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Fabrication of Separator Demonstration Facility Process Vessel

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Fabrication of
Separator Demonstration Facility
Process Vessel

1. INTRODUCTION

The process vessel system is the central element in the Separator Development Facility (SDF). It houses the two major process components, i.e., the laser-beam folding optics and the separator pods. This major subsystem is the critical-path procurement for the SDF project.

2. PROCESS-VESSEL CHAMBERS

The conceptual design for the vessel was begun in June 1983. The SDF process vessel system (Fig. 1) contains 5 chambers: a 3-section process chamber in the center (Fig. 2); 2 gas-scattering chambers, one on each end of the process chamber (Fig. 3); and 2 optics chambers, one at each end of the vessel (Fig. 4).

The vessel is approximately 97 ft (29.6 m) long, 16 ft (4.9 m) in diam, and will weigh 735,000 lb (333,400 kg) when it is fully loaded. The vessel houses several important process functions of the laser isotope separation process in addition to simply accommodating the process equipment. For example, the high-capacity vacuum system is attached to the vessel in locations designed to favorably direct the flow of gases within the vessel. The stabilization of the optics arrays is accomplished by mounting the vessel on rubber vibration isolators and straddling the optics foundation that runs the full length of the chamber. By mounting the arrays on the foundation and separating them from the vessel with flexible bellows, disturbances from such things as cooling-water flow in the pods will not disturb the critical laser light alignment. Four 18-ft (5.5-m)-diam Helmholtz coils located outside the process chamber deflect the electron beam through 270° from the guns mounted under the crucible to the melt within the crucible. Additional functions of each chamber of the vessel are described below.

Fig. 1. Geometry of the process vessel.

4. ALL DIMENSIONS ARE IN INCHES
5. ALL TOLERANCES ARE ± 0.125 UNLESS OTHERWISE NOTED
6. FOR THERMAL LINEAR DILAT. AT PORT LOCATIONS SEE DETAIL 202 (REV 1)
7. FOR PORT SCHEDULE SEE VESSEL GENERAL ARRANGEMENT DRAWG. 444-05-1100-02
8. FOR PROCESS VESSEL SPECIFICATION SEE VES 45-00-001
9. DRAWING FORMAT SIZE: 11" x 17" DRAWING SCALE: $\frac{1}{2}" = 1'-0"$

Fig. 2. Three-section process chamber.

3. THREE-SECTION PROCESS CHAMBER

The process chamber (Fig. 5) will accommodate up to three process pods and their associated guns, vaporizers, separators, and utility feedthroughs. The pods are mounted on tracks to facilitate their insertion and removal from the vessel. The doors in each gas-scattering chamber and a transporter outside the vessel enable the operators to easily handle the 24,000-lb (10,900-kg) pods. The utility panels [72 X 36 in. (183 X 91.5 cm)] on the sides of the pods become part of the vacuum boundary when the pods are located in the process chamber. A seal is provided by large rectangular bellows that mate the vessel port to the pod flange. This chamber also includes thermal liners to protect the vessel wall from excess process heat.

4. GAS-SCATTERING CHAMBERS

Protection of the optics is provided by the gas-scattering chambers. This system basically prevents the deposition of stray vapor on the optics arrays by creating a counterflow of inert gas from the optics chamber to the process chamber. The chambers are also equipped with 13 X 11.5-ft. (3.9 X 3.5-m) doors to provide access for pod installation and removal.

5. OPTICS CHAMBERS

The laser optics arrays are housed in the two 12-ft (3.6-m)-diam chambers on the ends of the vessel. The necessary cleanliness requirements are maintained by two 12 X 4-ft (3.6 X 1.2-m) slit-type vacuum valves located between the optics and gas-scattering chambers. The valves will be closed except when the laser optics-protection system is functioning.

6. FABRICATION CONTRACT

A fixed-price performance specification for the system was issued on September 26, 1983. The specification was based on the ASME pressure-vessel code and standard commercial fabrication techniques. Bids were received on November 16, 1983 from six firms. Following an LLNL

Fig. 5. Installation of the three-section process chamber in the Separator Demonstration Facility.

evaluation process based on cost, capability, and schedule, the Chicago Bridge and Iron Company (CBI), Salt Lake City, UT, was selected to build the vessel. A contract for delivery by January 30, 1985 at a cost of \$2,135,300 was signed on January 9, 1984.

7. FABRICATION

Fabrication of the vessel was divided between two CBI shops to speed delivery. The 12-ft (3.6-m)-diam optics chambers were built in Birmingham, AL, with machining being performed at nearby Cordoba. The remaining larger and harder-to-ship chambers were fabricated in Salt Lake City, UT. To further speed delivery, much of the machining for the gas-scattering chambers was subcontracted to two outside shops: General Electric and Bingham-Willamette, both in Salt Lake City, UT. The two vacuum valves were vended to GNB, Inc., Hayward, CA. This company has built many large gate valves including those used on the Mars vessel. Throughout the contract LLNL has maintained daily communication with CBI and several visits have been made to inspect on-going fabrication.

At present all major elements of the tank have been fabricated, delivered to LLNL, and are in the process of being installed.

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