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MASTER

Available reactor physics data from power reactors
Material utilized by the reactor physics section at Risø

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Introduction

In the following is given a short characterization of three power reactors as well as references from which reactor physics data, experimental and other, has been extracted.

In many respects these reactors are very far from modern power reactors, but since better material has apparently not been available they have never the less served as test examples for reactor physics codes at Risø.

Dresden 1. (BWR, 620 MWt)

Dresden 1 is a BWR. The core has only one enrichment. Descriptions of core data seem to be adequate. - However, only data for the coolant loop which are important for the performance of a BWR are scarce.

The operational history is not very well described.

Depletion calculations carried out by Combustion Engineering under the ISOCHECK project exist. It is not known whether these calculations are in agreement with experiments.

Some experimentaly determined critical configurations are reported as well as the radial power distribution for the initial core at half power. Some measurements of the build up of Pu isotopes can be found. However, the operational conditions for the elements for which the measurements have been performed are not very well defined.

Core discription

1. A.W. Kramer, Boiling Water Reactors (Addison-Wesley, New York, 1958) 443-499.

2. Directory of Nuclear Reactors, 4 Power Reactors (IAEA, Vienna, 1962) 91-96.

Burn-up measurements

3. M.R. Hackney, D.L. West, and R. Protsik, Isotopic Composition Experiments with Boiling Water Reactor Fuel. In: ANS Topical Meeting-Nuclear Performance of Power-Reactor Cores, San Francisco, 26-27 September 1963 (TID 7672) (USAEC, DTIE, Oak Ridge, Tenn., 1964) 288-302.

4. P.G. Aline et al., Fuel Management and Isotopic Composition Prediction and Experiment in Light Water Power Reactors. In: The Physics Problems in Thermal Reactor Design, Proceedings of an International Conference at the Institution of Civil Engineers. London SW 1, 27-29 June 1967. (British Nuclear Energy Society, London, 1967) 297-305.

5. R.J. Mc Whorter and G.R. Parkos, Nuclear Performance of Boiling Water Reactors- An Evaluation of Reactor Operating Data and Reactor Calculations. In: ANS Topical Meeting-Nuclear Performance of Power-Reactor Cores, San Francisco, 26-27 September 1963 (TID 7672) (USAEC, DTIE, Oak Ridge, Tenn., 1963) 71-94.

6. C.E. Foreman and A.F. Veras, Dresden Refueling and Physics Testing Results. In: ANS Topical Meeting-Nuclear Performance of Power-Reactor Cores, San Francisco, 26-27 September 1963 (TID 7672) (USAEC, DTIE, Oak Ridge, Tenn., 1964) 247-258.

Burn-up calculations

7. R. Kern and A.T. Shesler, Setup of ISOCHECK Method for determining heavy-isotope content in the operating fuel elements of DRESDEN 1 Core IV. CEND-289 (1967) 117 pp.

8. A.M. Hvidtfeldt Larsen, H. Larsen and T. Petersen, Calculations on a Boiling Water Reactor as a Test of the Risø Reactor Code Complex. Risø Report No. 268 (1972) 102 pp.

Reactivity coefficients

9. R.L. Crowther and D.L. Fisher, Nuclear Characteristics of Large Advanced Boiling Water Reactors. In: ANS Topical Meeting-Nuclear Performance of Power-Reactor Cores, San Francisco, 26-27 September 1963 (TID 7672) (USAEC, DTIE, Oak Ridge, Tenn., 1963) 381-423.

Power distributions

10. C.E. Foreman et al., DRESDEN Cycle 1 Discharged Fuel Exposure and Isotopic Composition Calculations. GECR-4299 (1963) 67 pp.

Critical Configurations

11. A.R. Kosmata and W.R. Kanne, Physics Tests at the DRESDEN Nuclear Power Station. Physics Measurements in Operating Power Reactors. Proceedings of an International Seminar, Rome 9-13 May 1966 (OECD/ENEA, Paris, 1967) 215-263.

Connecticut Yankee (PWR, 1825 MWt)

Connecticut Yankee is a 600 MWe PWR. It ~~is~~ different ~~ent~~ from what is normally build to-day in that it has stainless-steel cladding and its control rods are made of an Ag-In-Cd alloy.

The operational history of the first core is available and there exist both calculations and measurements of power distribution and burn up for different points of its history.

There also exist measured and calculated values of reactivity coefficients and control rod worths.

Core description

1. Connecticut Yankee Atomic Power Company: Facility Description and Safety Analysis. NYO-3250-5, DOCKET 50213-5. (1966) Vol. 1-2.

Measurements of
control rod worths and power distribution at different burn-ups

2. James R. Himmelwritht, Reactor and Plant Performance Engineering Tests and Measurements. DOCKET-50213-25 (1969) 126 pp.

Measurements of
initial criticality

3. James R. Himmelwright, The Startup Test Program for the Connecticut Yankee Reactor. NYO-3250-11 (1967) 37 pp.

Calculations of
Reactivity coefficients and power distributions

4. J.D. McGaugh, The Nuclear Design of the Connecticut-Yankee Reactor. NYO-3250-27 (1968) 129 pp.

5. H. Neltrup and Per B. Suhr, Survey of Calculations of the Haddam Neck (Connecticut Yankee) Power Plant as a Test of the Risø Reactor Physics Code System. Risø Report No. 298 (1973) 62 pp.

Calculations of
Isotope build-up during burn up

6. Z.R. Rosztoczy and R. Kern, Setup of Isocheck Method for determining Heavy-Isotope Content in the Operating Fuel Elements of Connecticut Yankee Core I. CEND-287 (1966) 38 pp.

7. H. Neltrup and Per B. Suhr, Survey of Calculations on the Haddam Neck (Connecticut Yankee) Power Plant as a Test of the Risø Reactor Physics Code System. Risø Report No. 298 (1973) 62 pp.

Yankee Rowe (PWR, 392 MWt)

Yankee Rowe is a small PWR compared with to-days standard. Its design is not caracteristic for modern PWR's. The fuel pins are clad with stainless-steel, they are thinner than normal and they have only one enrichment. In addition the control rods are cruciform and made of an Ag-In-Cd alloy.

However, a complete description of the core and data for the operational history are available from open literature. The history is reasonable simple to simulate in a computer code.

For the first core there exist both measured and calculated data for burn-up of individual fuel pins and measurements of overall reactivity. Some data for the hydraulic performance, pressure drops etc. are also available.

Core description

1. H.W. Graves, R.F. Janz and C.G. Poncelet, The Nuclear Design of the Yankee Core. YAEC-136 (1961) 88 pp.

2. Directory of Nuclear Reactors 4, (IAEA, Vienna, 1962)

Control rod history

3. C.G. Poncelet, Analysis of the Reactivity Characteristics of Yankee Core I. WCAP-6050 (1963) 139 pp.

Burn-up measurements

4. R.J. Nodvik et al., Supplementary Report on Evaluation of Mass Spectrometric and Radiochemical Analysis of Yankee Core I Spent Fuel, Including Isotopes of Elements Thorium Through Curium. WCAP-6086 (1969) 259 pp.

5. J. Jedruch and R.J. Nodvik, Experimentally Determined Burnup and Spent Fuel Composition of Yankee Core I. WCAP-6071 (1965) 131 pp.

6. R.J. Nodvik, Evaluation of Mass Spectrometric and Radiochemical Analyses of Yankee Core I Spent Fuel. WCAP-6068 (1966) 181 pp.

Overall reactivity

7. C.G. Poncelet, Effects of Fuel Burnup on Reactivity and Reactivity Coefficients in Yankee Core I. WCAP-6076 (1965) 93 pp.

8. C.G. Poncelet, Analysis of the Reactivity Characteristics of Yankee core I. WCAP-6050 (1963) 139 pp.

Calculated burn-up

9. P.G. Lacey and R.E. Radcliffe, Difusion-Theory Depletion Analysis of the Yankee Core I. WCAP-6077 (1966) 124 pp.

10. K.E. Lindstrøm Jensen, Development and Verification of Nuclear Calculation Methods for Light-Water Reactors. Risø Report No. 235 (1970) 161 pp.

Hydraulics

11. R.T. Berringer, A.A. Bishop, Model Study of the Pressure Drop Relationships in a Typical Fuel Rod Assembly. YAEC-75 (1959) 31 pp.

12. E.A. McCabe Jr., Thermal Design Aspects of the Yankee First Core Fuel Rod. YAEC-106 (1960) 62 pp.

13. A.G. Thorpe II., Design of the Yankee Core I Fuel Assembly. YAEC-154 (1960) 66 pp.