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1.36 The Operating Experience and Incident Analysis for High Flux Engineering Test Reactor

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Abstract

The paper describes the incidents analysis for High Flux Engineering test reactor (HFETR) and introduces operating experience. Some suggestion have been made to reduce the incidents of HFETR. It is necessary to adopt new improvements which enhance the safety and reliability of operation

Key words: HFETR operating experience incident analysis

1. INTRODUCTION

HFETR was designed and built by China own efforts. It's a high enriched uranium fuel, light water moderator and coolant, beryllium reflector and 125MW thermal power reactor with a pressure vessel. The main task of HFETR is to carry out the irradiation test of power reactor fuel element and nuclear materials, and to give consideration to the

production of isotopes with high specific radioactivity intensity as well.[1]

It has been verified that HFETR is successful since the reactor achieved high power operation in 1981. With the development of new technique and new method for nuclear engineering , more and more attention has been given to HFETR for its operating safety and reliability. It became important that How to use technology improvement and obtained rich operating experience to enhance operating safety and reliability .

2. HFETR incidents analysis

From 1981 to 1997, many abnormal incidents has occurred in operating process. All of them were recorded by staff who attended reactor operation as history record. Through statistic and analysis of those data, we can find out potential problem and deal with them in order to achieve good operation condition.

2.1 sub system incidents analysis

In order to confirm failure of sub system for HFETR concretely, we divide HFETR into eight groups according to function and demand[2], analyse abnormal incidents and figure out proportion of each group. The result was shown below.

A: reactor coolant system 18.1%

B: reactor control system 21.4%

C: reactor power supply system 17.2%

D: reactor thermal instrument system 7.3%

E: reactor water supply system 7.7%

F: reactor dose monitoring system 6.9%

G: reactor auxiliary system 10.8%

H: reactor test loop system failure 10.5%

Brief information of failure proportion for each group accounting for total incidents was shown in Figure-1.

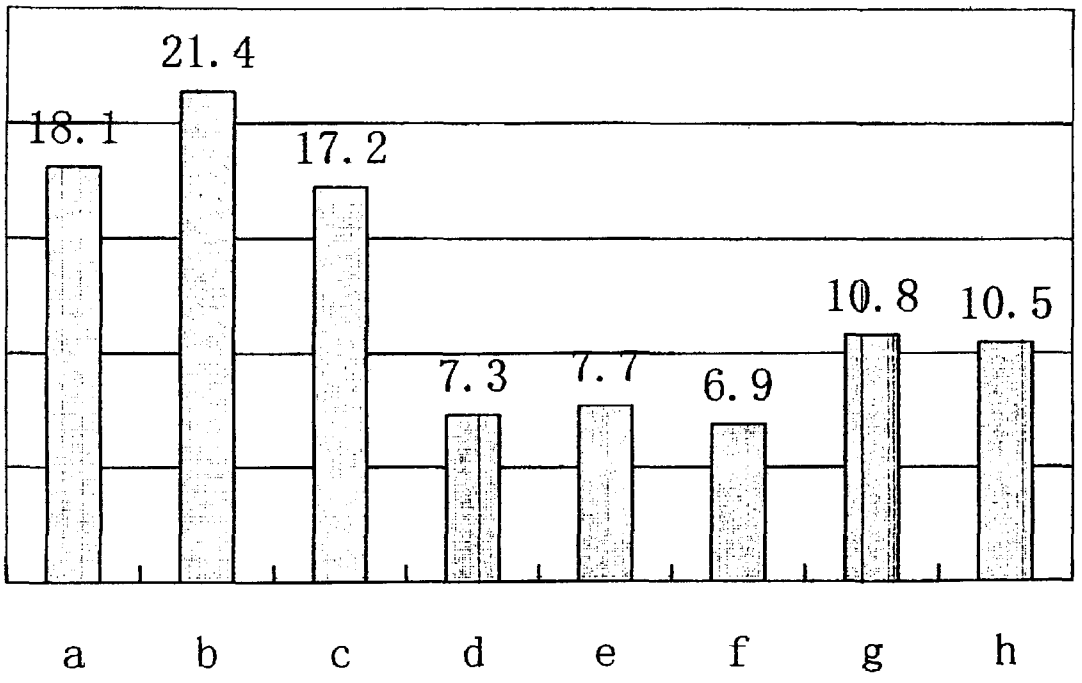

Figure-1 sub system failure proportion

2.2 Incident Cause Analysis

According to original records of incidents, we class incidents by cause. The result was shown below.

A: equipment failure	56.27%
B: operating failure	9.58%
C: maintenance	8.35%
D: external incidents	9.82%

The sum of A, B, C and D is 83%. Figure-2 showed the result .

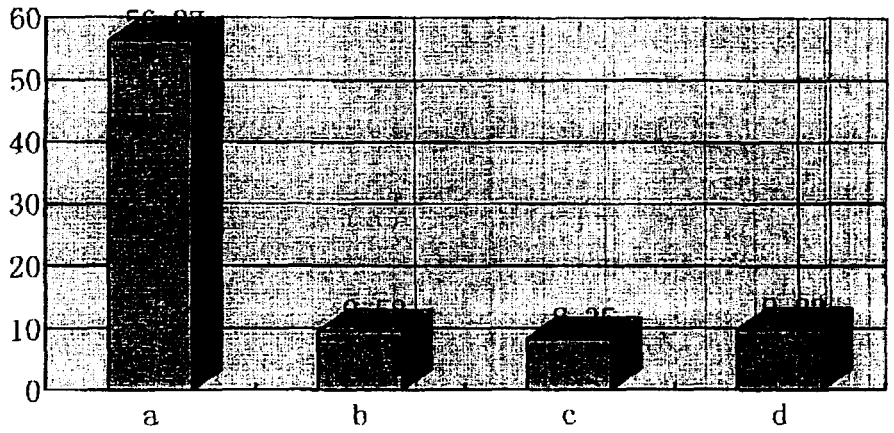

Figure-2 Incidents cause proportion

2.3 Incidents Consequence Analysis

Through the statistics of incidents, it has been verified that neither workers' radiation injury nor unplanned radiation release beyond dose limit has occurred. Almost 84% of incidents has no effect to safety, 6% of incidents lower the operation parameter , 5% of incidents has potential consequence. Only 2 piece of incidents make a reactor trip, which

resulted mainly from human errors. It is not to be ignored.

3. Operating Experience

The successful operation of HFETR has been for eighteen years, the safety of the reactor has been given top priority, a reasonable safety margin has been kept in the selection of operating parameters. The control protection and safety devices are installed strictly in accordance with the principle of multiplicity and independence . We have tried our best to protect environment following the principle of "ALARA" to treat radwastes.[3]

It should be emphasized that almost 18% of incidents has occurred due to human errors not only in operation but also in maintenance . Human errors are more frequent in system having low levels of availability or those not sufficiently automated. Activities such as testing and maintenance are a common cause of errors.

The control system and coolant system of HFETR have a higher failure percentage because of equipment failure (83%). The most of component for these system, especially some electric equipment and mechanism were manufactured twenty years ago, aging product has not been replaced by new product completely. It's necessary to make progress by use of advanced technology .

HFETR located in mountainous area, Thunderbolt threaten the safe

operation of HFETR in thunder storm season. Operating staff maintain reactor in normal operation with heavy mental pressure. lightning bring about the reactor shut down for because of action of protection system. The protection standard of thunderbolt in HFETR is voltage fluctuation lower 75% of rating voltage and continuable time over 0.5 second. There are three condition of reactor shut down.[1]

1. Continuable time over 0.7 second, loss of power supply , reactor shut down.
2. Continuable time between 0.5 and 0.7 second, power supply is in good condition, but some important equipment in using lose power supply, reactor shut down
3. Continuable time less 0.5 second, power supply and equipment are in good condition, reactor shut down.

The third condition account for a certain proportion in thunderbolt season.in order to ensure reactor safety and keep good condition for equipment, there are two ways to lower disadvantage of operation in lightning . One way is installing lightning arrester, another is selecting proper delay time of relay for protection system .How to resolve it is a considerable question.

4. Suggestion

4.1 Behavior of operator is very important to ensure the safety of the

reactor, operating experience shown that human errors accounts for a considerable proportion of safety-related incidents. Education and continuing education is necessary so that required performance levels are achieved and maintained, it includes initial training, retraining, and the updating and broadening of knowledge and skills.

4.2 With the progress of advanced technology and science , we should improve control & protection system and coolant system of HFETR , replace aging product , develop support system , ensure operating safety.

4.3 The safety operation of reactor is a large and complex interactive system , includes design , construction , operation , maintenance and management. It's very important to strengthen feedback and exchange of safety experience. We have ever solved disadvantage of design successfully from exchange of operating experience

Reference

[1] Compilation of Literatures on the First Ten-Years Operation of HFETR, NPIC, Sichuan science and technology publishing company,1991

[2] Research Reactor Safety Regularization, NNSA,HAF1000-2,1995

[3] Nuclear Power Plant safety Operation, NPIC report