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PRELIMINARY SITE DESIGN FOR THE SP-100 GROUND ENGINEERING TEST

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Introduction

In November, 1985, Hanford was selected by the Department of Energy (DOE) as the preferred site for a full-scale test of the integrated nuclear subsystem for SP-100. The Hanford Engineering Development Laboratory, operated by Westinghouse Hanford Company, was assigned as the lead contractor for the Test Site. The nuclear subsystem, which includes the reactor and its primary heat transport system, will be provided by the System Developer, another contractor to be selected by DOE in late FY-1986. In addition to reactor operations, test site responsibilities include preparation of the facility plus design, procurement and installation of a vacuum chamber to house the reactor, a secondary heat transport system to dispose of the reactor heat, a facility control system, and postirradiation examination. At the conclusion of the test program, waste disposal and facility decommissioning are required. The test site must also prepare appropriate environmental and safety evaluations.

This paper summarizes the preliminary design requirements, the status of design, and plans to achieve full power operation of the test reactor in September, 1990.

Preliminary Design Requirements

The basic function of the test site is to provide a location for the safe and reliable operation of an 8 Mw, high temperature (1350K), lithium-cooled fast flux reactor in an environment closely simulating space vacuum, (10^{-8} torr) and temperature conditions (350K vacuum vessel wall). Although the reactor will not be tested for an extended period, there is interest in understanding any life-limiting mechanisms which are observable within the reactor and heat transport loop during the test period (up to two years).

It is therefore planned to disassemble, inspect, and evaluate the condition of the reactor after nuclear testing. In addition, capability must be provided for repair and maintenance of the test article.

The operating test program includes (1) pre-nuclear testing, (2) performance measurements and operational transient tests, (3) sustained steady state operation, and (4) post-test inspection and evaluation.

Design Status

A comprehensive set of trade studies was performed to establish a technical basis for Conceptual Design, which was started in May, 1986.

Facility

The reactor test will be housed in the 309 Building, originally used for the now-decommissioned 70 Mw Plutonium Recycle Test Reactor (PRTR). The proposed arrangement is to locate the test article and its associated vacuum vessel in "B Cell", one of three below-grade equipment cells located adjacent to the PRTR vessel (Figure 1). New concrete walls will be constructed around the vacuum vessel to provide the necessary shielding. Heat rejection, vacuum systems, and other auxiliary equipment will be located in B Cell outside the shield, and in the other adjacent cells.

Work is underway to remove from the cell areas piping and equipment which would interfere with the SP-100 installation. In addition, a computer facility is being moved to make room to install the test site control room in the original Control Room area.

Heat Rejection System

The proposed heat rejection system is a two-loop secondary liquid sodium-to-air heat dissipation system. Intermediate heat exchanger(s) will be provided with the test article such that the secondary heat transport system can be constructed with austenitic stainless steel.

Sodium is the preferred coolant for the secondary heat rejection system because it presents lower overall technical, cost and programmatic risks.

It has a long operating history at the defined operating conditions, with a low and predictable corrosion rate with austenitic stainless steel. Its activation can be controlled to acceptably low levels with a shield provided for the intermediate heat exchanger(s).

The system design is based on the use of mostly existing liquid metal components located at Hanford, including a number of pumps, tanks, valves, dump heat exchangers, and other components from the Fast Flux Test Facility. A simple layout of the major components is shown in Figure 2.

Vacuum System

The test article will be contained in a vacuum vessel and maintained at ultra-high vacuum conditions during high temperature operation. This prevents damage to the refractory metal reactor and primary cooling system components and piping from reactive gases. Cryo-pumps will provide ultra-high vacuum pumping. They will be isolated from the reactor by a shield wall to prevent radiation damage to the pumps. Two large diameter vacuum headers will connect the pumps to the vessel. Rough and intermediate pumping will be provided by a three stage pumping system consisting of rotary vane pumps, roots blowers, and turbo-molecular pumps. Pre-assembly bake-out of the test article components, plus special treatment of vacuum vessel surfaces, will be used to minimize pump-down times.

Test Article Handling

Features will be provided to remove the irradiated test article from the facility following completion of testing. In addition, a capability to perform some interim maintenance on the test article is required. Our current concept uses a temporary hot cell that would be located over the cell for test article removal and maintenance. Secondary coolant lines would be cut and electrical and instrument cables disconnected, allowing the test article to be drawn up into the hot cell. The hot cell would be equipped with shielded windows, master slave manipulators, and necessary tooling to perform the specified operations. This concept is shown in Figure 3. Alternate concepts are being evaluated.

Plans

During fiscal year 1987, the facility cleanup will be completed, conceptual design will be completed and definitive design started, and purchase orders will be placed for long lead materials and components. The final design review is scheduled for mid-fiscal year 1988 such that construction and equipment installation will be completed in FY-1989 and the facility qualified in January, 1990. Other key activities which are planned include environmental and safety evaluations, and operator training.

SP-100 GROUND ENGINEERING SYSTEM TEST REACTOR FACILITY (309 BUILDING)

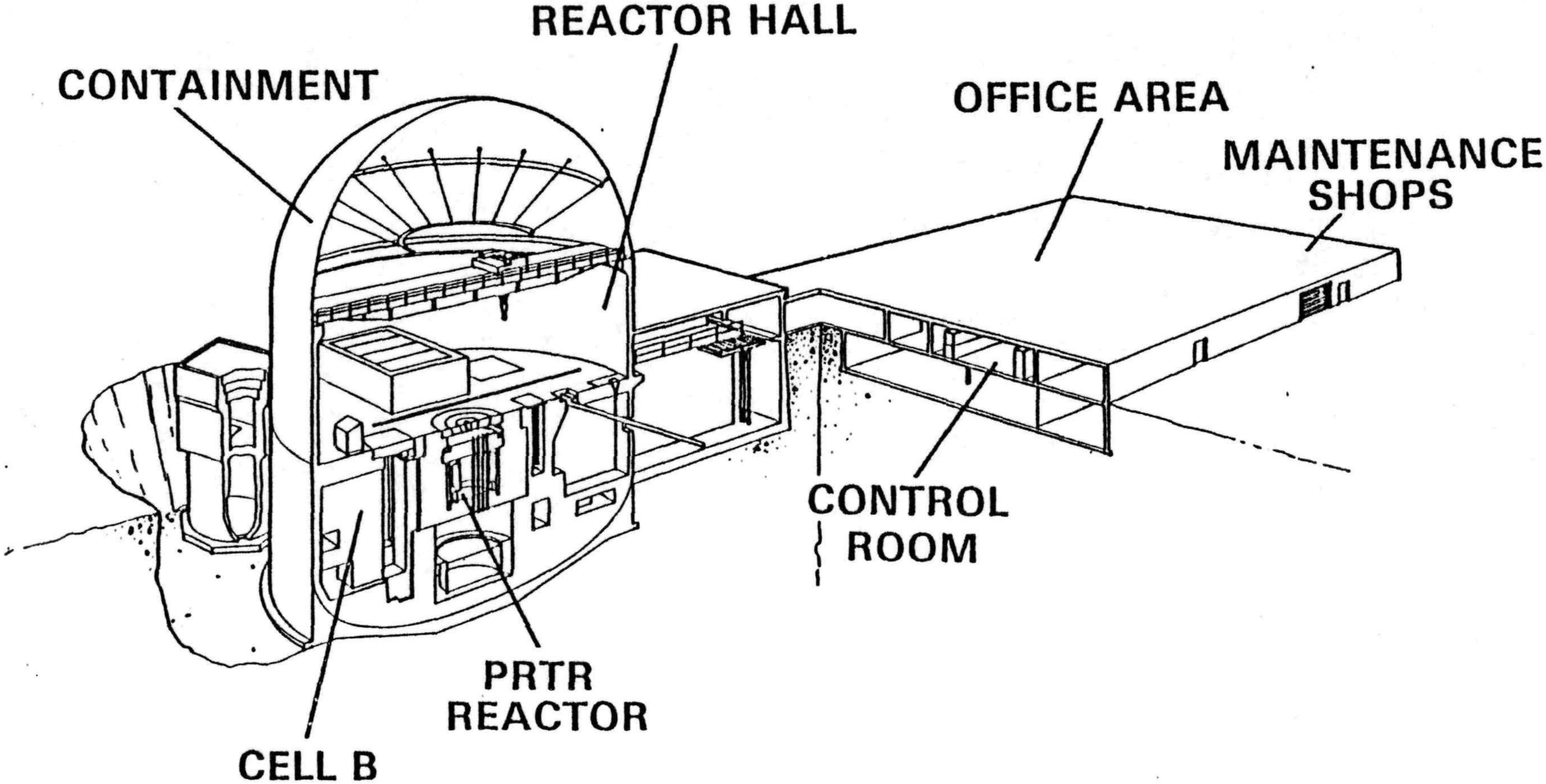

FIGURE 1

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SP-100 EQUIPMENT ARRANGEMENT 309 BLDG.

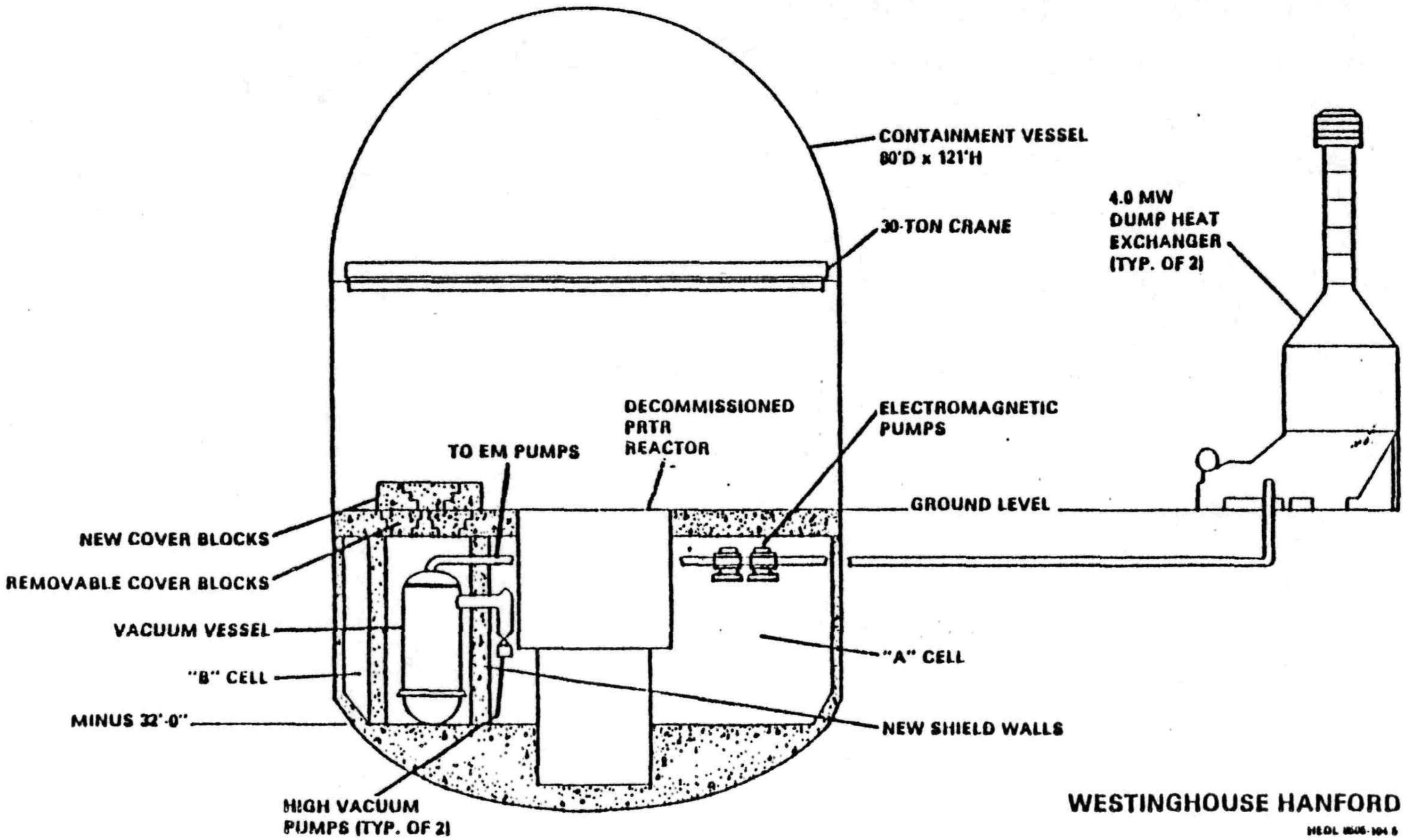

FIGURE 2

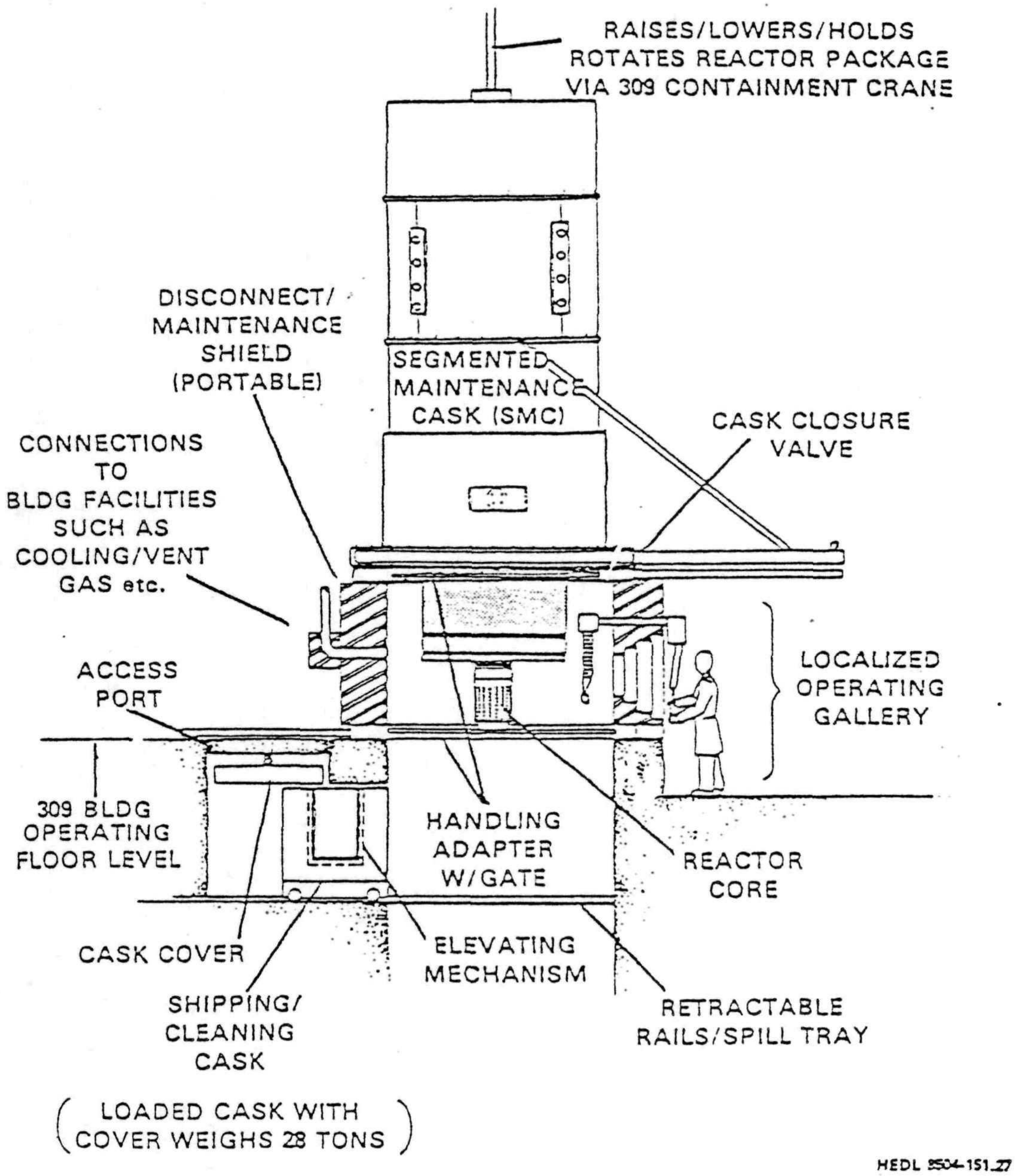
RAISES/LOWERS/HOLDS
ROTATES REACTOR PACKAGE
VIA 309 CONTAINMENT CRANE
DISCONNECT/
MAINTENANCE
SHIELD
(PORTABLE)
SEGMENTED
MAINTENANCE
CASK (SMC)
CASK CLOSURE
VALVE
CONNECTIONS
TO
BLDG FACILITIES
SUCH AS
COOLING/VENT
GAS etc.
ACCESS
PORT
LOCALIZED
OPERATING
GALLERY
309 BLDG
OPERATING
FLOOR LEVEL
HANDLING
ADAPTER
W/GATE
REACTOR
CORE
CASK COVER
ELEVATING
MECHANISM
SHIPPING/
CLEANING
CASK
RETRACTABLE
RAILS/SPILL TRAY
(LOADED CASK WITH
COVER WEIGHS 28 TONS)
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FIGURE 3