CONCEPTUAL DESIGN FOR IRRADIATION DEVICE USED TO IRRADIATE EXPERIMENTAL LFR FUEL ELEMENT IN TRIGA REACTOR, ACPR ZONE

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ABSTRACT

The paper presents the main steps followed to conceive a small, versatile and rather cheap irradiation device used for irradiation of an experimental fuel element, specific for Lead cooled Fast Reactor (LFR), adapted to TRIGA reactor, ACPR zone. This device must be instrumented with at least 4 thermocouples and a pressure transducer. The fuel element (150 mm fuel pellets column) will be immersed in maximum 0.350 kg pure hot lead (400 °C). The system has three protection barriers, as follows: first is the fuel tube, second is the lead container (maximum 20 mm inner diameter) and third is the external container (maximum 180 mm outside diameter). Before the reactor pulse, the temperature of the lead is set at the prescribed value using an electrical heater (300 W), coil on the second barrier. Outside the second barrier a very good thermal insulation is provided.

Key words: LFR, TRIGA

Introduction

This paper aims to propose a constructive solution for an irradiation device destined to receive, to protect and to measure an experimental fuel element LFR type, during a power pulse of TRIGA reactor. At same time, this device must be simple, versatile and rather cheap because it will be used only for a single reactor pulse.

Note: Ref [1], [2], [3]

Work&Results

The following steps of works were:

1. The exact position for the device and all dimensions of the irradiation channel of the ACPR-reactor were obtained.
2. The general concept of the new device was adapted to reactor safety conditions. Consequently, three protection barriers are to be provided. See Figure 1 to Figure 35.
3. Five design-concepts were created, to be compared and confronted with another involved specialists. Finally, only two concepts resisted, namely those which are presented in this paper: Figure 18 to Figure 21 present the second concept and Figure 22 to Figure 25 the first (but a very much heavier) concept.

Figure 1 and Figure 2 present the lower plug and the upper plug of the experimental fuel element. Figure 3 presents the components of a fuel element: plugs, fuel pelets, sheath. Figure 4 and Figure 5 present the fuel element, assembled.

Figure 6 to Figure 12 present different stages of assembling works of fuel element and of the barriers.

Figure 13 to Figure 15 gives fully assembled capsule image.
Figure 17 Section view of the second barrier

Figure 18 to Figure 21 present the components of the second barrier, second concept (final concept).
Figure 22 to Figure 35 present different stages of the general assembly of irradiation device.

Conclusions

1. The irradiation device must be very simple, easy to manufacture and rather cheap because it is destined to be used only for a single pulse of the reactor.
2. All materials are stainless steel AISI 316 except the thermocouples, the electrical resistance and the cables.
3. No special manufacturing procedures and techniques are needed for construction.
4. Because of the lead, no high gas pressure is imposed.

References