高温对 TVS-2M 燃料棒氦检漏结果的影响

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摘 要:分析(160~320)℃高温对 TVS-2M 燃料棒氦检漏结果的影响。利用检漏仪分析不同温度下,氦检漏结果的变化,分析高温是否影响检漏结果和影响因素。通过实验,找到放气速率最快的温度范围和放气时间。得出以下结论:TVS-2M 燃料棒放气是导致高温下氦检漏结果增大的根本原因;TVS-2M 燃料棒在(200~220)℃放气速率最快;延长 TVS-2M 燃料棒在(200~220)℃温度停留的时间,可消除放气速率引起的氦检漏结果增大的影响;保温温度在(200~220)℃,保温时间在(1~1.5)h 时,TVS-2M 燃料棒氦检漏结果真实准确。

关 键 词:核反应堆;燃料棒;高温影响;氦检漏;放气

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Effect of High Temperature on Helium Leak Test Results of the TVS-2M Fuel Rod

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Abstract: The effect of high temperature (160 ~320)℃ on the helium leak detection results of TVS -2M fuel rod was investigated. The leak detector is used to analyze the change of leak rate value under different temperatures, and to explore whether high temperature affect the leak detection results and influencing factors. Through the experiment, the fastest temperature range and time of outgassing were obtained. The following conclusions are drawn: the main reason for the increase of helium leak detection results under high temperature is the venting of tvs-2m fuel rod; the fastest venting rate of TVS-2M fuel rod is at(200-220)℃; prolonging the residence time of TVS-2M fuel rod at (200~220)℃ can eliminate the effect of the increase of helium leak detection results caused by venting; when the holding temperature is at(200~220)℃ and the holding time is at(1~1.5)h, TVS-2M helium leak detection results of fuel rods are true and accurate.

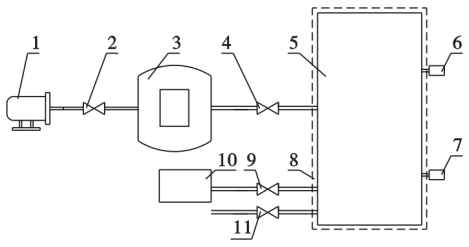
Key words: nuclear reactor; fuel rod; high temperature effect; helium leak detection; outgassing

燃料棒是核反应堆内重要的组成部分,其密封性优劣直接决定核电站能否安全运行[1]。国际上大部分国家压水堆的燃料棒密封性检测均在常温下进行检漏,而包括俄罗斯、我国田湾核电站(TVS-2M 燃料棒)以及实验快堆在内的燃料棒则在高温下进行[1]。国际上鲜有针对高温下 TVS-2M 燃料棒氦检漏的相关资料[2],为此特对(160~320)℃温度下 TVS-2M 燃料棒氦检漏结果进行探究。TVS-2M 燃料棒以下简称燃料棒。

1 实验原理和设备

1.1 实验原理

燃料棒内充有一定压力的氦气,当燃料棒密封性不好,氦气会从棒内释放,通过容器泄漏到检漏仪中,并被收集和转换为相对应的漏率值。将燃料棒分别加热到不同温度,利用检漏仪读出相应漏率结果,结合常温下燃料棒放气速率,探究高温对燃料棒检漏结果的影响。



1- 机械泵;2- 前级阀;3- 分子泵;4- 高真空阀;5- 检漏容器;6- 标准漏孔 F1;7- 标准漏孔 F2;8- 加热装置(图中虚线部分,在检漏容器 5 外部施加热源);9- 检漏阀;10- 检漏仪;11- 充气阀(放气)

图 1 高温氦检漏系统结构图

Fig.1 Structure diagram of the high temperature helium leak detection system

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