CHAPTER 7

CONCLUSIONS

7.1 Summary

In order to assure the Core fuel Management Schemes that have been established to use with the TRR-1/M1 effectively, a substantial investigations have been performed as follows :-

As previously mentioned at the beginning of this study by using the computer model, the core configurations and the ^{235}U mass loading in each position in the core were the same as actual experiments. The result was compared very favorable to the measured value as experimented by GA Technologies Inc.

The operational history of TRR-1/M1 is compared with that from calculations (see Table 4.1). The BOC excess reactivities of calculated values are slightly lower than that of measured values. The measured and calculated EOC excess reactivity values are in good agreement. The cold to hot core reactivity changes approximately \$ 2.41 or 1.69 % $\delta k/k$. It compares very closely to the value \$2.40 measured by GA(10) However, it is very difficult to predict the change of reactivity due to temperature defect. Especially, in pulsing operation, the reactivity difference can be as much as 50 %

Due to the simplicity of the schemes. If for any reasons the schemes have to be changed, they can be made without any difficulties (see section 6.6). This is very helpul in planning to make the new purchase of 20 wt % LEU elements.

From the result of calculations, Core No.'s 5-12 can provide total energy of 891.87 MWd. Upto now, core No.5 has been operated with energy release of more than 65.76 MWd. (Measured on March 3, 1986).

7.2 Discussions

As an independent check on the values of the microscopic cross sections generated with the EPRI-CELL/RERTR code, a unit cell with the identical geometry and material compositions was also set up and run using the VIM continuous-energy Monte Carlo code. The VIM cross sections were then collapsed into 11 broad energy groups. In separate diffusion theory calculations for the initial critical core, the Monte Carlo-generated fission and capture cross sections for ^{235}U and ^{238}U were substituted for those generated using EPRI-CELL/RERTR. All of the other cross sections were those generated with EPRI-CELL/RERTR.

The results are improved considerably using VIM-generated fission and capture cross sections for ^{235}U and ^{238}U. In this case, the calculated excess reactivity of 0.177 % $\delta k/k$ compares very well with the measured value of 0.168 % $\delta k/k$.

The results of this study can be summarized as follows.

1. The refueling scheme did not included fuel loading in the G-ring due to the larger number of fuel elements (26 elements), but relative low reactivity can be achieved. The loading schemes used

E- and F-ring can not be used economically in G-ring.

2. The study was performed only for the neutronic part, for research reactor it is very important to consider the overheat problem that may violate the safety limit regulatory

3. In rearranging the elements, the instrumented fuel elements located at B1 (8.5 wt.% LEU) and at D8 (20 wt.% LEU) were not removed from the original positions, regardless of ^{235}U content. This may adversly affected the flux within the core (only in B1)

4. Four Fuel Follower Control Rods used last to core No 12, the average ^{235}U about 21.2 grams/rod. This may cause the same problem as in B-1.

7.3 Suggestion for future research

The study of core, and fuel management for the TRR-1/M1 should be perfected with thermal hydraulic study as well as neutronic study. One should have the computer codes in hand in order to change the schemes whenever the situation requires.

In order to obtain the results more closer to the experimental values, one should use the "As-built" ^{235}U loading and VIM continuous-energy Monte Carlo code for generating cross sections.

To complete the refueling schemes in the G-ring the following procedure should be possible e.g. move eleven partially-burned elements with 20 wt.% U from the D-ring into the C-ring, insert eleven fresh elements with 20 wt.% U into the D-ring, discharge the eleven 8.5 wt.% U rods with the lowest ^{235}U content from the core, and move the eleven 8.5 wt.% U rods with the highest ^{235}U content into the G-ring.

For the next refueling, move the six 20 wt.% U elements with the lowest ^{235}U content into the B-ring, etc.

In this procedure, the fluxes in the lazy susan need to be checked to ensure that they are not adversely affected by having only 8.5 wt.% U elements in the G-ring.

Other equivalent fuel replacement sequences are also possible. One involves adding fuel elements with 20 wt.% U into the E-and F-rings at an earlier stage and shuffling partially-burned elements with 8.5 wt.% U between the inner zone and the storage pool in order to achieve the maximum burnup in the 8.5 wt.% elements.

In addition, the fuel follower rods need to be replaced at some point.