DELPHI: a New Subcritical Assembly at Delft University of Technology

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This paper describes the new subcritical assembly called DELPHI at Delft University of Technology. It consists of two vessels one upon the other, and contains 168 fuel pins made of 3.8% enriched UO$_2$ fuel. The upper acrylic vessel is used to store the fuel pins when the assembly is not in use. With a special handling tool the fuel pins can be loaded into the water-filled steel vessel. The source is stored in a shielding box below the steel vessel and can be inserted pneumatically up to a height of 2 cm below the fuel zone of the pins.

DELPHI became operational at the beginning of 2004 and will be used for training of students and reactor operators from the Netherlands and abroad and for basic research on reactivity determination methods.

KEYWORDS: Subcritical assembly, LEU fuel, Cf-252 source driven

1. Introduction

For educational purposes, the Reactor Physics Department of IRI used to operate a subcritical assembly containing 253 fuel pins made of natural uranium (metal) in a hexagonal lattice. As a moderator, light water was used. However, for some practical reasons, like the heavy weight of each fuel pin (almost 7 kg), the rather low $k_{eff}$ ($\approx 0.85$) and the fact that some fuel pins stuck to the grid plates, this assembly is not used anymore. Therefore, it was decided to build a new assembly, called DELPHI, for both the purposes of training and research. The following training exercises are foreseen:

- Static determination of the multiplication factor by the so-called critical assembly approach [1] [2].
- Axial and radial neutron flux measurements.
- Source jerk experiments.
- Neutron noise experiments like Feynman-$\alpha$, and correlation measurements.

In principle, DELPHI consists of two vessels one upon the other. The lower vessel is made of stainless steel and is filled with de-mineralized water before the start of an experiment. The upper acrylic air-filled vessel is used to store 168 fuel pins that can be loaded into the steel vessel one after the other using a special handling tool. Below the steel vessel, a shielding box is positioned containing a $^{252}$Cf-neutron source that can be inserted pneumatically to its experimental position in the steel vessel. This document gives a description of DELPHI and of the various safety aspects.

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