Computer Code Abstract

MELT-III

1. Name or Designation of Program: MELT-III.

2. Computer for Which Program Is Designed and Others upon Which it Is Operable: CDC Cyber 74 and CDC 7600.

3. Nature of Physical Problem Solved: The MELT-III Program is a multichannel, neutronics, thermal hydraulics digital computer program developed to investigate the transient behavior of a fast reactor during postulated transient overpower conditions.[1,2] Reactivity feedback resulting from Doppler broadening, coolant density change and expulsion, bulk core expansion, and fuel movement are explicitly taken into account. The bulk of the modeling detail has been addressed to the in-vessel portion of the reactor plant, although the friction and inertial aspects of up to three separate closed primary loops can be simulated. A wide variety of accident conditions may be investigated. Particular modeling emphasis has, however, been placed on the simulation capabilities required for an unprotected transient overpower accident sequence.

4. Method of Solution: The energy equations are solved by a Crank-Nicholson-type implicit scheme. The momentum equations are solved by an iterative implicit scheme.

5. Restrictions on the Complexity of the Problem: Calculations for up to 20 channels (e.g., 20 pins representative of subassembly clusters) and 20 axial segments within the fuel region may be performed simultaneously. A total of 10 different axial coolant flow zones having different flow areas (comprising a total of 75 nodes) can be explicitly modeled in the axial direction. Radial heat transfer calculations within each pin axial segment are done using up to 12 radial fuel nodes (including one surface node), three cladding nodes (including inner and outer surface nodes), a coolant node, and a structural node.

6. Typical Running Time: Typical CDC 7600 run times for cases using essentially full geometric detail are ~0.6 sec per channel for steady-state calculations, 0.2 sec per channel per time step up to the time of cladding failure, and 0.4 sec per channel per time step after cladding failure. These time estimates appear to be increased by a factor of ~2 for the CYBER 74.

7. Unusual Features of the Program: A zero neutron lifetime approximation is available to allow large time steps to be taken during slow moving portions of the transient. Protection is included, however, to assure that failure criteria levels are not overshot.

8. Related and Auxiliary Programs: The MELT-III code is a continuation of the MELT code series with MELT-I and -II being its predecessors. The MELT-III code has significant modeling improvements over the two previous codes, particularly with regard to system hydraulics. It also has incorporated as a subroutine the SIEX code for steady-state fuel pin simulation.[3]

9. Status: In use.

10. Machine Requirements: Storage requirements include 150K octal (55K decimal) of 60 bit words in the central memory of either the CDC CYBER 74 or CDC 7600, and ~300K decimal words of peripheral storage are required on nine logical units for wrapup and plotting purposes.

11. Programming Language Used: CDC Fortran.

12. Operating System or Monitor Under Which Program Is Executed: CDC scope 3.4 on the CYBER 74; the Lawrence Berkeley Laboratory BKY 7600 operating system for the CDC 7600; the scope 2.1 system for the CDC 7600 at the Brookhaven National Laboratory.

13. Other Programming or Operating Information or Restrictions: The MELT-III code uses a plot package that is unique to the local site. For the MELT-III code to be made operational at another site, the calls to these plot routines and the plot routines themselves will have to be removed or replaced with dummy routines. In the steady state, the routines involved are DRAW, LINE, and CSCALE, and in the transient the routines are XPLOTX, LINE, and CSCALE with DRAW and XPLOTX being the controlling subroutines. The call for DRAW is in subroutine STEADY and the call for XPLOTX is in subroutine MELT.

14. Material Available: Magnetic tape (card image form)
    File 1: steady-state program
    File 2: transient program
    Reference report
    Sample problem deck.

15. *References*:

[1]ALAN E. WALTAR et al., "MELT-III, A Neutronics, Thermal Hydraulics Computer Program for Fast Reactor Safety Analysis," HEDL-TME 74-47, Hanford Engineering Development Laboratory (1974).

[2]N. P. WILBURN and A. E. WALTAR, *Trans. Am. Nucl. Soc.*, **21**, 216 (1975).

[3]D. S. DUTT and R. B. BAKER, "SIEX, A Correlated Code for the Prediction of Liquid Metal Fast Breeder Reactor (LMFBR) Fuel Thermal Performance," HEDL-TME 74-55, Hanford Engineering Development Laboratory (1975).

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