Trip Reports

August 22, 1991

MEMORANDUM FOR: ORNL FILES

FROM: Jack C. Scarborough and Gail H. Marcus

SUBJECT: COMMISSIONER ROGERS VISIT TO OAK RIDGE NATIONAL LABORATORY ON 19-20 AUGUST, 1991

On August 19-20, 1991, Commissioner Rogers, accompanied by his Technical Assistants, Gail Marcus and Jack Scarborough, visited Oak Ridge National Laboratory for presentations on ORNL programs for the NRC. The agenda for the meetings is appended. Commissioner Rogers met first with ORNL Director Dr. Alvin Trivelpiece, after which a press briefing was held on Commission-related issues and ORNL support programs. Mr. Thomas M. Jelinek, Deputy Director, Department of Energy, Oak Ridge, made a brief statement of welcome and participated in the introductory discussions.

Dr. Trivelpiece opened the meeting by summarizing the overall missions of ORNL and presenting financial data related to the laboratory's support by various sponsors and by various programs. These data are presented in a briefing book provided by ORNL which is in the files.

1. Overview of NRC Programs at ORNL

Mr. Claud E. Pugh, Manager of NRC's ORNL programs, provided a brief overview of these programs, including the matrix organization supporting NRC specific tasks. There are 63 active FINs (projects) at ORNL that range from large experimental projects to small technical assistance efforts. Of these, 37 are sponsored by the Office of Nuclear regulatory Research, representing about 70% of the total funding. ORNL is a major participant in NRC's plant aging and license renewal programs. The generic environmental impact statement (GEIS) project, severe accident program, and fission product release are other major programs at the laboratory.

2. Nuclear Operations Analysis Center Activities (NOAC)

Gary T. Mays reviewed the activities of NOAC, which provides support to NRC on its Performance Indicator (PI) program, assists in operational analysis of short-term operational issues, and develops and maintains the Sequence Search and Coding System (SCSS), the codified Licensing Event Report (LER) data base. SCSS includes proprietary foreign event data in addition to U.S. event data. The SCSS provides a methodology for construction event

The impact on PTS analyses of various known uncertainties is thought to be large for shallow flaw constraint effects and of flaw population. The ORNL HSST senior staff were most helpful in providing copies of current literature on fracture mechanics and PTS applications, including the loan of a useful text, Fracture & Fracture Control in Structures, Prentice-Hall, N.J. (1987).

10. Overview of Magnetic Fusion Energy Research

Dr. John Sheffield, Director, Fusion Energy Division, presented an overview of international fusion research, including ORNL activities in this technology. Progress made by the European JET experiment was cited, including projected performance capabilities of the ITER experiment which is now planned to be constructed. Alloy developments were expected to yield substantial improvements in material properties which presently limit reactor design. Another spinoff is the development of automated maintenance techniques for the large superconducting coils; the successful development and test of these coils were another notable accomplishment. Finally, Dr. Sheffield commented on other fusion spin-offs to industry which enhance U.S. competitiveness in a great variety of technologies.

11. Passive Reactor Studies

Dr. Charles W. Forsberg of ORNL's Chemical Technology Division presented an overview of passive and inherent structures, systems, and components for water-cooled reactors. ORNL had initiated a study in 1989 to identify all such technologies and searched world scientific and patent literature. Over 70 classes of devices were found and reported in ORNL-6554, Proposed and Existing Passive and Inherent Safety Related Structures, Systems and Components (Building Blocks) for Water-Cooled Reactors, October 1989.

The Mitsubishi Simplified (MS) Pressurized Water Reactor in ratings of 600 to 1200 MWe was cited as a high priority program at Mitsubishi. while development work has been underway for over four years on this design, plant details have only recently been published. Unique features were said to include active/passive safety philosophy in safety system design, and the use of horizontal steam generators. New passive/inherent safety system components include accumulators with fluidic valve control, and a two-phase, natural-circulation, containment cooling system. A schematic of the innovative Mitsubishi MS-PWR design is attached which depicts the horizontal steam generator arrangement and spherical containment. Although a two-loop MS-PWR may be built for demonstration purposes, Mitsubishi's (Japan's) principal interest was said to be in large four-loop 1200 to 1400 MWe configurations.

Another example of advanced reactor conceptual design presented is the CANDU 9 (900 MWe) Heavy Water Reactor under development by AECL. The CANDU 9 would build on CANDU 3 developments, such as single calandria refueling, digital reactor protection and plant operational control I&C systems, single unit containment, and

modular construction techniques. Special features of the CANDU 9 include a vertical fuel and pressure tube core arrangement (with the on-line refueling machine moving in the horizontal plane across the reactor vessel top), a passive thermal switch mechanism in each pressure tube to convert the normally insulated pressure tube to a conductor at elevated (accident) temperatures, passive transfer of heat from the calandria to environment (air-cooled heat exchangers outside containment), and reactivity control by multiple mechanisms, the latter generally similar to the CANDU 3 advanced reactivity control design.

A final area of international research and development is containment design: development of "supercontainments". Such containments would withstand pressure vessel failure, hydrogen burns after a 100% Zr reaction, containment-corium reactions following a severe accident, and limit fission product releases even if containment failure were to occur. Two examples of supercontainment systems were discussed: the German advanced containment design, and the Core Melt Source Reduction System (COMSORS). The German containment design uses several unique features to withstand a maximum hydrogen burn, and to withstand core-concrete interactions, steel cables around an inner "containment vessel" to withstand a steel pressure vessel failure, and a filter system to limit radionuclide releases if containment leakage were to occur. COMSORs involves the use of special aggregate glass formers) in concrete which result in core-concrete reactions that yield a "glass" mixture to minimize volatile off-gas and prevent core melt through of the containment structure.

Dr. Forsberg concluded his summary of worldwide reactor development by discussing his views on certain regulatory issues in passive and inherent safety. These included:

- o the objective of the containment system (public protection versus avoidance of land contamination),
- o independence of containment systems from other reactor safety systems,
- o whether regulations should limit the in-containment accident source term,
- o the extent to which regulators should encourage designs which eliminate safety issues versus simply the prescription of safety goals,
- o the relationship between U.S. and foreign safety standards,
- o the role of defense in depth (redundancy) with designs featuring inherent safety, and
- o the requirements for emergency planning, plant security, and operator training with advanced passively safe plants.

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- the requirements for emergency planning, plant security, and operator training with advanced passively safe plants.

He presented Commissioner Rogers a copy of a paper which he had coauthored with Dr. Alvin Weinberg entitled "Advanced Reactors, Passive Safety, and Acceptance of Nuclear Energy", Annual Review of Energy, 1990.

12. Advanced Reactor Technology Development Programs at ORNL

Frank J. Homan, Director of ORNL's Reactor Programs Office, then provided a historical overview of ORNL reactor work, its current efforts in this area, technology development supporting NRC licensing for the MHTGR, and robotics technology supporting DOE's Advanced Reactor Design Programs. The current programs include work in four program areas supporting seven reactor types: LWRs, ALMRs, MHTGRs, New Production Reactors (NPR) Program, and Radioisotopic Thermoelectric Generators (RTGs) and the SP-100 reactor of the Space Nuclear Power Program. The technical orientation of the LWR and ALMR programs is technology development and data base management, whereas for the commercial MHTGR program it is design-oriented development. A summary of each program was provided.

13. Robotics for Advanced Reactors

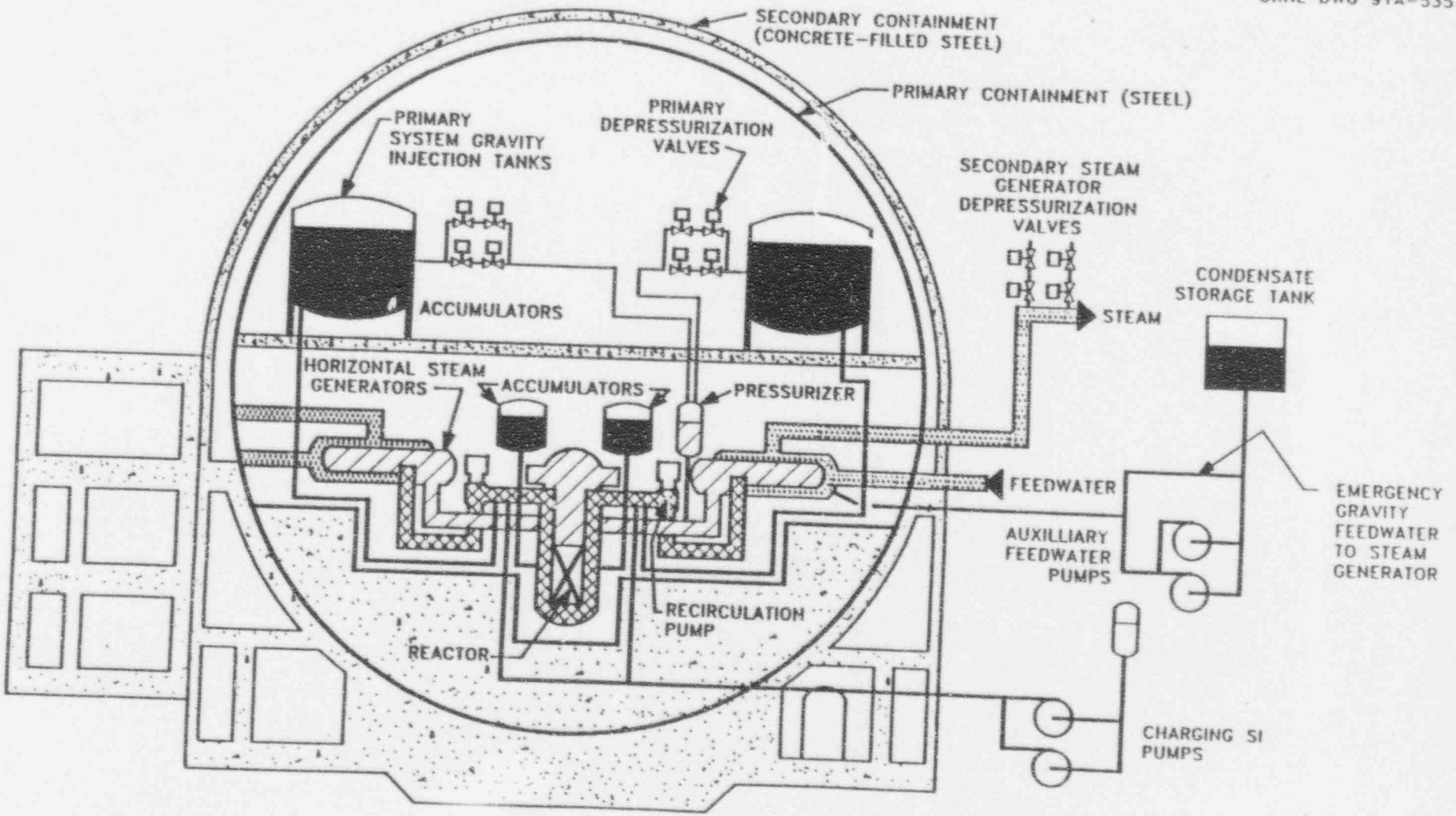
A unique ORNL, university, and industry cooperative program to develop new robotics technology intended primarily for advanced reactors was then presented. Drivers for this program were said to be the increasing costs of occupational exposure ($10,000 per person-rem), the ever increasing occupational annual exposure of workers in the commercial nuclear program, increasingly strict federal regulations, the greater liability of employers of occupational exposure-related illnesses, the high costs of plant down-time, and the demonstrated cost benefit of robots in current nuclear plants. ORNL is cooperating with a Utility/Manufacturer Robotics User Group (UMRUG) and with PSE&G in particular in developing utility robotics research needs.

14. Waste R&D Programs at ORNL

Dr. A. P. Malinauskas, Director, Waste R&D Programs at ORNL, outlined the waste management and environmental restoration programs at ORNL including the development of measurement devices and instruments for toxic and hazardous materials in very dilute quantities. Several ORNL developments described included an Ion Trap Mass Spectrometer (ITMS) for measurement of volatile organic carbon molecules in groundwater, a Derivative Ultraviolet Absorption Spectrometry (DUVAS) for quantitative measurement of common aromatic contaminants, a Spectrochemical Probe (SCP) for chlorinated solvents, nitro-explosives, and other contaminants, and the application of biotechnology to monitor remediation efforts. Examples of the application of these techniques at ORNL-contaminated sites were presented.

15. Depleted Uranium Waste Minimization at ORNL

ORNL DWG 91A-535



MITSUBISHI SIMPLIFIED PRESSURIZED-WATER REACTOR

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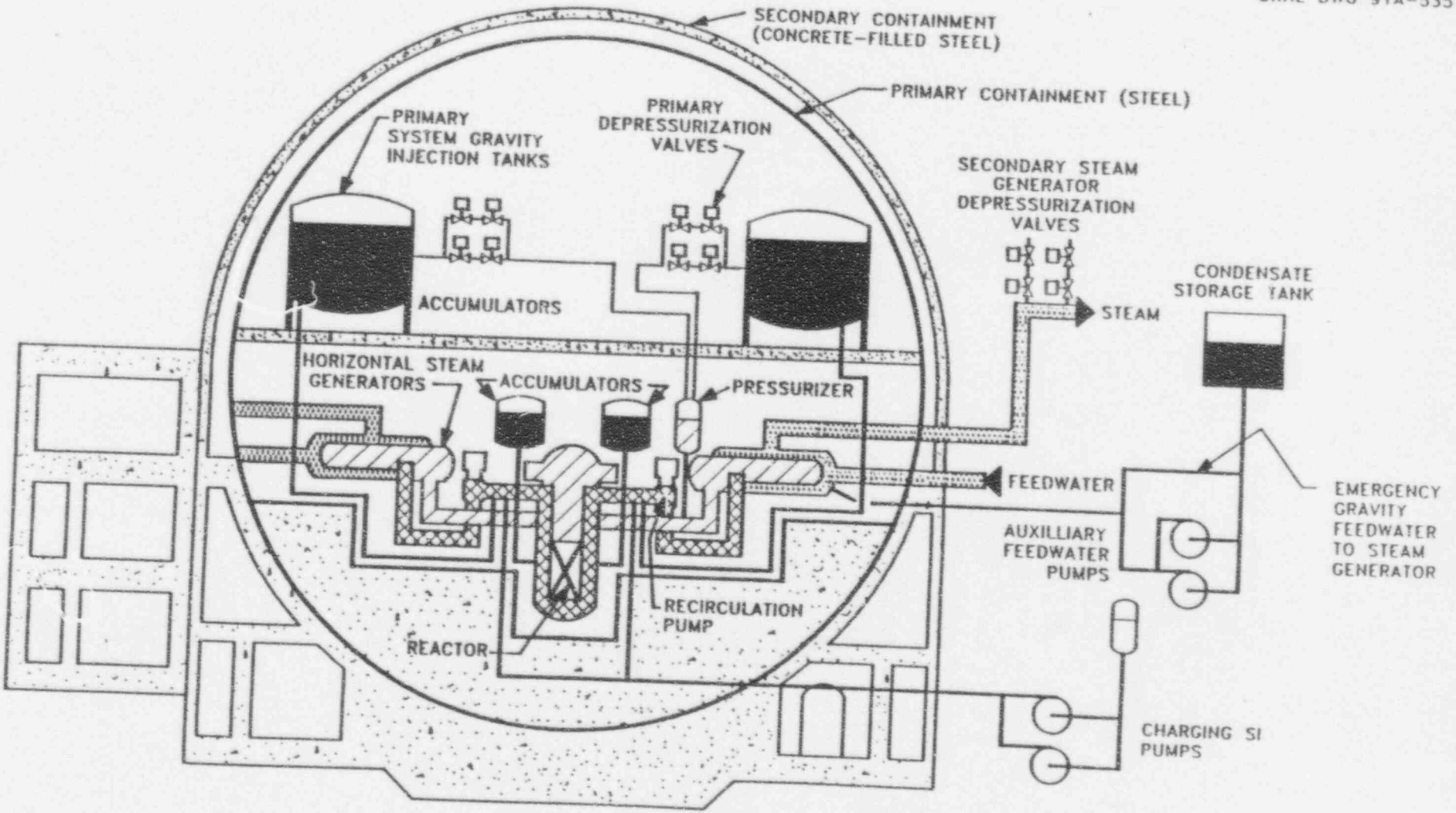

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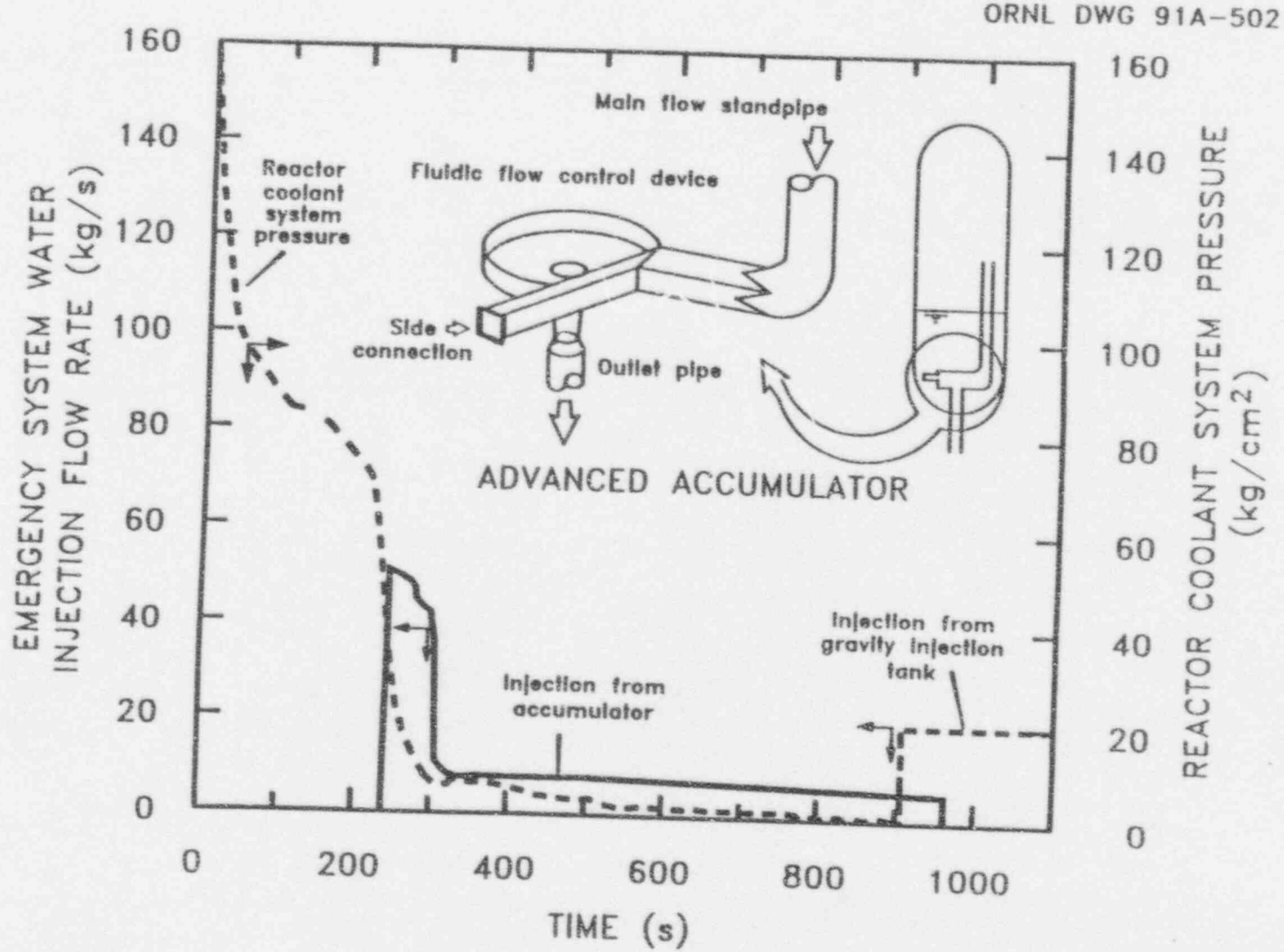
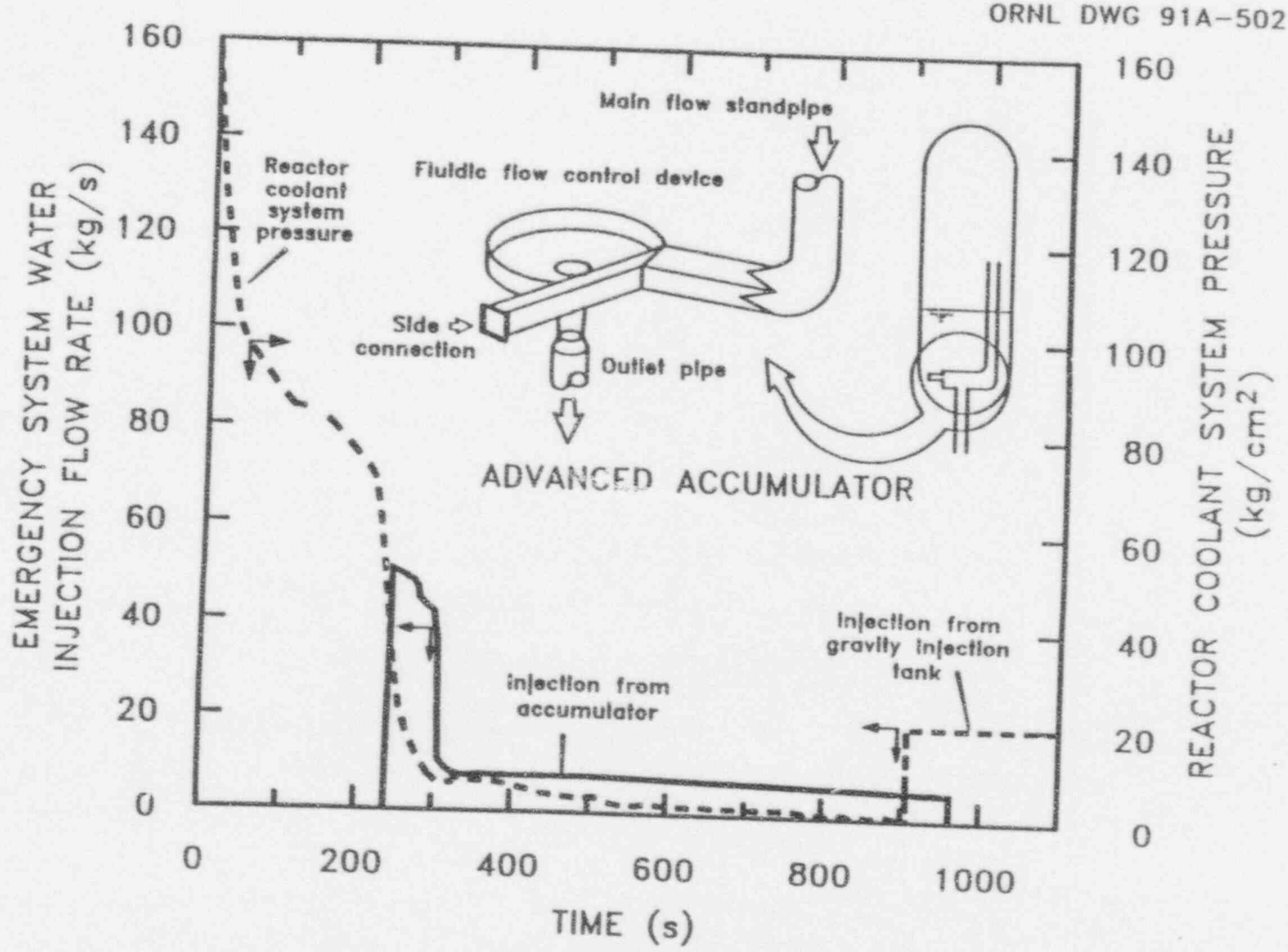


MITSUBISHI SIMPLIFIED PWR ADVANCED ACCUMULATOR AND ITS ACCIDENT PERFORMANCE



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