Conf-910116--30

WHC-SA-0896-S

Status Report of SP-100 Ground Engineering System Test Site Instrumentation, Control, and Plant Protection System Activities

W. F. Carlson
K. L. Bennett
G. V. Delisle
K. L. Hampsten
B. L. Philipp
T. C. Schneider

Date Published
May 1990

To be presented at
8th Symposium on Space
Nuclear Power Systems
Albuquerque, New Mexico
January 6-10, 1991

Prepared for the U.S. Department of Energy
Assistant Secretary for Nuclear Energy

Westinghouse
Hanford Company

P.O. Box 1970
Richland, Washington 99352

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Copyright License: By acceptance of this article, the publisher and/or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper.

MASTER

Approved for Public Release

RECEIVED

901163345

9 0 1 1 6 9 5 0 3 4 6

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Printed in the United States of America

DISCLM-2.CHP (2-89)

9 0 1 1 6 3 3 4 7

STATUS REPORT OF SP-100 GROUND ENGINEERING SYSTEM TEST SITE INSTRUMENTATION, CONTROL, AND PLANT PROTECTION SYSTEM ACTIVITIES

William F. Carlson, Kenneth L. Bennett, Gerald V. Delisle,
Kenneth L. Hampsten, Barbara L. Philipp, and Thomas C. Schneider.

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-7843

INTRODUCTION

The facility at which the SP-100 Nuclear Assembly Test (NAT) of a 100-kWe reactor will be conducted in the mid-1990's has been in the Definitive Design phase since November 1987. Considerable progress has been made since then in the design and procurement of instrumentation and control systems.

The tests will be conducted from a central control room using modern process control technology. A microprocessor-based Distributed Control System is being provided as the means for centralized control and monitoring.

A separate, seismically hardened area, the Auxiliary Shutdown Station (AXSS), is provided from which the reactor can be safely shut down and monitored in the event that the main control room becomes uninhabitable or if the control room equipment is not functional. From the AXSS the reactor can be shut down and post accident monitoring can be conducted, as well as controlling the removal of residual heat.

The Plant Protection System includes the AXSS, a Containment Isolation System, a Reactor Protection System, and a Vacuum Vessel Purge Control System. These are all designed to automatically perform safety functions so as to protect the public from the results of accidents or natural events such as an earthquake.

A Test Data Recording and Processing (TDRP) System is also being provided which is separate from the Process Control System. This system will acquire data from both the Test Assembly and the many support systems in the Facility, and will provide the capability for complex computations and displays.

Also discussed are the Liquid Metal Trace Heating Control System and the Plant Radiation Monitoring equipment.

This paper summarizes the present status of the design and procurement activities which support these systems.

FACILITY DESCRIPTION

The SP-100 Ground Engineering System (GES) Test Site is located in Richland, Washington. The basic functions and systems which comprise the Test Facility have been described in a previous symposium (Miller et al. 1988) and changes since the completion of conceptual design have been described at the 1989 Symposium (Renkey et al. 1989). Although the details of the Instrumentation and Control (I&C) systems (such as the numbers of inputs and outputs) which

monitor and control the Facility and Test Assembly change as system designs evolve, the basic concepts have remained the same throughout the Conceptual, Preliminary, and Definitive Design phases.

Figure 1 is an artist's conceptual view of the Test Site showing the Containment Building in which the Test Assembly will be installed. All of the equipment to be discussed is located within the buildings shown.

SYSTEM STATUS

System Design Specifications have been prepared for all of the I&C and protection systems to be discussed. These project documents describe how Test Site Functions and Requirements are to be implemented, and are major design documents. Following the completion of this task, actual design was begun. Progress in each area is discussed in the following sections.

Process Control System

A purchase order was issued to Powell Process Systems of Houston, TX, in March 1989 for a Distributed Process Control System. The system incorporates state-of-the-art microprocessor technology with color graphics operator interfaces. Approximately 1,000 input/output points will be available and the control room will contain three operator workstations, any one of which will be capable of controlling the plant. Normally, however, the three stations will be used for operator interfacing with the reactor, balance of plant, and alarms, respectively. The Reactor Control System itself, which is part of the Test Assembly, is being provided by General Electric (GE), but will interface with the control room displays for operator setpoint adjustment and monitoring. This interface will be implemented using standard process analog and discrete inputs and outputs. This arrangement, rather than the use of digital data links, allows the designs and procurements of GE and Westinghouse Hanford Company (Westinghouse Hanford) equipment to proceed in parallel. Figure 2 illustrates the GE/Westinghouse Hanford interfaces.

The Process Control System (PCS) is to be delivered in late 1990. It will be staged in a previously prepared area for preliminary configuration and engineering training while the control room is being constructed.

Preparation of Control and Monitoring Requirements (C&MR) documents for each system has been initiated, with the goal of having first revisions for all systems complete in August 1990. These C&MRs contain information which is the basis for configuring the PCS.

Plant Protection System

The AXSS is located immediately below a portion of the control room. It is easily accessible to the operators if the control room becomes uninhabitable for any reason. It is not intended as an alternate control room, but if operations become untenable in the control room, the reactor will be shut down and the function of decay heat removal will continue using the AXSS.

90116330348

9 0 1 1 6 3 3 4 9

Major accomplishments in this area include the determination of the parameters which will be monitored and controlled from the AXSS, and the design arrangement of the required equipment and instrument cabinets. In addition, U.S. Department of Energy (DOE) approval was obtained to use already seismically qualified cabinets which had been procured for the Clinch River Breeder Reactor Project. This will result in a cost savings to the SP-100 Project.

The design and procurement of the Reactor Protection System is the responsibility of GE. General Electric and Westinghouse Hanford have collaborated in the determination of the required trip functions for this system, and the equipment locations have been assigned in the Facility.

The Containment Isolation System closes the heating, ventilation, and air conditioning (HVAC) penetrations in the building containment whenever predetermined radiation levels are detected in the Containment Exhaust System, thereby preventing leakage to the ex-containment environment. The penetrations have been identified and the methods of isolating them have been determined. Equipment locations have been identified, and cabinet layouts have been completed.

Test Data Recording and Processing System

The Test Data Recording and Processing System acquires data from both Test Assembly and Facility support systems. The input data are manipulated to provide the GE Test Engineer with the condition of these systems at all times by the use of a variety of display techniques. A major activity being pursued is the determination of the many types of computations to be performed, the display types required by GE, the maximum sampling rates needed, and the numbers of various types of input signals. An Automatic Data Processing Equipment Acquisition Plan is also being prepared for approval by DOE. In parallel with these activities, a Procurement Specification is being prepared.

Trace Heat Control System

The Liquid Metal Trace Heat Control System provides temperature control and monitoring of all liquid metal piping, valves, and other components. It will be a commercial distributed system similar to the PCS, but of much smaller scope. While the PCS could also perform this function, operational considerations dictate a separate system. A preliminary layout of piping and component heating control zones has been prepared in order to initially size the control system. It will be updated as the liquid metal system designs are finalized. Draft specifications have been prepared for the control system, the heaters, and the control thermocouples. Installation details have been prepared. Also, surplus power controllers for the heaters have been obtained from another project and stored for SP-100 use. This will result in a large cost saving.

Other Equipment

A variety of liquid metal sensors have been obtained from another project. It appears that these will meet all presently known requirements for these types of sensors. This is a significant acquisition, because sensors for measuring liquid metal pressure are no longer manufactured in the United States.

Finally, the requirements for measurement of radiation in the Facility have been documented and equipment sources have been identified. Some equipment has been located elsewhere on the Hanford Site and acquisition steps are being taken.

SUMMARY

Design and procurement activities in the I&C area are proceeding on schedule in parallel with the designs of the other facility systems. This ensures that there is regular collaboration between the I&C engineers and the other facility system designers. In addition, close cooperation between GE and Westinghouse Hanford engineers has made it possible for the Test Site to track the evolution of requirements generated by GE as the design and testing requirements of the Test Assembly evolve.

All activities are scheduled so as to have the necessary equipment onsite in late 1992 when installation is to begin. The arrival of the PCS equipment in late 1990 represents the first of these major procurements.

Acknowledgements

This work was sponsored by the U.S. Department of Energy under Contract DE-AC06-87RL10930.

References

- Miller, W. C., J. L. Etheridge, P. J. Brackenburg, W. F. Carlson, P. A. Edwards, J. J. Irwin, E. J. Renkey, and E. J. Shen, 1988, "Conceptual Design of the SP-100 GES Test Site," in Space Nuclear Power Systems 1987, V7, M. S. El-Genk and M. D. Hoover, eds., Orbit Book Co., Malabar, Florida.
- Renkey, E. J., G. D. Bazinet, E. J. Bitten, P. J. Brackenburg, W. F. Carlson, J. J. Irwin, P. A. Edwards, E. J. Shen, and P. A. Titzler, 1989, "Definitive Design Status of the SP-100 Ground Engineering System Test Site," WHC-SA-0608-A, presented at the 7th Symposium on Space Nuclear Power Systems, Albuquerque, New Mexico.

9 0 1 1 6 8 6 0 3 5 1

FIGURE 1. SP-100 Test Facility.

FIGURE 2. General Electric/Westinghouse Hanford Company Equipment Interfaces.

**DATE
FILMED**

5/27/94

END