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CFD modeling of boiling bubbly flow for DNB investigations The CFD Wall Boiling Model The wall surface is assumed to be split into two parts (A 1 , A 2) each under the influence of one phase. Fraction A 2 is influenced by the vapour bubbles formed on the wall and participates in the evaporation and quenching heat transfer. CFD Two Fluid Model ...

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The description of boiling two-phase flow in CFD codes is commonly based on the two- fluid approach (Ishii, 1975), (Delhaye, 1981). In this approach, a set of local balance equations for mass,...

CFD modeling of boiling bubbly flow for DNB investigations
Subcooled boiling in upward non-isothermal turbulent bubbly flow in tubes is numerically modeled using ANSYS-CFX 12 in this contribution. The approach is based on the RPI wall boiling model developed by Kurul and Podowski. The interfacial non-drag forces are also investigated and included in the model.

CFD Modeling of Subcooled Boiling in Vertical Bubbly Flow ...
CFD modeling of boiling bubbly flow for DNB investigations CFD Two Fluid Model for Adiabatic and Boiling Bubbly Flows in Ducts 31 For the bubbly flow analyzed during this study, the two-fluid model is comprised of two fields: liquid continuous (k = 1) and dispersed bubbles (k = 2) and the mass

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Cfd Modeling Of Boiling Bubbly Flow For Dnb Investigations
This paper focuses on the Reynolds-averaged Navier-Stokes (RANS) approach as being the most reliable for simulation of realistic bubbly flows. New physical models developed within the NURESIM...

Computational Fluid Dynamics Modeling of Boiling Bubbly ...
Home > Journals > Multiphase Science and Technology > Volume 23, 2011 Issue 2-4 > COMPUTATIONAL FLUID DYNAMICS MODELING OF BOILING BUBBLY FLOW FOR DEPARTURE FROM NUCLEATE BOILING INVESTIGATIONS SJR : 0.183 SNIP : 0.483 CiteScore□ : 0.5

boiling bubbly flow, CFD, DNB, fuel rod bundle - Begell ...
This paper focuses on the modelling and the numerical simulation with the NEPTUNE_CFD code of cavitation phenomena and boiling bubbly flows. Compressible, unsteady, turbulent 3D two-phase flow is computed by the NEPTUNE_CFD solver, developed jointly by EDF R&D and CEA.

Modelling and computation of cavitation and boiling bubbly ...
The PWR tests were considered in PSBT. This paper describes the use of three-dimensional computational fluid dynamics (CFD) to model the boiling two-phase flows in one of the 5-by-5 rod bundle tests. The commercial CFD software STAR-CCM+ v6.06 was used in this study. The rod bundle with all the spacers was modeled explicitly using unstructured computational grids.

CFD Modeling of Boiling Flow in PSBT 5×5 Bundle
The two-fluid model we use for our boiling bubbly flow calculations is constituted of the following six balance equations (e.g.,): (i) two mass balance equations: where is the time, denote the volumetric fraction of phase , its averaged density and velocity and is the interfacial mass transfer per unit volume and unit time; the phase index takes the values for the liquid phase and for the gas phase;

Modeling of Multisize Bubbly Flow and Application to the ...
The turbulent convection heat flux is calculated in the CFX model version (see Wintterle, 2004) in much the same way as for a pure liquid flow without boiling, but multiplied by the fraction of area unaffected by the bubbles, i.e.: (2) Q C = (1 − A W) h C (T W − T L) Here h C is the heat transfer coefficient which is written using the temperature wall function T + (y +) known from Kader (1981) as (3) h C = ρ C P u τ T + where non-dimensional variables (indicated by superscript ...

CFD for subcooled flow boiling: Simulation of DEBORA ...
CFD Modeling of Subcooled Boiling in Vertical Bubbly Flow Condition Using ANSYS CFX 12 <jats:p>Subcooled boiling in upward non-isothermal turbulent bubbly flow in tubes is numerically modeled using ANSYS-CFX 12 in this contribution. The approach is based on the RPI wall boiling model developed by Kurul and Podowski [1].

CFD Modeling of Subcooled Boiling in Vertical Bubbly Flow ...
CFD Two Fluid Model for Adiabatic and Boiling Bubbly Flows in Ducts 31 For the bubbly flow analyzed during this study, the two-fluid model is comprised of two fields: liquid continuous (k = 1) and disperse d bubbles (k = 2) and the mass transfer across the interface is zero for adiabatic flows. Momentum conservation t k kk w D UX w

CFD Two Fluid Model for Adiabatic and Boiling Bubbly Flows ...
Subcooled boiling in upward non-isothermal turbulent bubbly flow in tubes is numerically modeled using ANSYS-CFX 12 in this contribution. The approach is based on the RPI wall boiling model...

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PDF | Subcooled flow boiling is a case of two phase bubbly flow, which is encountered in various engineering applications such as boilers, reactors,... | Find, read and cite all the research you ...

In the context of computational fluid dynamics (CFD), modelling low-pressure subcooled boiling flow is of particular significance. A review is provided in this book of the various numerical modelling approaches that have been adopted to handle subcooled boiling flow. The main focus in the analysis of such a challenging problem can be broadly classified according into two important categories: (i) Heat transfer and wall heat flux partitioning during subcooled boiling flow at the heated wall and (ii) Two-phase flow and bubble behaviours in the bulk subcooled flow away from the heated wall. For the first category, details of both empirical and mechanistic models that have been proposed in the literature are given. The enhancement in heat transfer during forced convective boiling attributed by the presence of both sliding and stationary bubbles, force balance model for bubble departure and bubble lift-off as well as the evaluation of bubble frequency based on fundamental theory depict the many improvements that have been introduced to the current mechanistic model of heat transfer and wall heat flux partitioning. For the second category, details of applications of various empirical relationships and mechanistic model such as population balance model to determine the local bubble diameter in the bulk subcooled liquid that have been employed in the literature are also given. A comparison of the predictions with experimental data is demonstrated. For the local case, the model considering population balance and improved wall heat partition shows good agreement with the experimentally measured radial distributions of the Sauter mean bubble diameter, void fraction, interfacial area concentration and liquid velocity profiles. Significant weakness prevails however over the vapor velocity distribution. For the axial case, good agreement is also achieved for the axial distributions of the Sauter mean bubble diameter, void fraction and interfacial area concentration profiles. The present model correctly represents the plateau at the initial boiling stages at upstream, typically found in low-pressure subcooled boiling flows, followed by the significant rise of the void fraction at downstream.

This book is intended to serve as a reference text for advanced scientists and research engineers to solve a variety of fluid flow problems using computational fluid dynamics (CFD). Each chapter arises from a collection of research papers and discussions contributed by the practiced experts in the field of fluid mechanics. This material has encompassed a wide range of CFD applications concerning computational scheme, turbulence modeling and its simulation, multiphase flow modeling, unsteady-flow computation, and industrial applications of CFD.

Thermal Hydraulics of Water-Cooled Nuclear Reactors reviews flow and heat transfer phenomena in nuclear systems and examines the critical contribution of this analysis to nuclear technology development. With a strong focus on system thermal hydraulics (SYS TH), the book provides a detailed, yet approachable, presentation of current approaches to reactor thermal hydraulic analysis, also considering the importance of this discipline for the design and operation of safe and efficient water-cooled and moderated reactors. Part One presents the background to nuclear thermal hydraulics, starting with a historical perspective, defining key terms, and considering thermal hydraulics requirements in nuclear technology. Part Two addresses the principles of thermodynamics and relevant target phenomena in nuclear systems. Next, the book focuses on nuclear thermal hydraulics modeling, covering the key areas of heat transfer and pressure drops, then moving on to an introduction to SYS TH and computational fluid dynamics codes. The final part of the book reviews the application of thermal hydraulics in nuclear technology, with chapters on V&V and uncertainty in SYS TH codes, the BEPU approach, and applications to new reactor design, plant lifetime extension, and accident analysis. This book is a valuable resource for academics, graduate students, and professionals studying the thermal hydraulic analysis of nuclear power plants and using SYS TH to demonstrate their safety and acceptability. Contains a systematic and comprehensive review of current approaches to the thermal-hydraulic analysis of water-cooled and moderated nuclear reactors Clearly presents the relationship between system level (top-down analysis) and component level phenomenology (bottom-up analysis) Provides a strong focus on nuclear system thermal hydraulic (SYS TH) codes Presents detailed coverage of the applications of thermal-hydraulics to demonstrate the safety and acceptability of nuclear power plants

This book is intended to serve as a reference text for advanced scientists and research engineers to solve a variety of fluid flow problems using computational fluid dynamics (CFD). Each chapter arises from a collection of research papers and discussions contributed by the practiced experts in the field of fluid mechanics. This material has encompassed a wide range of CFD applications concerning computational scheme, turbulence modeling and its simulation, multiphase flow modeling, unsteady-flow computation, and industrial applications of CFD.

Advances of Computational Fluid Dynamics in Nuclear Reactor Design and Safety Assessment presents the latest computational fluid dynamic technologies. It includes an evaluation of safety systems for reactors using CFD and their design, the modeling of Severe Accident Phenomena Using CFD, Model Development for Two-phase Flows, and Applications for Sodium and Molten Salt Reactor Designs. Editors Joshi and Nayak have an invaluable wealth of experience that enables them to comment on the development of CFD models, the technologies currently in practice, and the future of CFD in nuclear reactors. Readers will find a thematic discussion on each aspect of CFD applications for the design and safety assessment of Gen II to Gen IV reactor concepts that will help them develop cost reduction strategies for nuclear power plants. Presents a thematic and comprehensive discussion on each aspect of CFD applications for the design and safety assessment of nuclear reactors Provides an historical review of the development of CFD models, discusses state-of-the-art concepts, and takes an applied and analytic look toward the future Includes CFD tools and simulations to advise and guide the reader through enhancing cost effectiveness, safety and performance optimization

This book provides an overview of state-of-the-art methods in computational engineering for modeling and simulation. This proceedings volume includes a selection of refereed papers presented at the International Conference on Advances in Computational Mechanics (ACOME) 2017, which took place on Phu Quoc Island, Vietnam on August 2-4, 2017. The contributions highlight recent advances in and innovative applications of computational mechanics. Subjects covered include: biological systems; damage, fracture and failure; flow problems; multiscale multiphysics problems; composites and hybrid structures; optimization and inverse problems; lightweight structures; computational mechatronics; computational dynamics; numerical methods; and high-performance computing. The book is intended for academics, including graduate students and experienced researchers interested in state-of-the-art computational methods for solving challenging problems in engineering.

Multiphase computational fluid dynamics (M-CFD) modeling approaches allow for the prediction of critical three-dimensional thermal-hydraulics phenomena in nuclear reactor applications. The advancement and consistent adoption of such tools could transform the industry's approach to the design of reliable systems, and the efficient operation of systems existing, which in the past have been dependent upon correlation-based sub-channel analysis codes. The success of these M-CFD methods in simulating two-phase flow and boiling heat transfer depends on their demonstrated accuracy and robustness, which signals a dual need for the comprehensive analysis of existing data and a reevaluation of the underlying physics. By virtue of the Eulerian-Eulerian two-fluid approach, additional terms manifest in the M-CFD phase momentum equations, which represent information that has been lost, and require closure through prescription of interfacial force models. These momentum "closures" are vital to M-CFD prediction of mean flow profiles, including void fraction and phase velocity distributions, and require high-resolution, robust models to perform accurately throughout a diverse array of flow conditions. While an overwhelming number of models have been developed with a wide range of varying performance, no consensus exists about how to assemble these models successfully in a CFD framework, suggesting that their predictive power is still limited. The lift force, responsible for lateral void fraction redistribution, is particularly refractory to the development of a consistent modeling strategy for these closures. Historically, CFD approaches have been forced to inconsistently leverage existing models derived for single bubbles in laminar flow, which disregard the complex dynamics and interactions of bubbles with turbulence and bubble wakes. Current understanding of the lift force in turbulent flow has been limited to qualitative evidences that small spherical bubbles experience a positive lift, resulting in a wall-peaked void fraction distribution, while larger deformed bubbles experience a negative lift and corresponding center-peaked profile. The present work brings forward a new physical interpretation of the lift force in turbulent bubbly flow through a synthesis of information from DNS studies, fine and coarse scale experiments, and analytical investigations. To overcome the limitations of previous models, a simple dimensionless quantity, the Wobble number, a number which systematically describes the unsteady behavior of bubbles in turbulent flow conditions, is proposed. Introducing this dependency into the lift formulation allows for precise identification of lift inversion, which alone exceeds capabilities of existing models. Additionally, the model is extended to account for group behavior with the introduction of a swarm-like function based on void fraction. Its formulation is built on the conceptual understandings of drift phenomena, bubble interaction probability, and the maximum packing factor for dispersed bubbly flow. These two key mechanisms are assembled into a lift model for turbulent bubbly flow, which is implemented in CFD and validated on several experimental databases spanning an extensive range of flow conditions. Error analyses demonstrate the new formulation's robustness and predictive abilities, allowing for a more comprehensive representation of the two-phase phenomena particularly significant in nuclear reactor applications; moreover, it avoids the introduction of case-specific adjustments to unphysical coefficients and tunable parameters which are characteristic and typical limitations of previous models, indicating another valuable improvement. Finally, the new model's performance in a prototypical rod bundle is evaluated and a qualitative assessment of its applicability in a nuclear reactor geometry context is demonstrated.

This book is a printed edition of the Special Issue "Engineering Fluid Dynamics" that was published in Energies

This book has been written for graduate students, scientists and engineers who need in-depth theoretical foundations to solve two-phase problems in various technological systems. Based on extensive research experiences focused on the fundamental physics of two-phase flow, the authors present the detailed theoretical foundation of multi-phase flow thermo-fluid dynamics as they apply to a variety of scenarios, including nuclear reactor transient and accident analysis, energy systems, power generation systems and even space propulsion.

The book summarises the outcom of a priority research programme: 'Analysis, Modelling and Computation of Multiphase Flows'. The results of 24 individual research projects are presented. The main objective of the research programme was to provide a better understanding of the physical basis for multiphase gas-liquid flows as they are found in numerous chemical and biochemical reactors. The research comprises steady and unsteady multiphase flows in three frequently found reactor configurations, namely bubble columns without interiors, airlift loop reactors, and aerated stirred vessels. For this purpose new and improved measurement techniques were developed. From the resulting knowledge and data, new and refined models for describing the underlying physical processes were developed, which were used for the establishment and improvement of analytic as well as numerical methods for predicting multiphase reactors. Thereby, the development, lay-out and scale-up of such processes should be possible on a more reliable basis.