

CAE ADVANCED REACTOR DEMONSTRATORS FOR CANDU, PWR AND BWR NUCLEAR POWER PLANTS



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Abstract

CAE, a private Canadian company specializing in full scope flight, industrial, and nuclear plant simulators, will provide a license to IAEA for a suite of nuclear power plant demonstrators. This suite will consist of CANDU, PWR and BWR demonstrators, and will operate on a 486 or higher level PC. The suite of demonstrators will be provided to IAEA at no cost to IAEA.

The IAEA has agreed to make the CAE suite of nuclear power plant demonstrators available to all member states at no charge under a sub-license agreement, and to sponsor training courses that will provide basic training on the reactor types covered, and on the operation of the demonstrator suite, to all those who obtain the demonstrator suite.

The suite of demonstrators will be available to the IAEA by March 1997.

1. INTRODUCTION

CAE, a private Canadian company with considerable experience in the design of nuclear power plant simulators, has agreed to provide IAEA with a suite of nuclear power plant demonstrators at no charge to IAEA. The suite of nuclear power plant demonstrators will consist of CANDU, PWR and BWR demonstrators and will operate on a 486 or higher level PC.

IAEA has agreed to make the CAE suite of nuclear power plant demonstrators available to member states at no cost to the recipients, and to provide training on the reactor types covered by the suite of demonstrators and on the operation of the demonstrators, to all organizations receiving the CAE suite of demonstrators.

2. CAE

2.1 Background

CAE Inc., with headquarters in Toronto, Canada, and facilities throughout Canada, the United States, Europe, Asia and Australia, is the world leader in the design and production of commercial flight simulators and visual simulation systems. The company, with over 6,200 highly skilled employees, is a leading supplier of military simulation systems, electronic control systems, and maintenance, repair, modification and overhaul services for military aircraft and offers a complete range of technical information development and delivery services. CAE is also a leading supplier of nuclear power plant simulators, and is the only simulator supplier to provide full scope simulators for CANDU, PWR and BWR plants. CAE's Industrial Technologies Group is a leading supplier of environmentally friendly aqueous-based cleaning equipment, sophisticated separation technologies for various industries,

- ATTAC™ (Advanced Two-Phase Thermal Hydraulic Code Generator), which is used to generate models for key systems that may experience two-phase flow, including the heat transport system (RCS), steam generators, pressurizer and pressure relief tank; and
- TIGERS™ (The Interactive Graphics Environment for Real-time Systems), which allows the operator of the simulator to generate graphics for data and control panel mimics.

The CAE simulators incorporate integrated test and validation tools, and include an integrated instructor/operator station.

3.2 Simulator Operation

The CAE simulators replicate the performance of the Nuclear Steam Supply System (NSSS) and the impact on the plant performance of key Balance of Plant (BOP) systems. The basic graphic displays for CANDU, PWR and BWR are presented in Figures 1, 2, 3 and 4 respectively; actual displays are in colour.

The simulators include a menu of typical plant malfunctions and animated pages that are used by the simulator operator to control and monitor the simulations.

The CAE simulators make extensive use of colour graphics to display data (for example, core flux, core temperature, HTS/RCS void, HTS/RCS temperature, and steam generator secondary side level), and to display the status of devices such as pumps and valves.

Animation features include the ability to zoom, resize and reposition displays; the ability to overlay data (from current or previous simulations). These features are enhanced by the "Windows" environment.

The simulations can be conducted in slow motion, real time, or accelerated time (for relatively slow transients).

The suite of nuclear power plant demonstrators (CANDU, PWR, BWR) operate in much the same manner and incorporate similar features and operational characteristics for each of the nuclear plant types. The instructor can therefore conduct simulations of the different reactor types with ease, utilizing a common approach and format.

The CAE suite of demonstrators are extremely capable and very user friendly; they are therefore of interest to both novices and experienced workers in the nuclear energy field.

The suite of nuclear power plant demonstrators will represent generic plants (CANDU, PWR, BWR) in the 600 MW(e) or larger size range. However, to assure precise simulation, detailed models of plant features/characteristics will be incorporated. This requires that the simulations be plant specific in many cases; however, the demonstrators will not identify the specific basis of the simulation, and will be made to appear as generic as possible.

4. USES OF THE CAE "PC BASED" DEMONSTRATORS

The suite of "PC based" CANDU, PWR and BWR nuclear power plant demonstrators is intended to provide basic information and training to a variety of people/organizations in the field of nuclear power, providing a level of knowledge regarding the operation of nuclear power plants.

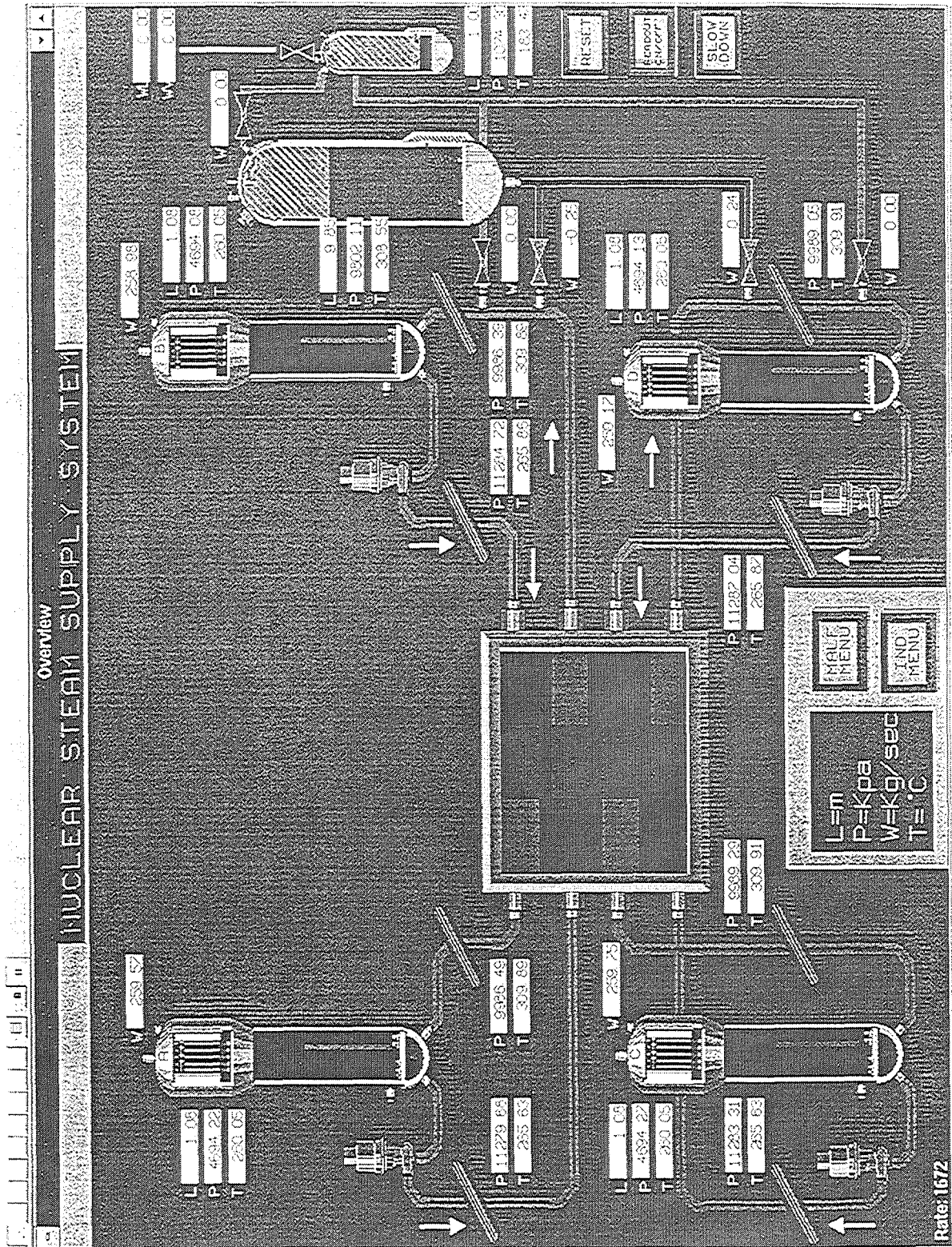


FIG. 1.

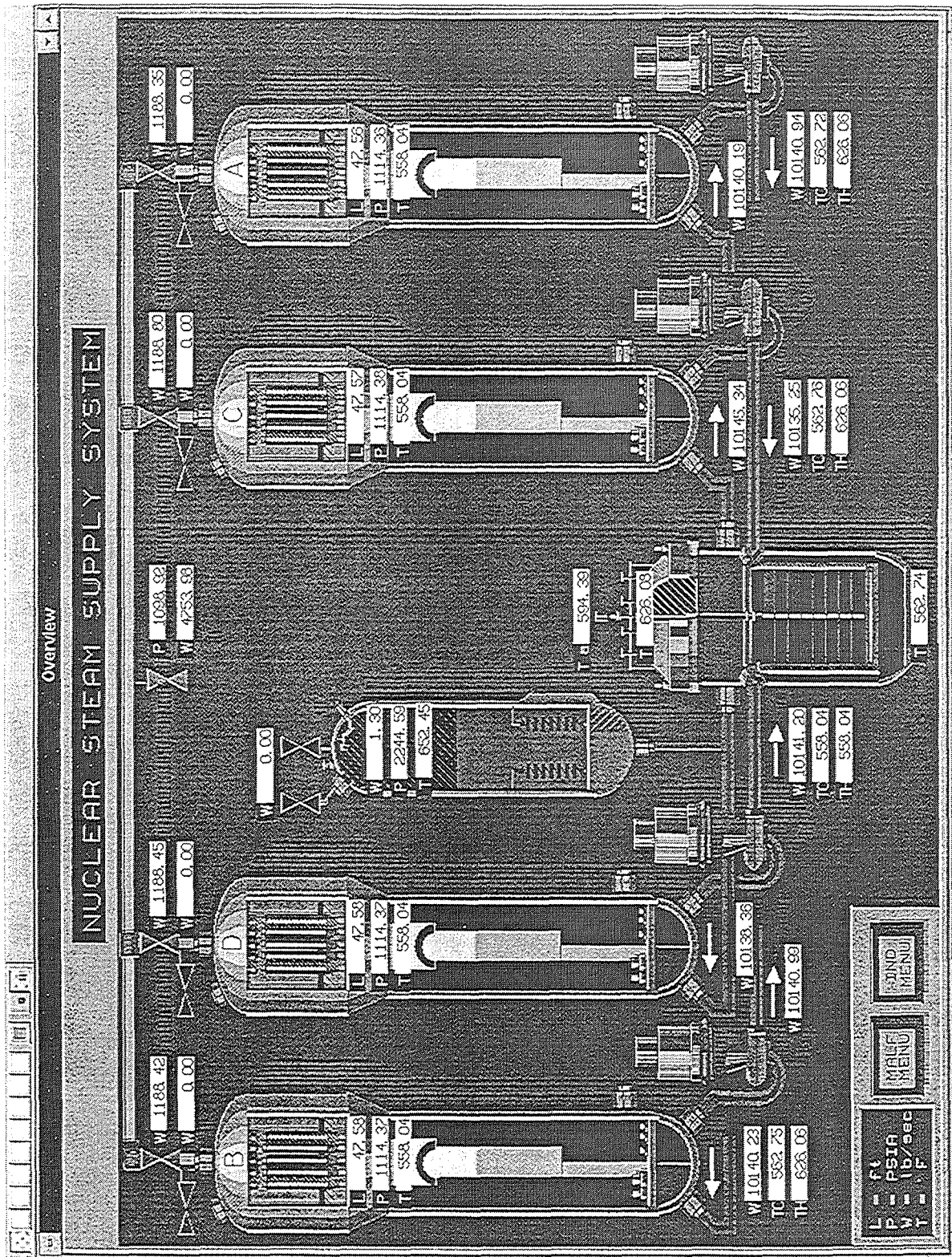


FIG. 2.

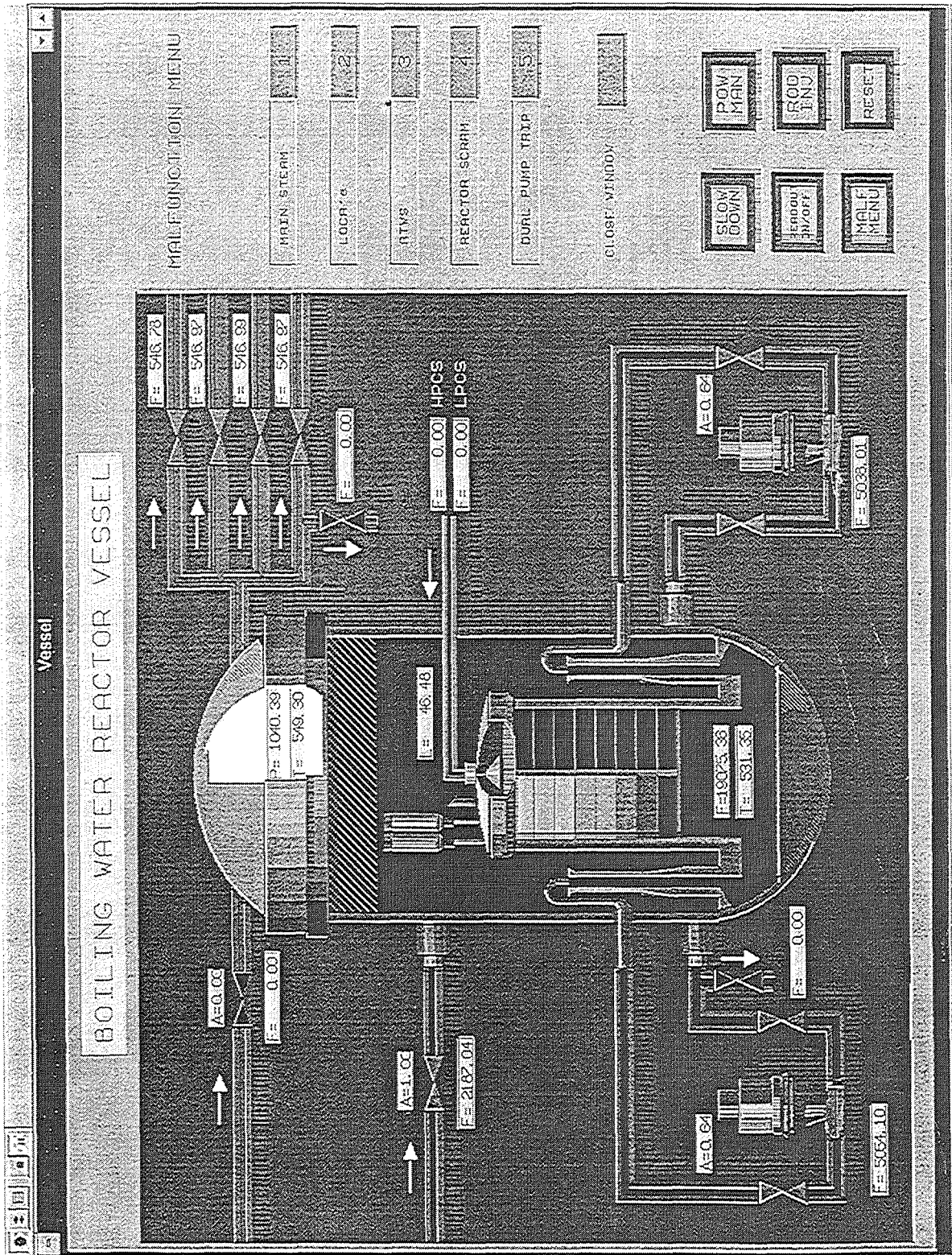


FIG. 3.

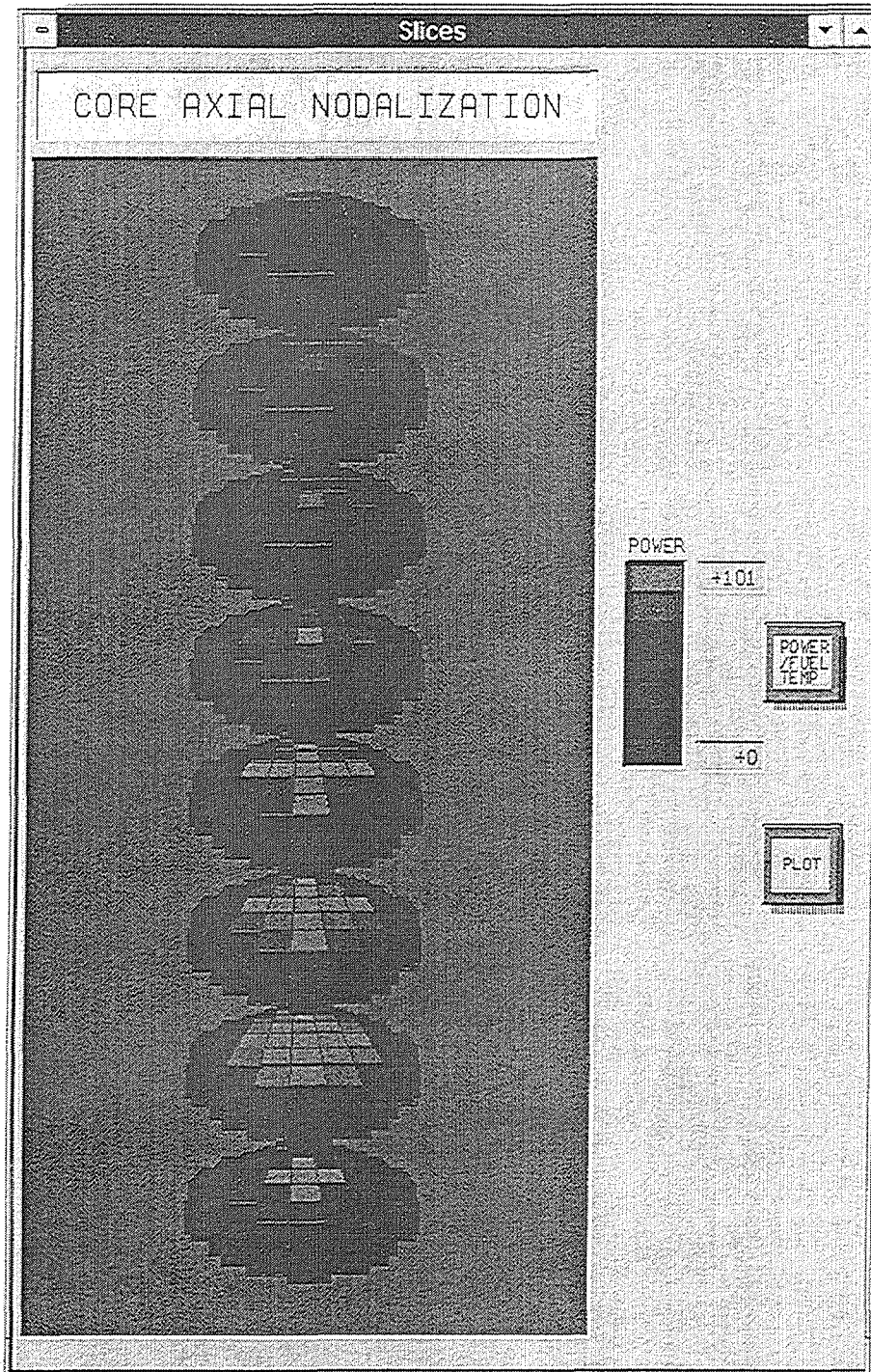


FIG. 4.

The intended audiences include research organizations, universities and utilities that anticipate a future involvement with nuclear power, and which do not have a basic understanding of nuclear power plant operation.

The suite of demonstrators is not intended for plant operator training, or to form the basis of the specific evaluations of reactor types.

5. TRAINING

The individuals/organizations receiving the CAE suite of demonstrators must be familiar with both the basic characteristics of the reactor types (CANDU, PWR and BWR), and the operation of the simulators in order to derive real benefit from operation of the demonstrators. Hence, completion of a training program covering reactor characteristics and simulator operation is a prerequisite to obtaining the suite of demonstrators.

The IAEA has agreed to sponsor the training courses. The training courses will include experts in the reactor types (likely to be provided by reactor vendors) and experts in operation of the demonstrators (to be provided by CAE).

6. SUMMARY

The suite of nuclear power plant demonstrators (CANDU, PWR, BWR) provided by CAE will make very capable user friendly PC based simulators available to a wide variety of organizations world-wide, without cost, via the IAEA. These simulators will substantially enhance the nuclear power knowledge base, particularly in developing countries, and promote the understanding and acceptance of nuclear power world-wide.

The CAE suite of demonstrators would normally sell for several hundred thousand dollars for each seat (user). Making the suite of simulators available world-wide at no cost is a very generous offering by CAE, and of substantial benefit to users.

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