ISSN 2185-4823

PROGRESS IN NUCLEAR SCIENCE AND TECHNOLOGY

Volume 3

October 2012



ATOMIC ENERGY SOCIETY OF JAPAN http://www.aesj.or.jp/

PROGRESS IN NUCLEAR SCIENCE AND TECHNOLOGY

Published by THE ATOMIC ENERGY SOCIETY OF JAPAN

3-7, Shimbashi 2-chome, Minato-ku, Tokyo 105-0004, Japan

Editorial Board (July 2012- June 2013)

Editor-in-Chief Toyohiko YANO (Tokyo Inst. Tech.)

Associate Editor-in-Chief Kengo HASHIMOTO (Kinki Univ)

Advisory Editor Kiyoshi KAWADE (Prof.emeritus of Nagoya Univ) Hiroshi HAYASHI Kenji MORITA (NISRI) Ken NAKAJIMA (Kyoto Univ)

Ken NAKAJIMA (Kyoto Univ) Toshihiko OHNUKI (Japan Atomic Energy Agency)

Editors (Chair of Sections) Hiroshi AKIE (Japan Atomic Energy Agency) Osamu IWAMOTO (Japan Atomic Energy Agency) Kazunori MORISHITA (Kyoto Univ) Yasushi SAITO (Kyoto Univ) Takayuki SASAKI (Kyoto Univ) Hiroshi SHIMODA (Kyoto Univ) Tatsuya SUZUKI (Nagaoka Univ. of Tech) Takashi TAKATA (Osaka Univ) Masayoshi UNO (Fukui Univ) Hirokuni YAMANISHI (Kinki Univ) Naoki YAMANO (Fukui Univ)

Editors

Mivuki AKIBA (Toshiba Corp.) Masao CHAKI (Hitachi, Ltd., Hitachi Research Lab.) Go CHIBA (Hokkaido Univ) Kenji DOHI (Central Res Inst. Electric Power Ind) Haruo FUJIMOTO (Japan Nuclear Energy Safety Organization) Tomonari FUJITA (CRIEPI) Hirokazu HAYASHI (Japan Atomic Energy Agency) Eiichi HORI (Mitsubishi Heavy Industris' Ltd.) Tsutomu IKENO (Nuclear Fuel Industires, Ltd) Tomoaki INAMURA (Central Res Inst. Electric Power Ind) Ikuo IOKA (Japan Atomic Energy Agency) Yasunori IWAI (Japan Atomic Energy Agency) Mamoru KAMOSHIDA (Hitachi, Ltd., Hitachi Research Lab.) Yuko KANI (Hitachi, Ltd.) Masato KATO (Japan Atomic Energy Agency) Tatsuya KATO (Toshiba Corp) Hiroshi KIMURA (Univ of Tokyo) Akira KITAMURA Japan Atomic Energy Agency) Kazuaki KITOU (Hitachi, Ltd, Hitachi Research Lab.) Mitsuhiro KODAMA (Nippon Nuclear Fuel Development Co., LTD.) Shinya KOSAKA (TEPCO SYSTEMS Corp) Akihide KUGO (Japan Atomic Energy Agency) Masaki KURATA (Japan Atomic Energy Agency) Wei LIU (Japan Atomic Energy Agency)

Qiusheng LIU (Kobe Univ) Fujio MAEKAWA (Japan Atomic Energy Agency) Koji MIZUGUCHI (Toshiba Corp) Jun MORIIZUMI (Nagoya Univ) Shinichi MOROOKA (Waseda Univ) Kenji NISHIHARA (Japan Atomic Energy Agency) Masanobu NOGAMI (Kinki Univ) Masashi OHNO (Univ of Tokyo) Toshihiko OHNUKI (Japan Atomic Energy Agency) Kunio ONIZAWA (Japan Atomic Energy Agency) Michitaka SASOH (Toshiba Corp) Satoshi SATO (Japan Atomic Energy Agency) Tetsuo SAWADA (Tokyo Inst.Tech) Yuji SHIBAHARA (Fukui Univ) Tamaki SHIBAYAMA (Hokkaido Univ) Koji SHIRAI (Central Res Inst. Electric Power Ind) Mitsuo TACHIBANA (Japan Atomic Energy Agency) Naoyuki TAKAKI (Tokyo City Univ) Ryuta TAKASHIMA (Chiba Inst. Tech) Masayuki TAKEUCHI (Japan Atomic Energy Agency) Masashi TAMITANI (Global Nuclear Fuel - Japan) Koichi TANIMOTO (Mitsubishi Heavy Industris' Ltd.) Masahiro TATSUMI (Nuclear Fuel Industries, Ltd.) Hirofumi TSUKADA (Inst. for Environmental Sciences) Yusuke UOZUMI (Kyushu Univ) Genichiro WAKABAYASHI (Kinki Univ) Mitsuaki YAMAOKA (Toshiba Corp) Akira YASUO (Central Res Inst. Electric Power Ind) Sumi YOKOYAMA (Fujita Health University) Akira YUNOKI (AIST)

Committee Chairperson Tetsuo IGUCHI (Nagoya Univ.)

Director Yuji ARITA (Fukui Univ.) Mitsuru UESAKA (Univ. of Tokyo) Kazuhiko YAMAMOTO (The Japan Atomic Power Company)

All papers should be submitted to the editorial board of the Atomic Energy Society of Japan. A detailed directory for submission of papers is available at http://www.aesj.or.jp/

Copyright©2012 Atomic Energy Society of Japan. All rights reserved.

Opinions expressed in this publication by the authors are their own and do not necessarily reflect the opinions of the editorial board, Atomic Energy Society of Japan, or the organizations with which the authors are affiliated. Thus, no responsibility is assumed by the Society and the organizations for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the materials herein. Although all advertising material is expected to conform to ethical standards, inclusion in this publication does not constitute a guarantee or endorsement of the quality or value of such product or the claims made of it by its manufacturer.

PROGRESS IN NUCLEAR SCIENCE AND TECHNOLOGY

Proceedings of the Sixth International Symposium on Radiation Safety and Detection Technology

ISORD-6

July 12 – 14, 2011 Awana Porto Malai Langkawi, Malaysia