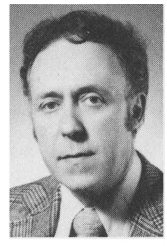
nuclear technology®

AUTHORS — FEBRUARY 1985

FABRICATION OF COMPONENTS OF THE CREYS-MALVILLE PLANT

SUPERPHÉNIX 1 AT CREYS-MALVILLE: OVERALL NUCLEAR STEAM SUPPLY SYSTEM COORDINATION AND CONSTRUCTION BY NOVATOME-NIRA

Jean Befre



Jean Befre (BSc, Paris and Ecole Supérieure d'Electricité, Paris, 1954) joined the Commissariat à l'Energie Atomique teams working on experimental and prototype power reactors following three years in an engineering firm that specialized in fossil fuel power plants. Apart from gas-graphite reactors (G2, G3), gas-cooled heavy water reactors (ELe 4), and high flux reactors, he participated in the construction of the sodium-cooled experimental breeder Rapsodie. Between 1968 and 1974, his efforts were focused almost exclusively on directing certain aspects of the construction of the first French power breeder, Phénix. In 1977, he joined Novatome as project department manager, responsible, in particular, for the direction of the construction of Superphénix, the first commercial size breeder reactor, designed to equip the Creys-Malville plant.

SUPERPHÉNIX 1 REACTOR BLOCK FABRICATION

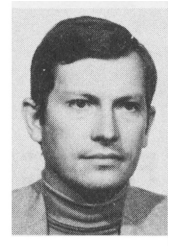
Joël Branchu
Charles Gigarel

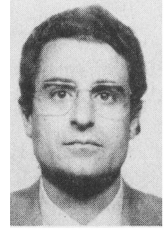
Joël Branchu (top) [Ecole Nationale Supérieure d'Arts et Métiers (ENSAM), Angers, 1955; atomic engineer, Saclay, 1960] has worked with Groupement Atomique Alsacienne Atlantique, then Novatome, since 1962. Following participation in the design and production engineering work on fuel handling equipment for the ESSOR and CELESTIN reactors, he coordinated the basic and detailed design studies for the reactor block of Phénix, as assistant to the reactor block group leader. During the startup tests for Phénix, he was in charge of the reactor block. In 1976, as head of the reactor block department, he coordinated the reactor block detailed design studies for the Creys-Malville Plant. Since 1982, he has been in charge of the Novatome Equipment Design Division and, in this capacity, directs the preliminary design work on the SPX2 nuclear steam supply system equipment. **Charles Gigarel** [ENSAM, Paris (silver medal award), 1947] joined Neyrpic, Grenoble, in 1947 as an engineer, first in the prototype department, then in the hydraulic valve department. In 1960, after a one-year specialization at INSTN, Saclay,

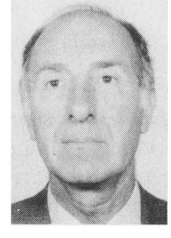
he headed the development of nuclear activities in Neyrpic, which has participated in the construction of most of the French reactors. In 1974, as manager of the Nuclear Division, he directed the design, construction, and erection of a considerable part of the reactor block and internal handling systems for Superphénix. He is presently deputy general manager of Neyrpic, Grenoble.

SUPERPHÉNIX 1 INTERMEDIATE HEAT EXCHANGER FABRICATION

Henri Noël
Francesco Granito
Pierre Pouderoux



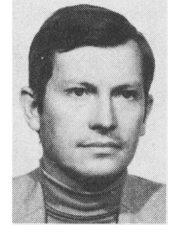




Henri Noël (top) (Ecole Polytechnique, Paris, 1964) joined the Commissariat à l'Energie Atomique where within an integrated team associating Electricité de France and Groupement Atomique Alsacienne Atlantique he headed the design and construction work for the Phénix secondary loops and steam generators, and then was in charge of the site tests for the Phénix circuits, primary and secondary pumps, steam generators, etc. After a period with the directing staff of Technicatome, he joined Novatome in 1977, where, for the construction of the nuclear steam supply system (NSSS) equipping Creys-Malville, he was named head of the safety department, responsible for the safety analyses, accident studies, and preparation of documents required by the safety authorities; and head of the circuits department, responsible for engineering studies and purchasing for the circuits, primary and secondary pumps, intermediate heat exchangers, and steam generators. Since early 1983, he is the project department manager delegate on the Creys-Malville site, in charge of NSSS erection and testing. **Francesco Granito** (center) (PhD, nuclear engineering, University of Pisa, 1963) joined Nira in 1974 to oversee the activities associated with the Italian participation in the Superphénix project at Creys-Malville, following 10 years of experience in the Italian public utility, Ente Nazionale per l'Energia Elettrica. From 1979 to 1983 he was director of the Fast Breeder Division of Nira and was responsible, in addition to the Superphénix 1 and 2 activities, for the realization of the experimental fast breeder PEC. He is presently deputy general manger of Nira. **Pierre Pouderoux** (bottom) (Ecole Nationale Supérieure des Arts et Métiers, Paris, 1952; MS, mechanical engineering, Oregon State College, 1953) has been associated with the design and construction of sodium loops and heat exchangers for the French liquid-metal nuclear reactors Rapsodie, Phénix, and Superphénix. He is presently director of the Nuclear Division of Stein Industries.

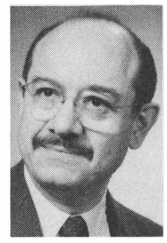
FABRICATION AND TESTING OF MAIN SODIUM PUMPS OF SUPERPHÉNIX 1

Henri Noël
Gilbert Pasqualini



Henri Noël (right) (Ecole Polytechnique, Paris, 1964) joined the Commissariat à l'Energie Atomique where within an integrated team associating Electricité de France and Groupement Atomique Alsacienne Atlantique he headed the design and construction work for the Phénix secondary loops and steam generators, and then was in charge of the site tests for the Phénix circuits, primary and secondary pumps, steam generators, etc. After a period with the directing staff of Technicatome, he joined Novatome in 1977, where, for the construction of the nuclear steam supply system (NSSS) equipping Creys-Malville, he was named head of the safety department, responsible for the safety analyses, accident studies, and preparation of documents required by the safety authorities; and head of the circuits department, responsible for engineering studies and purchasing

for the circuits, primary and secondary pumps, intermediate heat exchangers, and steam generators. Since early 1983, he is the project department manager delegate on the Creys-Malville site, in charge of NSSS erection and testing. **Gilbert Pasqualini** (right) (Ecole Polytechnique, Paris, Ecole Supérieure d'Electricité, Paris) joined Jeumont-Schneider in 1960, where his assignments included taking charge of the analytical studies and laboratories. In 1977 he assumed responsibility for nuclear studies and equipment, and in 1981 he became manager of the Nuclear Equipment Division.



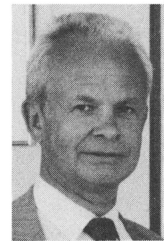
SUPERPHÉNIX 1 PRIMARY HANDLING SYSTEM FABRICATION AND TESTING

Joël Branchu
Charles Gigarel
Kurt Ebbinghaus

Joël Branchu (top) [Ecole Nationale Supérieure d'Arts et Métiers (ENSAM), Angers, 1955; atomic engineer, Saclay, 1960] has worked with Groupement Atomique Alsacienne Atlantique, then Novatome, since 1962. Following participation in the design and production engineering work on fuel handling equipment for the ESSOR and CELESTIN reactors, he coordinated the basic and detailed design studies for the reactor block of Phénix, as assistant to the reactor block group leader. During the startup tests for Phénix, he was in charge of the reactor block. In 1976, as head of the reactor block department, he coordinated the reactor block detailed design studies for the Creys-Malville Plant. Since 1982, he has been in charge of the Novatome Equipment Design Division and, in this capacity, directs the preliminary design work on the SPX2 nuclear steam supply system (NSSS) equipment. **Charles Gigarel** (center) [ENSAM, Paris (silver medal award), 1947] joined Neyrpic, Grenoble, in 1947 as an engineer, first in the prototype department, then in the hydraulic valve department. In 1960, after a one-year specialization at INSTN, Saclay, he headed the development of nuclear activities in Neyrpic, which has participated in the construction of most of the French reactors. In 1974, as manager of the Nuclear Division, he directed the design, construction, and erection of a considerable part of the reactor block and internal handling systems for Superphénix. He is presently deputy general manager of Neyrpic, Grenoble. **Kurt Ebbinghaus** (bottom) (mechanical engineering, Ecole Supérieure Technique de Hagen, 1960; nuclear engineering, Kiel University, 1961) has been with Interatom since 1961. He worked in France and Italy on the ESSOR project from 1964 to 1970; he then participated in the ORGEL and SNR-300 preliminary design. From 1970 to 1971, he was site manager for the German supply packages for the high flux reactor in Grenoble (France). From 1971 to 1974, he served as project leader for small nuclear plant engineering studies (integrated-type pressurized water reactor). Since 1974, he has been Interatom's representative, responsible for the Superphénix 1 handling system supply packages. In 1983 he also became SNR2 project leader for the NSSS.

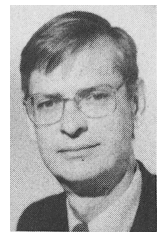
SUPERPHÉNIX 1 STEAM GENERATOR FABRICATION

Jean-Paul Crette
Thierry Zuber



Jean-Paul Crette (right) (Ecole Polytechnique, Paris, 1949; atomic engineer, Saclay, 1955) has consistently specialized in nuclear engineering since 1954, when he joined SACM, and subsequently at Groupement Atomique Alsacienne Atlantique and Novatome. He has participated in the development of many different types of reactors: gas-graphite (G1, G2, G3, etc.), heavy water (ESSOR, CELESTIN, etc.) and breeders. From 1967 to

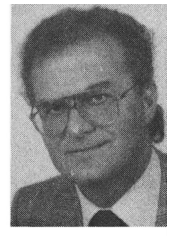
1974, he was in charge of the Phénix engineering studies. He is presently manager of the Novatome Design Engineering Division. **Thierry Zuber** (right) (mechanical engineer, ENSEM, Nancy, France, 1957) was assigned from 1960 to 1967 to the technical department of the French company Babcock & Wilcox (B&W), for conventional thermal nuclear steam supply system design work and testing. From 1968 to 1976, in the nuclear engineering department of B&W, he was in charge of the fast breeder steam generator design and development program. From 1976 to 1982, as head of the fast breeder reactor/steam generator design and development department of Creusot-Loire, he was in charge of the steam generator design studies for Creys-Malville and the breeders. In 1982, he joined Novatome, where he is presently in charge of the heat exchanger and steam generator department.

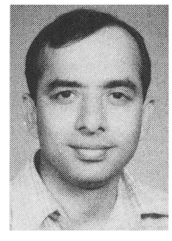


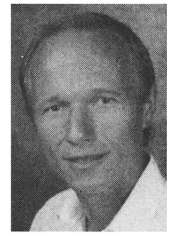
NUCLEAR SAFETY

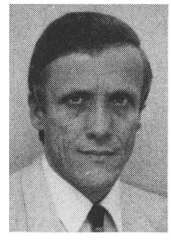
A SURVEY OF EXPERT OPINION AND ITS PROBABILISTIC EVALUATION FOR SPECIFIC ASPECTS OF THE SNR-300 RISK STUDY

Eduard Hofer
Vijen Javeri
Horst Löffler
Dankward F. Struwe





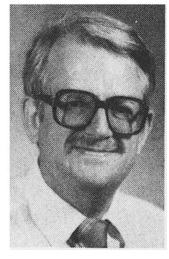




Eduard Hofer (top right) [Dipl.-Math., mathematics, Technical University of Munich, Federal Republic of Germany (FRG), 1970] is head of a mathematics group at the Gesellschaft für Reaktorsicherheit (GRS). His professional interests are in numerical analysis and probabilistics. **Vijen Javeri** (top left) (Dipl.-Ing., nuclear engineering, 1968; Dr.-Ing., Technische Universität Berlin, FRG, 1972) worked in the field of process data processing and magnetohydrodynamics until 1973 then on the transient analysis of a pressurized water ship's reactor. Since 1976, he has worked at GRS as a consultant to the nuclear licensing authority involved with the accident analysis of fast breeder reactors (FBRs). **Horst Löffler** (bottom right) (Dipl.-Ing., nuclear engineering, University of Karlsruhe, FRG, 1977) joined GRS, Köln, in 1977. He works on the accident analysis of FBRs and has been a consultant in the licensing procedure for SNR-300. Currently, he leads a group that investigates core disruptive accidents. **Dankward F. Struwe** (bottom left) (Dipl.-Ing., University of Berlin, FRG, 1967; Dr.-Ing., University of Karlsruhe, FRG, 1977) worked in the field of reactor physics until 1970 and then on safety problems of liquid-metal fast breeder reactors, especially hypothetical core disruptive accident analyses. Since 1972, he has been session head at the Institut of Reactor Development of the Nuclear Research Center Karlsruhe. His current interest is in the safety analysis of large breeder reactors and its impact on the design and risk-oriented evaluations.

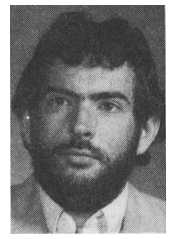
TWO MEASURES OF RISK IMPORTANCE AND THEIR APPLICATION

William E. Vesely
Thomas C. Davis



William E. Vesely (right) (BS, physics, Case Institute of Technology, 1964; MS, 1966, and PhD, 1968, nuclear engineering, University of Illinois) is a reseach leader in the Risk, Saftey, and Reliability Analysis Section at Battelle, Columbus Laboratories. He is responsible for methods development and application, data

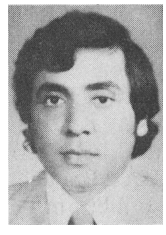
analysis, statistical analysis, and decision analysis in the fields of risk assessment, probabilistic modeling, and reliability theory. **Thomas C. Davis** (right) (BS, nuclear engineering, University of Cincinnati, 1980) is a research scientist in the Nuclear Systems Section at Battelle, Columbus Laboratories. His interests include probabilistic risk analysis, severe accident analysis, and nuclear power plant operation and management.



FUEL CYCLES

THE FUEL CYCLE EFFECT OF ^{236}U IN PRESSURIZED WATER REACTORS

Ansar Parvez

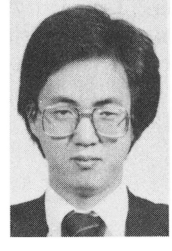


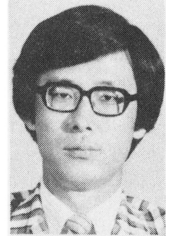
Ansar Parvez (MSc, physics, Punjab University, Pakistan, 1969; MSc, nuclear technology, Quaid-i-Azam University, Pakistan, 1971; PhD, nuclear engineering and science, Rensselaer Polytechnic Institute, 1977) is currently teaching at the Centre for Nuclear Studies, Pakistan Institute of Nuclear Science and Technology. He was a visiting assistant professor at Purdue University from 1982 to 1984. His areas of interest include core neutronics, fuel cycle analysis, nuclear fuel management, computer applications, and interactive graphics computing.

CHEMICAL PROCESSING

EXPERIMENTAL AND ANALYTICAL STUDY ON THE TIME-DEPENDENT REMOVAL EFFICIENCY OF METHYL IODIDE BY AN IMPREGNATED CHARCOAL BED

Soon Heung Chang
Won Jin Cho

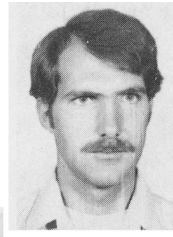


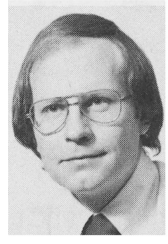


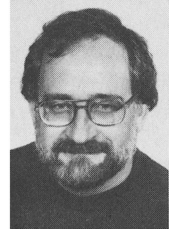
Soon Heung Chang (top) (BS, nuclear engineering, Seoul National University, 1976; MS and PhD, nuclear engineering, Massachusetts Institute of Technology, 1981) is an assistant professor in the Department of Nuclear Engineering at Korea Advanced Institute of Science and Technology (KAIST). His research activities are thermal-hydraulic safety analysis and probabilistic risk assessment, including natural circulation, severe accident phenomena, source terms, fast running computer code development, data treatment, and uncertainty analysis. Prior to joining the faculty at KAIST, he was on the nuclear staff of Bechtel Power Corporation. **Won Jin Cho** (BS, chemical engineering, Korea University, 1979; MS, nuclear engineering, KAIST, 1984) is a researcher at the Radwaste Division, Korea Advanced Energy Research Institute. His interests and activities include fission product behavior, source term assessment, and the safety analysis of radioactive waste disposal.

CONSIDERATIONS FOR MODELING CRITICAL HEAT FLUX BEHAVIOR

Joe E. Dahlquist
Fred S. Gunnerson
Ralph A. Nelson



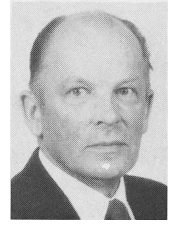




Joe E. Dahlquist (top) (BS, mechanical engineering, University of Central Florida (UCF), 1982; MS, 1983) is an engineer in the Computational Methods Division, EG&G Idaho, Inc. Current work has been in two-phase flow measurement instrumentation and thermodynamic properties modeling. **Fred S. Gunnerson** (center) (BS, mechanical engineering, Colorado State University, 1972; MS and PhD, nuclear engineering, University of New Mexico, 1979) is an assistant professor of engineering at UCF. His research activities at UCF have focused on two-phase flow modeling for light water reactors and for cryogenic systems. **Ralph A. Nelson** (bottom) (BS, mechanical engineering, 1965; MS, engineering mechanics, 1968; PhD, mechanical engineering, 1970, North Carolina State University) is currently a staff member of the Safety Code Development Group at Los Alamos National Laboratory working in the area of two-phase flow and heat transfer modeling with applications to nuclear reactors (the TRAC code). Prior to this position, his research activities included thermal-hydraulic code development (RELAP4 and RELAP5) and experimental work in post-critical-heat-flux nonequilibrium heat transfer while at Idaho National Engineering Laboratory.

REACTOR PHYSICS CALCULATIONS ON CLOSE-PACKED PRESSURIZED WATER REACTOR LATTICES

Erik Johansson



Erik Johansson (graduate engineer, School of Engineering Physics, The Royal Institute of Technology, Stockholm, Sweden, 1954; Licentiate of Technology, physics, The Royal Institute of Technology, Stockholm, 1959; Dr. of Technology, reactor physics, Chalmers University of Technology, Gothenburg, Sweden, 1967) is a reactor physicist at Studsvik Energiteknik AB, Sweden. He joined the company, then AB Atomenergi, in 1955. His current work mainly concerns physics investigations on advanced reactors.