TVS-2M 燃料棒用氦检漏预装盒上料装置研制

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摘 要:氦检漏预装盒上料装置是使 TVS-2M 燃料棒从水平工位变换到铅锤工位的重要装置。预装盒上料装置组成包括机架、升降机构、顶料机构、拨料机构、推齐机构、预装盒支撑架以及电气控制系统。机架采用 8080 型号的铝型材,升降机构选用步进电机搭载减速箱和驱动,拨料机构采用双直线运动、抗变形结构、热处理设计,推齐机构为不等值双推力方式。设备研制后,分别进行了燃料棒无痕实验、拨片准确率和装盒效率实验,结果均符合或优于设计指标。结论:新研制的装置可以满足 TVS-2M 燃料棒预装工作;预装后的燃料棒表面无划伤或划痕;装盒准确率 100%;一次装入 330 支燃料棒用时 25min。

关 键 词:预装盒;上料装置;燃料棒;双直线运动

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Development of Helium Leak Detection Pre-packed Feeding Device for the TVS-2M Fuel Rod

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Abstract: Helium leak detection pre-packed box device is an important unit for the TVS-2M fuel rod to change from horizontal to plumb position. The charging device of the pre-packed box consists of a frame, lifting mechanism, jacking mechanism, material shifting mechanism, pushing mechanism, pre-packed box support frame and an electrical control. The frame is made of 8080 aluminum profile, with adjustable accessories such as feet. The lifting mechanism is equipped with a gearbox and drive by a stepping motor, on which an aluminum profile blanking frame is installed. The feeding mechanism adopts double linear motion design, which is divided into linear feeding and plumb bob lifting to avoid the deformation caused by rotation. The pusher mechanism is driven by two unequal cylinders at the same time and the pusher plate is made of polyethylene material. After the development of the equipment, the effect verification was carried out respectively, including the selection of 500 fuel rods for test, the manual inspection of the accuracy of the paddle of the pre-packed device for helium leak detection, and the timing of 330 fuel rods with a stopwatch. The above verification results are in line with or better than the design indicators, which indicates that the design of the device meets the requirements. The conclusion is as follows: the newly developed device can meet the requirements of the TVS-2M fuel rod pre-packed assembly, no scratch or scratch on the surface of the fuel rod after pre-packed assembly, and the accuracy of packing is 100%. It takes 25 minutes to load 330 fuel rods at a time.

Key words: pre-packed box; loading device; fuel rod; double linear motion

为将水平放置的燃料棒装入立式的高温氦检漏容器进行氦检漏,需将燃料棒装入预装盒(一次性最多装入 330 支),旋转后吊入容器,执行预装燃料棒动作, 采用的是氦检漏预装盒上料装置。国外包括法国、美国、日本等因工艺不同,采用水平检漏方式,不用氦检漏预装盒上料装置。根据工艺需求,目前仅有俄罗斯采用该装置。中核建中为田湾核电站生产的 TVS-2M 燃料棒采用俄罗斯工艺,目前还未有自动化预装盒装置,为满足使用需求和实现国产化需研发一台。

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