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Summary

The HRT cell was pressure tested and proven to be capable of containing a static gas pressure of 30 psig. The test is described and typical data are presented.

Test of HRT Cell

A test of the HRT cell was conducted to establish the ability of the cell to contain a static gas pressure of 30 psig.

The test was necessary because the cell was originally designed to contain only 15 psig in conformity with the American Institute of Steel Construction Code, which permits steel stresses of 20,000 psi. This pressure would result from a failure of the reactor pressure vessel and expansion of its contents, the fuel and blanket solutions, into the cell. Only after the cell was essentially complete was it decided that a release of the contents of both fuel and reflector heat exchangers, steam drums and piping through two steam lines of six inch diameter should be added to the instantaneous release of the reactor contents, and that pressures as high as 30 psig might result from such a catastrophe.

In that a test to 30 psig would involve stresses near or beyond the yield strength of the material, an air test would be too hazardous; so the tank was filled with water and a hydrostatic over-pressure applied. If during the progress of the test weaknesses became evident, modifications were to be made so that the test could be carried to a satisfactory conclusion.

A review of the design of the cell had indicated certain weaknesses, and modifications had been made to correct these before the time of the test: (1) The entire roof structure had been redesigned to contain the higher pressure before its components were fabricated (2) the anchorage of the column bases to the

concrete slab had been strengthened by the addition of toggle bolts. It was assumed that the 1000 psi concrete backfill between the cell and the undisturbed shale on the east, west and south sides would fully support the cell and no further modification would be necessary in these areas. Thus, the only area of the cell that was questionable was the north wall structure.

The cell was instrumented with 80 strain gages, the locations of which appear in Figure 2. These gages were located to indicate the stresses in the struts, in the north wall plates, and in the truss members of the north wall. Two extensometers, consisting of water-proofed linear differential transformers, were used to measure the relative movement of opposite walls and to indicate whether the backfill concrete was indeed supporting the east and west walls as had been assumed.

During the first phase of the test, the cell was subjected to an overpressure of 11.5 psi at which point it became evident that certain members of the vertical trusses would not be able to resist the stresses that would be expected at 30 psi, and would have to be modified for the test to continue.

Two modifications were possible: (1) to reinforce the weak members and (2) to fill the north wall with barytes concrete. In that the latter choice would necessitate filling the wall immediately, even before all penetrations had been completed, it was decided to follow the first alternative. The modification consisted of reinforcing 78 truss members and stiffening the upper section of the inner wall plate.

Upon completion of the modifications the test was resumed, and the cell was successfully subjected to an overpressure of 26 psi, representing a pressure of 36 psi at the bottom of the cell. The data taken during this phase can be extrapolated to show that the cell is capable of containing a gas

pressure of 30 psig.

Figure 3 is a plot of the strain data versus pressure for a tensile member. From the initial zero the strain increased as the cell was filled with water to the base of line 1. Lines 1 through 4 represent the successive runs as the pressure was extended to its final value. It had been anticipated that the structure would by local yielding adjust itself to carry the load. This was realized in a series of sharp booms wherein all gages shifted and is indicated by the displacement of the lines at high strains. In that the shift at the gage is in the direction opposite to that caused by yielding, this indicates that yielding occurred at the end connections of the truss members. The line representing the air test data is extrapolated to show that under a 30 psig gas pressure the strain in this member will not exceed a strain that it safely experienced during the test. The difference between the initial zero and the air test zero is seen to be equal to the total displacement at the gage due to yielding elsewhere.

Figure 4 is a similar plot for one of the compression members which was modified during the test, and shows the slope of the line before modification superimposed on the plot for the fourth run.

Since the hydrostatic loading imposes a different load distribution in the truss members than would result from a gas loading, it was not possible to subject all members to a strain equal to that which they would encounter at 30 psig gas pressure. However, the extrapolated stresses of those members which were not strained to this value in no case exceeds 1.6 times the AISC Code allowable value. The minimum tensile strength of the material as indicated in mill test reports is 35,000 psi or 1.75 times the code allowable value of 20,000 psi, so these stresses of less than 1.6 times the code values are deemed to be safe.

The east-west extensometer indicated a maximum deflection of $1/16$ of an inch, which when contrasted with $7/32$ of an inch for the north-south extensometer, proves that the concrete supported the wall adequately.

The tank was designed and erected by the Chicago Bridge and Iron Company, under subcontract to V. L. Nicholson Company. The test of the tank was carried out under the direction of W. R. Gall. Instrumentation was installed by R. D. Cheverton with the assistance of J. F. Potts and T. H. Mauney.

Fig. 1. Diagram of HRT Cell Structure.

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CL CELL

PLAN AT ELEVATION 825'-0" - NE CORNER OF CELL

ROOF EL.
+825'-0"

VIEW A-A

CL VERTICAL TRUSSES

VIEW B-B

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Fig. 2. Strain Gage Locations.

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Fig.3. Strain-Pressure Plot — Member AE-9.

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Fig. 4. Strain-Pressure Plot -Member AW11

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