

Entry Date 5-10-93
Data Base H80CNDX
Index # INS. 0205901

ORAL HISTORY INTERVIEW

DATE OF DOCUMENT [Date of Interview] = 08 - 01 - 68
OFFICE OF PRIME RESPONSIBILITY = JSC
NUMBER ON DOCUMENT = 00
TYPE OF DOCUMENT [Code for Interview] = 1
PROGRAM [3-letter Program Archive code] = INS
AUTHOR [Interviewee's Last Name] = BALLARD
LOCATION OF DOCUMENT [Numeric Shelf Address] = 091-1

SUBJECT OF DOCUMENT: [use relevant bold-face introductory terms]

Oral history interview with James L. Ballard, Jr.
[full name of interviewee]

about design and construction of Manned Spacecraft
[main focus of interview]

Center by U.S. Army - Corps of Engineers.

Title: Special Assistant to Corps of Engineers District
[interviewee's current and/or former title and affiliation]

Engineer

Interview conducted by Robert B. Merrifield, Staff
[interviewer's name/position]

Historian at MSC
[location of interview]

Transcript and tape(s). [for inventory only: # pages 8; # tapes 1]

Edited

CONTENTS:

Biographical - [date/place of birth; family background] _____

Education - _____

Career Path - _____

Topics - *(Luckman Co. for)* master plan by Brown & Root, Inc.; liaison role of Corps of Engineers; steel frame structure; precast exposed aggregate facing (PEAF) panels; window wall construction; time saving advantages; complexity of Space Environment Simulation Facility and Flight Acceleration Facility; problems with state of the art equipment; Corps claims against government and designers (Bechtel ^{corp.} re Space Chambers and Ford, Bacon & Davis, Inc. re flight accelerator); high degree of quality control demanded; ^{NASA} organizational problems; praise for Kaiser Engineers for Mission Control Center design; post-construction facility changes; inspection; incremental construction and modifications; Corps pride with MSC

1309

Interview with James L. Ballard, Jr.

8/1/68

143 In 1961, the Corps of Engineers was requested to assist NASA in the design and construction of MSC. In July 1962, I was asked to serve the District Engineer as a special assistant for the NASA work, In addition to my other duties as chief of the NASA section, I was charged with the responsibility for monitoring the design done by the architect-engineers as well as contracting and administration of the contracts with the AE firms. The initial design which included the master plan for the facility was developed under a contract with Brown and Root, Inc. of Houston. Brown & Root acted as the administrator and called on other AE firms in the area to assist them. The Corps of Engineers, in monitoring this contract established offices along side of Brown & Root in Houston, so that our various disciplines such as architectural, structural, mechanical, electrical, and civil could oversee the development of the drawings and thereby save time. We acted as intermediary between the A-E and the Facilities Division of MSC to work MSC requirements into the early design.

146 I was most impressed by the master planning that was accomplished by the Luckmann Company for Brown & Root. I think they did an outstanding job of meeting the functional requirements that had been set forth in developing a campus-like atmosphere for the facility. I don't think we would have been able to have met the tight schedules imposed upon us had Luckmann not come up with the modular design system and the materials that were recommended the architectural vocabulary. The basic structure

of all buildings was steel frame and the exterior surfacing was what we came to know as "Pear" (precast exposed aggregate facing) panels, and the window wall type of construction. I think the advantages as far as saving time in construction are readily apparent. While the foundations are being placed the structural steel can be fabricated off site. While the structural steel is being erected on site, the precast panels are being cast off site. As soon as the steel frame is up, the facing panels are installed and an enclosed structure is thus available in a short period of time. Furthermore, the designs have a simplicity that I think is pleasing and functional. We had occasion to visit the MSC last month and reviewed the site's maintenance history with the Facilities people. We were well pleased with the low maintenance that has been required. However, we must remember that these buildings have not yet been subjected to the hurricane winds for which they were designed. They still have to prove themselves in that respect.

✓40
✓41
The two most complex facilities that the Corps was asked to design were the Space Environment Simulation Facility and the Flight Acceleration Facility. Since both of these facilities bordered on the state-of-the-art, they experienced development failures which had to be corrected during the process of construction. Perhaps if we had this requirement placed upon us again, we would not use the lump sum construction contract method. That is one of the reasons that there were a number of claims made against the government, due to the developmental failures. If we had used a cost plus fixed fee type contracting, no doubt the same type of failures would have been experienced, but they wouldn't have been

✓22-3

237
234
noted as claims; they simply would have resulted in extra cost in development instead of as claims. I think on the overall basis, we probably obtained facilities at a cost which is as economical as could be obtained by any other method of contracting.

240
241
Speaking of claims, I feel we have served the best interest of the government in the way these claims have been settled. For the most part they have been settled within a year or so after construction completion of the site. There are still some outstanding of course, but none are of significant proportions against the government. We do have two significant claims that we have instituted against the designers. One is against Bechtel Corp for negligent design in connection with the space chambers, and the other is against Ford, Bacon, and Davis, Inc. of New York for negligent design in connection with the flight accelerator.

40
The deformation of Space Chamber A occurred during a vacuum pumpdown test to determine whether the required degree of vacuum could be obtained. Extensive investigation and redesign was accomplished on both Chambers A and B by the Bechtel Corp, the AE as a result of this deformation to insure that specified safety requirements were met. Verification of redesign was performed concurrently with the redesign and gave NASA and the Corps of Engineers the confidence in the ultimate safety of these test facilities. The failure resulted in almost doubling the weight of Chamber A, since stiffening members had to be added to resist the buckling that was experienced.

41
The structural failures experienced in connection with the fabrication of the flight accelerator were in the gimbal ring, which holds the gondola (the test chamber in which the subjects ride). It failed under a simulated static test loading equivalent to a maximum

loading of 30 g's. It was successfully repaired and reinforced until it withstood structural tests. Furthermore, the gondola which was built by Lockheed under a subcontract, imploded during the vacuum tests at 30 g's static load simulation. This occurred at the factory and the design was corrected and the gondola rebuilt to withstand the required test. Several other complex facilities were designed under Corps supervision, but they didn't offer the problems encountered in the two larger facilities.

142
145
For years we have designed facilities for the Army and AF -- offices, training facilities, housing facilities-- and have done this for so long that we have confidence that they will serve their function and not fall down, so to speak. Facilities of the type required for the MSC since they were in the realm of the state-of-the-art, we had no experience in, and did not know what the results of our design would be. We felt the sense of urgency that was needed and we knew that these structures must be safe as these factors were impressed upon us all the time. The degree of quality control that was stipulated was more than is ordinarily expected of Corps-produced designs.

147
148
149
Through all of this we had occasional differences of opinion with the user and with the Facilities Division. We had to repair the two facilities that did not meet test requirements and at the same time try to avoid excessive loss of time. After the failure of the gimbal ring on the flight accelerator, the user couldn't understand why the Corps wouldn't immediately direct the fabricator to redesign the gimbal ring so it would meet the required tests. Under our method of contracting we had to give the design to the fabricator rather than ask him to do the

design. We had to contract with the supplier to upgrade the design in order to meet the requirement. Ford, Bacon and Davis designed the gimbal ring. It was fabricated by the Martin Company under a subcontract to the Rucker Co.

We feel the deformation of the chamber under the first vacuum test was a result of negligence on the part of the designer.

240 [The Bechtel Corp had used Chicago Bridge & Iron as a consultant on the design and we feel they did not check their consultant's work in sufficient depth to discover the weakness. When asked to re-evaluate their design, Bechtel called in a different group.]

The responsibility for the design rested first with the Bechtel Corp. That these designs were reviewed both by the Corps and NASA personnel did not relieve Bechtel of its responsibility. Had the Corps used more knowledgeable personnel in the field of structural dynamics, the error might have been discovered before it went to fabrication. [I think we all put too much confidence in the designer and the designer's consultant, Chicago Bridge and Iron.] This is hindsight.

237 There were good capable engineers and scientists, working for both the Corps and NASA. The NASA organization was going through growing pains, and the Corps found it difficult to find someone who could make necessary decisions as the design developed. [Sometimes we had to go all the way to Mr. Thornevik or Mr. Bond when we needed an answer.] The Facilities Division at that time was headed by Mr. Zbanek and he had difficulties of getting information from the users that was needed for completion of the design.

243
Insofar as special recognition is concerned, I would like to single out the Kaiser Engineers. They designed the Mission Control Center and were faced with the almost impossible task of designing a facility to accommodate equipment which still hadn't been designed. The electronic equipment to be housed and served by this facility was being developed at the time by the Philco Corp. of Palo Alto. The management capabilities of Kaiser Engineers became very evident when they were able to work with Philco and obtain from them sufficient information to satisfy the housing requirements. This company was very cooperative, met their schedules, and provided us with incremental ~~packages~~ ^{PACKETS} so we could go out for construction of the foundation and the frame of the building while they were completing the design. The Bechtel Corp deserves special recognition for their responsiveness on redesign of the chambers in spite of the fact that we received a negligent design from them.

155 245
337
The asbuilt drawings that were furnished MSC at the completion of construction were accurate. The problem was that immediately after NASA moved into the buildings, they started making changes and unless they were recorded on the as-built drawings, the drawings immediately became inaccurate. This was particularly true in the case of complex facilities because just as soon as we released the facility to the NASA people, they would start upgrading or changing them to meet another requirement. I can understand it, but that's the reason they complain that as-builts didn't fit existing facilities.

245
145

Insofar as the adequacy of the inspection was concerned, it was probably as adequate as could be expected except under quality control procedures. I think that is what the MSC people expected. They, particularly the scientists or engineers, expected aircraft industry standards of quality control, and perhaps rightfully so insofar as these 2 complex facilities were concerned. But for the structures themselves--the brick and mortar work--the inspection was adequate. The inspection of complex facilities was based to a great extent on the acceptance test procedures that had been developed.

147

230

We in the Corps are more or less accustomed to incremental type construction such as the MSC was faced with since Congressional appropriations were spread out over several years. In our civil works projects, particularly dams, we are accustomed to this type of contract and we build a spillway perhaps in one year and start the dam the next. As new facilities were added at the MSC it was necessary to make additions to the central heating plant to accommodate the next year's facilities. I believe we made three or four additions to the central heating and cooling plant in this fashion. However, it was basically designed with this in mind, so that the extensions could be added and the capacity increased as demand required. There was no loss in operating capabilities or appearance. We simply left one wall as a false enclosure. The same procedure was followed with the cooling tower which was also built in increments to keep pace with requirements of the central heating cooling plant. Some extensions of utilidor were required which were not anticipated in the basic design due to revised locations of the facilities or unanticipated

facilities. These didn't present any major problem.

The Corps is very proud of the facility at MSC. We think it is pleasing in appearance and functionally adequate without being gaudy. I think it very well identifies itself with the space age.