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GRID-SPACER REMOVAL MODEL

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SUMMARY

A model has been developed for SCDAP to treat the effect of grid spacer removal. The model simply tests the grid temperature against the melting temperature of the grid spacer material. If the grid spacer temperature is equal to or above its melting temperature, the grid is removed as an obstruction.

CONTENTS

SUMMARY	ii
1. INTRODUCTION	1
2. GRID SPACER MODEL DESCRIPTION	2
3. GRID SPACER MODEL USE AND CODING	3
3.1 Model Use	3
3.2 Model Coding	3
4. ACCEPTANCE TESTS	4
5. REFERENCES	5

TABLES

1. Arguments for subroutine GRID	3
2. Pseudo-language for subroutine GRID	3

1. INTRODUCTION

The U.S. Nuclear Regulatory Commission is sponsoring the development and assessment of best estimate computer models which analyze the behavior of nuclear reactors during off-normal and accident conditions. This includes development of a computer code to provide information on severely damaged cores. The Severe Core Damage Analysis Package (SCDAP)¹ is being developed for this purpose with the first step being to model the phenomena for a single fuel bundle. Included in this development are models which account for behavior of each component existing in a fuel bundle. The component described in this report is the grid spacer.

Section 2 describes the grid spacer removal model. Section 3 presents the coding aspects of the model. Section 4 presents the acceptance tests.

2. GRID SPACER MODEL DESCRIPTION

The grid spacer model consists of a simple removal process, whereby, a grid spacer is removed as an obstruction when the grid temperature reaches or exceeds the melt temperature of the grid material. The grid spacer is only modeled as an obstruction for debris regions or flow of liquefied material.

Grid spacers are constructed from either zirconium or inconel. The melt temperature of zirconium is approximately 2150 K while the melt temperature of inconel is approximately 1670 K.

This model assumes no oxidation of the grid spacer and no chemical interaction between inconel and the zircaloy fuel rod cladding.

3. GRID SPACER MODEL USE AND CODING

3.1 Model Use

The grid spacer removal model is implemented by calling subroutine GRID as follows.

CALL GRID (GTEMP, ZGRID, NGRID, TMPMEL, NDGRID)

The arguments are defined in Table 1. The grid melt temperature will be provided by the user.

TABLE 1. ARGUMENTS FOR SUBROUTINE GRID

<u>Variable</u>	<u>Definition</u>	<u>Units</u>
GTEMP	Grid spacer temperature	K
ZGRID	Grid spacer locations from bottom	m
NDGRID	Maximum number of grid spacers	--
NGRID	Number of grid spacers	--
TMPMEL	Grid spacer melt temperature	K

No library routines are called by GRID. GRID is called by FUELAN CYLIN, and SLABC before the call to the damage routines outside of the convergence loop and returns the location of each remaining grid spacer. The grid temperature will be defined in FSTATE.

3.2 Model Coding

The pseudo-language for subroutine GRID is shown in Table 2.

TABLE 2. PSEUDO-LANGUAGE FOR SUBROUTINE GRID

```
:DO UNTIL: ALL SPACER LOCATIONS ARE EXAMINED
  :IF: GRID TEMPERATURE .GE. MELT TEMPERATURE :THEN:
    GRID LOCATION IS REMOVED AND THE NUMBER OF GRID SPACERS (NGRID)
    IS REDUCED BY ONE
  :END IF:
:END DO
```

4. ACCEPTANCE TESTS

An acceptance test where five grid spacers spaced one meter apart is posed. The grid spacers were placed above the melting temperature in varying sequences and removing anywhere from one to all grid spacers and removing two and three at one time. In all cases the final configuration was correct both in number and location.

In conclusion, the grid spacer removal is working properly and is ready for incorporation into SCDAP.

5. REFERENCES

1. C. M. Allison et al., Severe Core Damage Analysis Package (SCDAP) Code Conceptual Design Report, EGG-CDAP-5397, April 1981.