THE DESIGN AND USE OF PROFICIENCY BASED BWR REACTOR MAINTENANCE AND REFUELING TRAINING MOCKUPS

BY

GUY J. FORD

WITH ASSISTANCE FROM

ROLF PETTERSSON AND TOM LONNHOLM

ABB

THE DESIGN AND USE OF PROFICIENCY BASED BWR REACTOR MAINTENANCE AND REFUELING TRAINING MOCKUPS

The purpose of this paper is to describe the ABB experience with the design and use of boiling water reactor training facilities. The training programs were developed and implemented in cooperation with the nuclear utilities. ABB operates two facilities, the ABB ATOM Light Water Reactor Service Center located in Vasteras, Sweden, and the ABB Combustion Engineering Nuclear Operations BWR Training Center located in Chattanooga, Tennessee, USA. The focus of the training centers are reactor maintenance and refueling activities plus the capability to develop and qualify tools, procedures and repair techniques.

The training centers are equipped with full-scale mockups of the reactor internal components, control rod drives, dummy fuel assemblies and all the necessary service equipment and tooling. Important components of the mockups, such as Incore Power Range Monitoring instruments and control rod drives are actual components. The reactor mockups are equipped with fully functional fuel handling/service bridges and overhead cranes that permit extremely accurate simulation of all key reactor maintenance and refueling activities. The mockups are constructed to provide the trainee accessibility and inspection of the reactor assembly and important components, and observation of the interaction between tools and components during servicing. This is an important benefit unavailable to trainees receiving "on the job training" at an operating reactor. This feature also provides the capability to demonstrate or simulate abnormal conditions or events that may have occurred at an operating plant, and more importantly, demonstrate why it occurred and how it can be avoided.

Training Mockups are also provided for the disassembly, inspection, rebuild, and testing of critical reactor components including reactor coolant recirculation pumps, control rod drives, and reactor instrumentation.

Attention to details in the training, such as performing activities in full anti-contamination clothing, using remote closed circuit television cameras, and communications with the "control room" provide an extremely realistic learning environment.

The construction of the ABB training centers was motivated by the desire to improve nuclear plant performance through shorter outages and increased availability. Key to achieving these objectives was improving nuclear worker skills to ensure the work performed was of the highest quality, completed in timely and efficient manner, and errors, with a resulting negative impact on plant performance or safety, were eliminated. By emphasizing the development of worker proficiency as a key concept of the training, other benefits were realized including a reduction in the radiation dose received due to the efficient task performance and the elimination of "rework" due to incorrectly performed maintenance.

The objectives for the design of the training programs and facilities included classroom and hands-on mockup training for both ABB personnel and nuclear plant employees, the testing and qualification of new tools, procedures and repair techniques, research and development activities, and response to unforeseen circumstances encountered at the operating plants. The facilities are also employed for demonstrations and industry exhibitions. The capability to accurately simulate key activities required for reactor servicing and refueling was judged to be essential for an effective program.

Effective training requires qualified instructors, software including course materials, visual aids, and documentation, and facilities and equipment including full-scale mockups that permit use of actual reactor components and service tools. The ability to combine and reinforce classroom training with mockup training results in a high level of knowledge retention and results in development of highly proficient workers.

To be effective, the training programs must be tailored for different targeted groups. Since personnel training is essential at all organizational levels, the training programs must be adaptable to the different needs of entry level trainees, experienced workers (updating skills and knowledge), supervision, operations and support personnel. For example, a reactor service technician employs detailed knowledge of reactor assembly and skill in manipulating underwater tools to uncouple and remove a control rod. The control room operator supporting the same task requires an overview understanding of the mechanical steps, but an in-depth knowledge of the CRD system and its required configuration at key points in the procedure to support the task and ensure plant safety is preserved. Miscommunication or misunderstanding between the reactor service personnel and

control room can result in delays, damaged equipment, an unsuccessful result or an unrecognized condition.

Instructors are typically Senior Field Services Supervisors with extensive practical experience and in-depth knowledge of the subject training course. Frequently, when the training is being conducted for nuclear plant employees, the plant will also send a representative of their training department as an instructor or observer.

The key elements of an effective training program start with identifying who the course is for and what the course is intended to accomplish. For each operation within a course, the trainee learns why and when the operation is performed; who is responsible for the performance and how it is accomplished. Instruction manuals may be "generic" (applicable to many nuclear power plants) or "plant specific" as circumstances dictate. Frequently, plant specific procedures are incorporated into the training program to ensure student familiarity and confidence with the procedure.

The next elements of an effective program are the practical training, which consists of an initial observation of task performance and familiarity with the equipment, tools and components, followed by actual performance of the task. Repetition is then employed to develop speed, accuracy, confidence and finally, proficiency. The final element of an effective program consists of verifying the student can meet the objectives set out for the course. The verification of knowledge and skills is accomplished using written and/or oral exams and a proficiency or skill demonstration by the trainee. Results of the testing are documented and retained as part of the individuals training record.

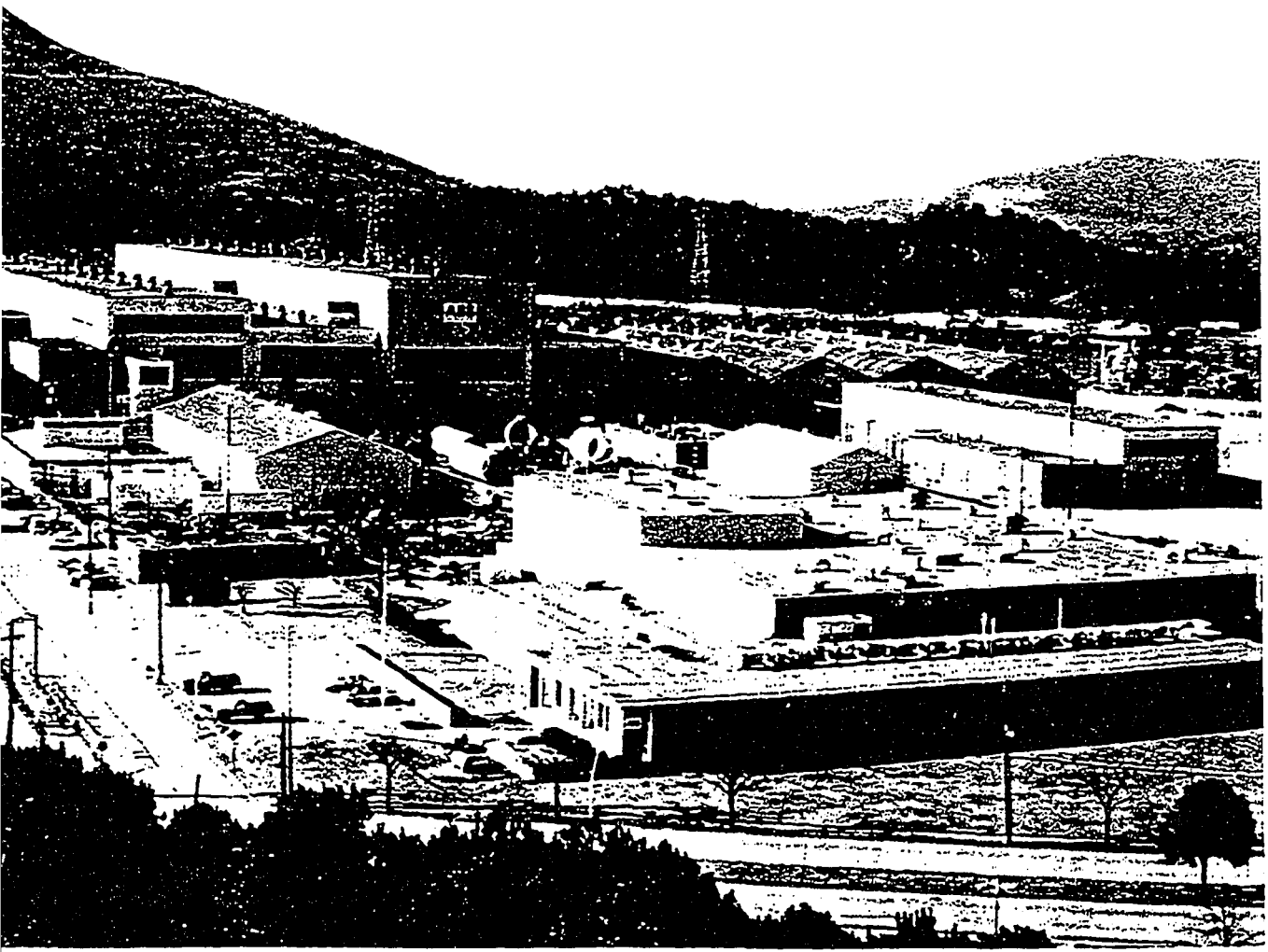
Typical course subjects include Basic Reactor Technology, Plant Systems, Reactor Disassembly and Reassembly, Invessel Servicing, Fuel Technology, Control Rod Drive Maintenance, Recirculation Pump Maintenance, and Refueling Supervisor Training.

Classrooms are selected to enhance the learning environment and are fully equipped with audio visual equipment including overhead and slide projectors, and video equipment. Large poster size drawings and cutaways depicting the reactor and internals, major components and the entire nuclear plant are utilized frequently. Table top scale models of components such as a fuel bundle are employed in the classroom to assist the learning process.

The objective for mockup design and construction is to provide the capability to train students on the critical but infrequently performed tasks such as those typically performed only during a refueling and maintenance outage. Maintaining the skills of workers is particularly difficult for nuclear plants due to the eighteen and 24 month fuel cycles common in the US and the twelve month cycles common in Sweden. The problem is of somewhat less magnitude for vendor personnel who typically work several outages at several different plants during the course of a year. Nevertheless, "refresher" training or retraining, to stay abreast of the latest technologies, procedures, industry experience with lessons learned, and to maintain skill proficiency, is necessary and clearly of benefit.

The results of conducting proficiency based reactor maintenance and refueling mockup training have been extremely positive both for companies such as ABB and for the nuclear plants. The importance of this type of training has been recognized, encouraged and required by the operators of the nuclear plants, industry groups, suppliers, and regulatory authorities. The need for and future of training programs and facilities such as described herein is virtually assured in an economically competitive, safety-focused industry such as ours. The economic sense of investing in training is easily justified when the value of one days power production is compared with the cost of training.

Guy J. Ford is the Manager of BWR Services for
ABB-Combustion Engineering Nuclear Operations
and oversees the BWR Training Center in Chattanooga, TN.
The assistance of Rolf Pettersson and Tom Lonnholm
of ABB-Atom's Reactor Services in Vasteras, Sweden
is gratefully acknowledged.



SOUTHEAST NUCLEAR SERVICE CENTER
HOME OF ABB BWR TRAINING FACILITY
CHATTANOOGA, TENNESSEE