuel, safe working procedure should emphasize the radiation exposure to operators and environment. This safe working procedure still in revision process and need to be improved time to time before commence the job. This working procedure is open to receive any feedback and comment for improvement.

## 2. SAFE WORKING PROCEDURE

The proposal of the procedure is show below:

| Process flow | Description |
|---|---|
|  | The fuel Transfer cask need to be pulled out from its storage by crane. |
|  | **<u>The option</u>**<br>The fuel transfer cask will be hanging 2.5m from the top of the reactor pool.<br>**Or**<br>Lowered down the cask into the reactor tank until reach on the top of the reactor core and will lay down at the side of the reactor core (on rotary rack) |
|  | Take out the fuel transfer cask cap and drawer. |
|  | Enter the fuel handling tool inside the center of the fuel transfer cask until it come out from the bottom of the fuel transfer cask. |

| | |
|---|---|
|  | Lift up the spent fuel by using the fuel handling tool. Then pull out the fuel handling tool in order the spent fuel to get in the fuel transfer cask. |
|  | Pull in the drawer at its original position. |
|  | Release the fuel and take out the fuel handling tool. |
|  | Insert the fuel transfer cask cap at its original position. |
|  | Take off the fuel transfer cask to the spend fuel pond. (Location of the spent fuel pool will be defined later). |

A typical design consists of a heavy lead container (i.e. 1500 kg) suspended on the overhead crane, then the cask is The fuel transfer cask will be hanging 2.5m from the top of the reactor pool or lowered down the cask into the reactor tank until reach on the top of the reactor core and will lay down at the side of the reactor core (on rotary rack) and the spent fuel element is pulled with the handling tool into the transfer cask. The bottom shutter is closed and the security lock is activated. Hereafter the fuel element can either be transferred to the spent fuel storage or to the spent fuel inspection container. Unless an emergency transfer is required, the fuel element is stored in the reactor tank for about 6 to 8 weeks for decay of the fission products and activated cladding materials.

## 3. RADIATION PROTECTION

All of the radiological protection measures in connection with planning the procedure and handling the fuel elements were aimed at the following:

1. minimizing the dose rate for staff involved
2. minimizing the local dose rates
3. avoiding contamination and the spread of contamination
4. preventing the release of airborne radioactive materials into the environment
5. avoiding radioactive fluid waste
6. avoiding additional radiation for persons not involved

ALARA concept will be implemented during this task. ALARA is an acronym formed from the phrase “As Low as Reasonably Achievable.” The ALARA principle will be implemented for individual and collective doses, in an evolving design process and demonstration adequate radiological occupational dose level.

The following mitigation methods can often be a practical and effective means of minimizing external radiation hazards. These methods are based on three aspects:

1. **Time** - Reduction of time of exposure can directly reduce radiation exposure.
2. **Distance** - Increasing the distance between you and the radiation source will reduce exposure by the square of the distance. This principle applies to sources of penetrating radiation (x-rays, gamma rays, or high-energy beta particles). Increasing distance may not be necessary if the radiation is non-penetrating (alpha particles or low energy beta particles).
3. **Shielding** - Shielding a radiation source often involves additional economic considerations. It is not necessary to shield every source. However, shielding can effectively reduce radiation doses in some situations. All these approach were used in loading process.

These principles had also been applied to the technical design of the components used for handling the fuel elements.

For measuring for avoiding the spread of contamination along the process, this action will be suggested to be taken to avoid the spread of the contamination:

1. The floor will be covered with protective cloths before any components which had been in contact with water from the reactor tank were set down.
2. Extra overshoes will be provided in the reactor room and in the temporary building.
3. The floor of the transfer route will be covered with protective sheeting.
4. The individual components will be checked to make sure they were free of contamination when they will be brought into the control area.

During handling of the fuel elements direct surveys were made of adherent and non-adherent contamination and wipes were taken. The survey included:

1. The concentration of activity in the air will be determined every working day (dust collectors in the reactor room, the temporary building and along the transfer route)
2. The concentration of activity in the ventilation bypass in the temporary building will be determined every working day
3. Contamination of the floor in the reactor room, along the transfer route and in the temporary building will be measured directly
4. Persons will be checked before leaving the reactor room and the temporary building in order to ensure that they were free from contamination
5. Decontrolling measurements will be made along the transfer route and in the temporary building after the handling of the fuel elements was completed

## 4. CONCLUSION

To ensure the safety during the process, this working procedure should be established to optimize the hazard. Next, guidance from other countries and assistance from expert are required to complete this procedure.

The radiation protection should be emphasized in order to ensure the safety and health for the operator and environment during this process.

## REFERENCES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[4] Anonymous, ***"TRIGA Reactor Main Systems"***