problems of graphite in nuclear reactors. The structural and dimensional changes which occur when graphite is irradiated and the effect of irradiation on the electrical, thermal, and mechanical properties of graphite are all discussed very fully from an experimental point of view. A special chapter is devoted to stored energy and the problems of reactor safety rising from it. There is a very good treatment of the theory of the displacement of atoms and, arising from this, a discussion of the relation between various scales of dose measurement. The timing of the book has permitted only preliminary references to the new insight into radiation damage which is now being obtained as a result of electron microscope studies. A single chapter on gas–graphite systems deals with a wide range of topics on the thermal and radiation induced reactions between graphite and various gases, in particular oxygen, carbon dioxide, hydrogen, and steam. Some of the problems associated with the applications of graphite to advanced reactor systems are covered in a chapter on graphite–molten salt and graphite–metal systems and on the use of graphite as a fuel matrix. A final chapter discusses moderator designs.

No single book could be a complete guide to a subject which is developing so rapidly but all concerned with the development and use of graphite will find this book a valuable reference to the well established parts of the subject. Newcomers to the field will be spared much tedious searching in a voluminous report literature.

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(About the Reviewer: The reviewer is a physicist working in the Metallurgy Division of the Atomic Energy Research Establishment, Harwell. He joined the Harwell staff in 1946 after a period of war-time work on radar. At Harwell he has been associated with research into the effect of irradiation on graphite. This work has led to the development of a model for the dimensional changes of graphite, which has had important practical applications, and to advances in the theory of radiation damage, notably in the study of the nucleation and growth of radiation defects.)

Computer Code Abstracts

ADJUST

1. Name of code: ADJUST
2. Computer for which code is designed: IBM 7090
   Programming system: FORTRAN
3. Nature of problem solved: The code performs a numerical redistribution of pulse-height spectra for the correction of gain and/or zero shifts occurring between spectral measurements. The code will operate on and redistribute a pulse-height spectrum as if it had been measured at virtually any desired gain and zero setting.

   Internally the code generates a table of quadratic least-squares fits to the contents of consecutive and overlapping groups of three channels of the original pulse-height spectrum. These are stored as a function of the invariant relating the gain curves of the original and redistributed spectra; that is, if the gain were in channels/volt, the curves would be stored as a function of volts. A new channel width is computed based on the desired new gain and zero. The contents of the new channel is then determined by selecting a curve from the stored table as a function of a value of the invariant, e.g., voltage, corresponding to the location of a new channel and integrating it over the new channel width.

   It should be noted that this code assumes that the original spectrum has been assigned the correct gain and zero parameters. The redistributed spectrum will have no greater accuracy in this respect than the original. The area of the original pulse-height spectrum is conserved in the redistributed spectrum to within $\sim 0.1\%$ unless a large zero shift is encountered. The code also generates a set of pseudo count-rate statistics based on the channel contents of the redistributed spectrum.
4. Restrictions on the complexity of the problem: maximum number of channels, 400; code assumes a linear gain curve; gain shift of no greate than a factor of two (2).
5. Typical running times: less than 1 min for most problems.
6. Availability: in production at Oak Ridge National Laboratory. Copies of this program may be obtained from Mr. John D. Jarrard, Neutron Physics Division, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, Tennessee.

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* Operated by Union Carbide Corporation for the U. S. Atomic Energy Commission.

XITE

1. Name of code: XITE
2. Computer for which code is designed: 32K Philco 2000 with two tape units
   Programming system: modified ALTAC
3. Nature of the problem solved: Transient, two-dimensional hydrodynamic equations (*1*, *2*) representing the conservation of mass, energy, and momentum are solved for flow of water and steam in a vertical rectangular channel of high aspect ratio (width to thickness). The distribution of heat generation in the two plates bounding the channel may be nonuniform in both the axial and transverse directions but must be the same in each plate. Flow redistribution within the channel caused by nonuniform heat input to the fluid (e.g., where boiling is nonuniformly distributed) or by nonuniform surface characteristics is determined by the program. Fluid expansion effects are represented during transients such that, in general, the mass rate of flow leaving the channel is not equal to the mass rate of flow entering the channel. Transient driving functions specified by the

user are the plate power generation rate, inlet enthalpy, and either the inlet mass velocity or pressure drop across the channel.

4. Method of solution: The channel flow distribution is determined at each axial level by neglecting the transverse pressure gradient ($\partial p/\partial y$) in the transverse momentum equation and applying the iterative method of Miller and Pyle (*2*). Integration of the axial momentum equation over the length of the channel is performed by an adaptation of the momentum integral model of Meyer (*3*). The hydrodynamic equations represent the conservation laws for the subcooled, nucleate, and bulk boiling regions of the fluid. In the two-phase region, the hydrodynamic model is that of separated or slip flow. Fluid friction is represented by the use of Blasius type friction factors with experimentally determined corrections of the Martinelli-Nelson type during boiling. Nucleate boiling heat transfer rates are predicted using the Jens and Lottes technique. Nonboiling heat transfer is represented by Dittus-Boelter type heat transfer correlations. The program predicts the distribution of enthalpy, density, mass velocity and pressure drop throughout the channel. Provision is also included for computation of departure from nucleate boiling heat flux. Heat transfer in the film boiling and superheat regions is not incorporated in the XITE program.
5. Restrictions on the complexity of problems solved:
   A. Restricting physical assumptions are as follows:
      1. Energy transfer between control volumes by thermal and eddy diffusion (or turbulent exchange for two-phase flow) is neglected compared to that transferred by convection.
      2. Frictional forces between the fluid boundaries of the control volumes are neglected in comparison to the shear forces at the wall boundaries of the control volumes.
      3. Neglecting the transverse pressure gradient is assumed to have a negligible effect on the flow distribution.
      4. The liquid and vapor velocities in the two-phase region may be different in magnitude but are assumed to act in the same direction.
   B. Restrictions on problem size are as follows:
      1. Number of axial mesh intervals, ≤ 30
      2. Number of transverse mesh intervals ("tracks"). ≤ 10
      3. Number of time-steps, no specified limit
6. Typical running time: If the running time is expressed as follows:

$$T = KN_pN_t$$

where

T = Philco 2000-211 time in minutes (10 μsec memory)

K = proportionality constant depending on the type transient (e.g., the number of iterations) in minutes per point per time-step

N_p = number of mesh points, given by the product of the number of axial and transverse mesh intervals

N_t = number of time-steps required during the transient

the value of the constant, K, will range from 1.0×10^{-3} to 1.7×10^{-3} (or from 60 to 100 μsec of machine time will be required per point per time-step). Hence, a problem with 150 mesh points and an average time-step of 10 msec would require 15 to 22.5 min of machine time for a 1-sec transient. These estimates are based on a Philco 2000-211 with a 10-μsec memory and include output preparation times. The time-step size may be specified as input and will be used in the calculations, provided it does not exceed the minimum fluid transit time through any mesh interval.

7. Unusual features: None
8. Present status: XITE is in production at Bettis. Copies of the program may be obtained from: TUG Executive Secretary, Philco Corporation, Computer Division, 515 Pennsylvania Avenue, Fort Washington, Pennsylvania.
9. *References:*

1. R. P. Rose and R. S. Pyle, "XITE—A Digital Program for the Analysis of Two-Dimensional Boiling Flow Transients with Fluid Expansion," WAPD-TM-302 (April 1963).
2. R. I. Miller and R. S. Pyle, "TITE—A Digital Program for the Prediction of Two-Dimensional Two-Phase Hydrodynamics," WAPD-TM-240 (February 1962).
3. J. E. Meyer, "Hydrodynamic Models for the Treatment of Reactor Thermal Transients," *Nucl. Sci Eng.* **10,** 269-277 (1961).

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ADONIS (UNC Code-90-4)

1. Code name: ADONIS (UNC Code-90-4).
2. Computer for which code is designed: IBM 7090
   Programming system: FORTRAN and FAP
   A 32K core and 10 tapes are required
3. Nature of problem solved: ADONIS calculates the solution to the transport equation for primary neutrons (or gammas) in a three-dimensional rectangular geometry. The program computes either neutron or gamma fluxes and their standard deviations in each of up to 80 regions. By use of response functions, dose and strength of secondary gamma rays from any neutron induced reaction can be computed throughout the configuration. In addition, it is possible to generate a population of secondary gamma rays as input to a gamma ADONIS problem by appropriate editing of a tape record of interactions generated in an associated neutron ADONIS problem. In particular the code has proved useful in analyzing the penetration of neutrons or gammas through ducted shields.
4. Method of solution: ADONIS is a Monte Carlo program that tracks either neutrons or gammas through shields composed of rectangular parallelepipeds of differing compositions. Particle splitting is employed to improve the efficiency of the calculation by assigning importance weights to each of the regions.

   A source tape containing the position coordinates,