

DATE: JULY 16, 1973

PRELIMINARY  
SUMMARY REPORT ON  
SNUBBER REPAIR ACTIVITIES  
DURING SPRING 1973  
REFUELING OUTAGE

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## I. INTRODUCTION

AS PART OF THE IN-SERVICE INSPECTION PROGRAM FOR THE APRIL 1973 REFUELING OUTAGE, AN INSPECTION OF THE DRYWELL HYDRAULIC SHOCK AND SWAY ARRESTORS (HSSA) WAS CONDUCTED. THIS INSPECTION REVEALED THAT A MAJORITY OF THE UNITS WERE TOTALLY DEVOID OF FLUID WHICH, CONSEQUENTLY, RESULTED IN THEIR INOPERABILITY. IMMEDIATE STEPS WERE TAKEN TO CONTACT THE SNUBBER SUPPLIER, BERGEN PATERSON PIPE SUPPORT COMPANY, WHO RECOMMENDED THAT A REPRESENTATIVE SAMPLING OF THE SNUBBERS IN THE DRYWELL BE SENT TO THEIR SHOPS FOR ANALYSIS.

ON MAY 5, 1973, THREE (3) SNUBBERS WERE REMOVED FROM THE DRYWELL AND SHIPPED TO THE REX HANNA COMPANY, THE SNUBBER MANUFACTURERS FOR BERGEN PATERSON. THE SNUBBERS, WHICH HAD BEEN LOCATED ONE ON EACH MAIN STEAM LINE AND ONE ON THE ELECTROMATIC RELIEF VALVE DISCHARGE PIPING, WERE COMPLETELY DISMANTLED AND INSPECTED. IT WAS REPORTED TO JERSEY CENTRAL POWER AND LIGHT COMPANY THAT THE TWO SNUBBERS LOCATED ON THE MAIN STEAM LINES WERE IN A VERY DETERIORATED CONDITION REQUIRING COMPLETE REBUILDING. THE THIRD SNUBBER WAS FOUND TO BE IN SATISFACTORY CONDITION REQUIRING ONLY HYDRAULIC FLUID ADDITION, WHICH IS CONSIDERED NORMAL MAINTENANCE. IT SHOULD BE STATED THAT THE TWO FAILED UNITS WERE IN SERVICE LONGER THAN THE THIRD WHICH WAS INSTALLED DURING THE 1972 REFUELING OUTAGE.

AS A RESULT OF THIS INVESTIGATION, IMMEDIATE STEPS WERE TAKEN TO REMOVE AND REBUILD ALL SNUBBERS IN THE DRYWELL AND THOSE SNUBBERS IN THE REACTOR BUILDING ASSOCIATED WITH SAFEGUARD EQUIPMENT.

## II. EQUIPMENT DESCRIPTION

THE HYDRAULIC SHOCK AND SWAY ARRESTOR (HSSA) UNIT (ILLUSTRATED IN FIGURE ONE) IS USED TO PROTECT PIPING SYSTEMS AND EQUIPMENT PIECES SUBJECT TO POSSIBLE DAMAGE FROM SHOCKS OR VIBRATION. IN EFFECT, THE ARRESTOR BECOMES A RIGID STRUCTURAL MEMBER UNDER IMPACTIVE LOADING CONDITIONS. IN DOING THIS IT IS CAPABLE OF TRANSFERRING LOADS FROM THE PIPING OR EQUIPMENT PROTECTED TO RIGID STRUCTURAL MEMBERS. THE ARRESTOR IS FURTHER DESIGNED TO ACCOMMODATE NORMAL THERMAL MOVEMENT OF THE EQUIPMENT PROTECTED WITH A MINIMUM OF RESISTANCE.

THE UNIT CONSISTS OF A DOUBLE ACTING PISTON CYLINDER ARRANGEMENT, AN EXTERNAL VALVE BLOCK AND A SPRING LOADED ACCUMULATOR ASSEMBLY (SEE FIGURE II).

DURING OPERATION, THE PISTON IS FREE TO MOVE UNRESTRICTED IN EITHER DIRECTION WITH THE POPPET VALVES REMAINING FULLY OPEN FOR ALL PISTON VELOCITIES UP TO 10 INCHES PER MINUTE. THIS VELOCITY IS GREATER THAN ANY OPERATIONAL THERMAL GROWTH AND LESS THAN THE VELOCITY OF ANY NORMALLY ANTICIPATED DISTURBING FORCE. BOTH THE COMPRESSION AND TENSION CONTROLLING POPPET VALVES ARE DESIGNED AND SET FOR CLOSURE WHEN THE PISTON VELOCITY EXCEEDS 10 INCHES PER MINUTE. WITH THE POPPET VALVES CLOSED, THE FLUID FLOW IS ESSENTIALLY STOPPED, THEREBY TRANSFORMING THE UNIT INTO A RIGID STRUCTURE (NOT ABSOLUTELY TRUE, DUE TO THE COMPRESSIBILITY OF THE SILICON FLUID; I.E., 3000 PSI WILL COMPRESS FLUID TO PERMIT 20 MILS OF PISTON TRAVEL). CLOSURE IS DESIGNED TO BE EFFECTED WITHIN  $1/32$ -INCH OF PISTON ROD TRAVEL.

THE SPRING LOADED ACCUMULATOR SERVES AS AN OIL RESERVOIR TO MAKE UP FOR SMALL EXPECTED LEAKS. IN ADDITION, IT SERVES TO KEEP THE HYDRAULIC FLUID UNDER PRESSURE, THEREBY ALLOWING THE HSSA TO BE MOUNTED IN A VARIETY OF POSITIONS WITHOUT THE HYDRAULIC FLUID DRAINING OUT OF THE CYLINDER.

THE HYDRAULIC FLUID USED IN THE SNUBBERS IS OF TWO TYPES; ONE WHICH IS HIGHLY RADIATION RESISTANT FOR USE IN THE DRYWELL, THE OTHER NON-RADIATION RESISTANT FOR USE IN THE BALANCE OF THE PLANT. THE TWO FLUIDS ARE, RESPECTIVELY, G.E.S.F. 1154 WHICH IS METHYL PHENYL SILICONE, AND G.E.S.F.-96(50) WHICH IS DIMETHYL POLYSILOXANE SILICONE. SILICONE BASE FLUIDS ARE USED BECAUSE THEY ARE NON-FLAMMABLE, NON-CORROSIVE, CHEMICALLY INERT AND RELATIVELY STABLE OVER A WIDE TEMPERATURE RANGE. NORMAL AMBIENT TEMPERATURE RANGE FOR CONTINUOUS OPERATION IS FROM MINUS 30°F TO PLUS 400°F.

ALL THE SEALS USED IN THE SNUBBERS ARE MADE FROM DUPONT ADIPRENE L-167 WHICH IS A POLYURETHANE ELASTOMER MADE FROM TOLUENE DIISOCYANATE POLYETHER LIQUID PREPOLYMER.

TESTS VERIFY THAT THE SEALS ARE GOOD EVEN AFTER EXPOSURE TO RADIATION IN EXCESS OF  $1 \times 10^8$  ROENTGENS.

THE TEMPERATURE CHARACTERISTICS OF THE SEALS ARE IN QUESTION AT THIS TIME. ACCORDING TO BERGEN PATERSON THE POLYURETHANE SEALS ARE SUITABLE FOR CONTINUOUS OPERATING TEMPERATURES OF 150°F AND ARE CAPABLE OF OPERATING AT TEMPERATURES UP TO 200°F FOR "SUSTAINED PERIODS WITHOUT IMPAIRMENT OF FUNCTION." THE SEALS SUPPLIER ON THE OTHERHAND SAY THAT 150°F SHOULD BE CONSIDERED THE MAXIMUM OPERATING TEMPERATURE FOR THE SEALS AND THAT OPERATION AT 200°F WILL CAUSE SEAL FAILURE.

#### IV. ANALYSIS

TABLE ONE LISTS THOSE SNUBBERS REPAIRED AND TABULATES THE INDIVIDUAL COMPONENTS REPLACED. IN ALL CASES, THE SNUBBERS WERE MADE INOPERABLE DUE TO A LACK OF HYDRAULIC FLUID. THOSE SNUBBERS LOCATED WITHIN THE DRYWELL SHOWED SEVERE SEAL DETERIORATION TO THE POINT OF BEING INCAPABLE OF RETAINING HYDRAULIC FLUID EVEN FOR A SHORT TIME. IT IS NOT FULLY KNOWN, AS YET, EITHER THE CAUSE OF SEAL FAILURE OR THE LENGTH OF TIME IT TOOK FOR THE FAILURES TO OCCUR.

IT IS FURTHER NOT UNDERSTOOD WHY THERE APPEARED TO BE SAND, GRIT, DIRT AND WATER IN THE ACCUMULATOR, OR WHY MANY OF THE ACCUMULATOR SPRINGS WERE BROKEN. INSPECTION OF THE SEALS INDICATED THAT A POSSIBLE CAUSE OF FAILURE MAY HAVE BEEN DUE TO EITHER EXCESSIVE HEAT OR CHEMICAL ATTACK. PRESENTLY, DISOGRIN COMPANY, THE SEALS SUPPLIER, IS RUNNING A SERIES OF TESTS HEATING SEALS IMMERSED IN THE RADIATION-RESISTANT HYDRAULIC FLUID TO VARIOUS TEMPERATURES AND OBSERVING THE RATE OF DEGRADATION.

THEIR PRELIMINARY RESULTS SHOW THAT AMBIENT DRYWELL TEMPERATURES IN CERTAIN AREAS (165°F) ARE HIGH ENOUGH TO CAUSE SEAL DAMAGE OVER EXTENDED PERIODS OF TIME. HOWEVER, THE BULK OF THE SNUBBERS ARE NOT SUBJECT TO TEMPERATURES IN EXCESS OF 125°F AND, THEREFORE, SHOULD NOT EXPERIENCE SEAL FAILURE. TO EXPLORE THIS AREA FURTHER, TWO THERMOCOUPLES WERE PLACED ON A SNUBBER (SEE FIGURE III) ATTACHED TO THE MAIN STEAM LINE AT A POINT JUST UPSTREAM OF THE MAIN STEAM SAFETY VALVES ON THE NORTH HEADER.

THIS SNUBBER WAS CHOSEN BECAUSE IT EXHIBITED THE MOST SEVERE SEAL FAILURE. THE TEMPERATURE OF THE SNUBBER ACCUMULATOR AT RATED REACTOR PRESSURE, TEMPERATURE, AND STEAM FLOW WAS 139°F, WHICH IS WITHIN THE WORKING

RANGE OF THE SEALS. IT SHOULD BE POINTED OUT THAT THE MEASURED TEMPERATURE IS A "SKIN" TEMPERATURE AND IT IS CONCEIVABLE THAT THE INTERNAL TEMPERATURE IS HIGHER. THIS IS POSSIBLE DUE TO SMALL AMPLITUDE VIBRATIONS BEING CONVERTED INTO HEAT BECAUSE OF FLUID FRICTION ON THE POPPETS AND SEATS.

THE DAMAGING EFFECTS OF RADIATION HAS BEEN RULED OUT SINCE BOTH THE SEALS AND 1154 HYDRAULIC FLUID ARE HIGHLY RADIATION RESISTANT.

IT HAS BEEN SUGGESTED THAT PERHAPS THE SNUBBERS HAD BEEN STORED OUTSIDE DURING THE CONSTRUCTION OF THE PLANT AND THIS IS THE REASON FOR THEIR FAILURE. THIS WOULD THEN EXPLAIN HOW SAND, DIRT AND GRIT ENTERED THE ACCUMULATOR. HOWEVER, WE HAVE BEEN ASSURED BY HAROLD ERICKSON OF BERGEN PATERSON THAT THIS WAS NOT THE CASE. HE STATED THAT HE SUPERVISED THE INSTALLATION OF THE SNUBBERS ORIGINALLY AND MAINTAINS THEY WERE STORED INDOORS AT THE SITE FOR ONLY A VERY SHORT PERIOD OF TIME PRIOR TO INSTALLATION.

A FINALIZED REPORT FROM REX HANNA IS EXPECTED WHICH WILL DETAIL THE RESULTS OF THEIR INVESTIGATION AS TO WHY THE UNITS FAILED AS THEY DID AND THEIR RECOMMENDATION TO ASSURE THIS WILL NOT HAPPEN AGAIN IN THE FUTURE.

## V. SAFETY SIGNIFICANCE

THE SAFETY SIGNIFICANCE OF THE SNUBBER FAILURES IS QUITE PROFOUND SINCE, IN THE EVENT OF AN EARTHQUAKE, NO CREDIT COULD BE TAKEN FOR THE SEISMIC RESTRAINING ABILITY OF THE UNITS. THE CONSEQUENCES OF LOSING THIS ABILITY MAY OR MAY NOT PRESENT A CONDITION WHEREBY THE PROTECTED COMPONENTS WILL FAIL; THIS IS SOLELY DEPENDENT UPON THE SPECTRAL ENERGY OF THE EARTHQUAKE. THE DYNAMIC LOADING CAUSED BY THE EARTHQUAKE, IN ITSELF, DOES NOT CAUSE APPRECIABLE STRESSES IN THE PROTECTED SYSTEMS UNLESS THE FREQUENCY OF THE EARTHQUAKE RESULTS IN RESONANT VIBRATION. IN THIS EVENT, THE FAILURE PROBABILITY IS VERY GREAT SINCE THE DYNAMIC LOADING IS AMPLIFIED QUITE SIGNIFICANTLY.

THE FUNCTION OF THE SNUBBER IS TO INCREASE THE RESONANT FREQUENCY OF THE SYSTEM TO A POINT WHERE IT IS UNLIKELY THAT AN EARTHQUAKE WILL CONTAIN VIBRATIONAL ENERGY IN THIS FREQUENCY RANGE. THIS IS ACCOMPLISHED BY ADDING SNUBBER RESTRAINTS AT POINTS IN THE PIPING SYSTEM WHERE THE RESONANT AMPLITUDE IS A MAXIMUM FOR THE FIRST SIX MODES OF RESONANT VIBRATION.

IN THE FINAL ANALYSIS IT CAN ONLY BE CONCLUDED THAT THE PROBABILITY OF A COMPONENT OR SYSTEM FAILURE WAS INCREASED UNDER DESIGN BASES EARTHQUAKE CONDITIONS.



To: James P. O'Reilly  
Directorate of Regulatory Operations  
Region I  
970 Broad Street  
Newark, New Jersey 07102

From: Jersey Central Power & Light Company  
Oyster Creek Nuclear Generating Station Docket # 50-219  
Forked River, New Jersey 08731

Subject: Abnormal Occurrence Report 73-14.

The following is a preliminary report being submitted  
in compliance with the Technical Specifications  
paragraph 6.6.2.

Preliminary Approval:

J. T. Carroll, Jr. 7/24/73  
J. T. Carroll, Jr. Date

cc: Mr. A. Giambusso

B/199

Date: 7/21/73  
Time: 3:40 a.m.

Abnormal Occurrence

Report No. 73-14

SUBJECT: Violation of the Technical Specification, paragraph 3.3D, Reactor Coolant System Leakage. Operation of the reactor at power continued when it was not recognized that an increasing Absorption Pool Level combined with the rate of leakage into the Drywell Sump resulted in an "unexplained" leak rate in excess of 5 gpm.

This event is considered to be an abnormal occurrence as defined in the Technical Specifications, paragraph 1.15B. Notification of this event as required by the Technical Specifications, paragraph 6.6.2a, was made to AEC Region I, Directorate of Regulatory Operations by telephone on Monday, July 23, 1973, at 4:20 p.m., and by telecopier on Tuesday, July 24, 1973 at \_\_\_\_\_.

SITUATION:

As indicated in Figure I, attached, an increasing rate of leakage into the Drywell Sump began to occur on July 1, 1973 and continued through July 19, 1973, reaching a peak of approximately 3.92 gpm when averaged over 24 hours. As shown in Figure 2, attached, a plot of Absorption Pool (Torus) water level developed on July 23, 1973 over the same period indicated the level to be increasing starting about July 11, 1973. It is now estimated that the unexplained leak rate increased to >5.0 gpm at some time during July 17, 1973 and continued to be above the 5.0 gpm limit until the plant was shutdown and depressurized on July 21, 1973.

CAUSE: The cause was found to be a feed water leak around one of the feed-water check valve hinge pin seal plugs, which due to its position and the manner in which the water was spraying, resulted in leakage to both the Drywell floor and the Torus. Valve data is as follows:

Manufacturer: Anchor Valve Company  
Type: 18" - 600# Swing Check Valve P. S.  
Material: Cast Carbon Steel - Stellite Trim BW ends

REMEDIAL ACTION:

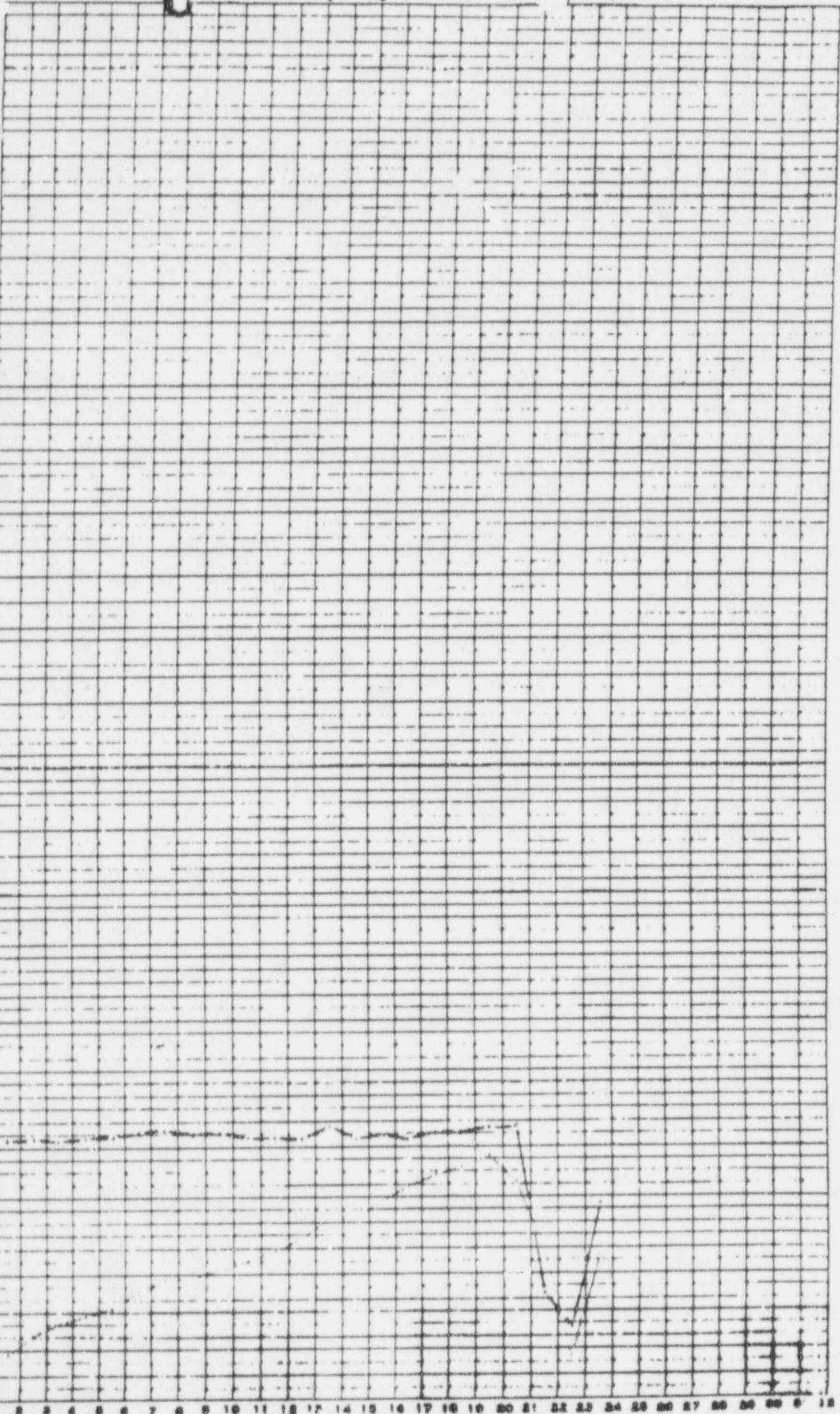
The erosion of the seating surface on the valve body was machined out, minimum wall thickness checked to be satisfactory, and the plug adapted to fit. A successful leak test was conducted at operating pressure on \_\_\_\_\_ and the plant returned to service.

SAFETY SIGNIFICANCE:

The allowable leakage rates of coolant from the reactor system are based in part on predicted and experimentally observed behavior of cracks in pipes. As noted in the bases of the Technical Specifications, "... evidence suggests that for leakage somewhat greater than the limit specified for unidentified leakage, the probability is small that imperfections or cracks associated with such leakage would grow rapidly." The Technical Specification limit referred to in the above is 5.0 gpm; whereas, in this instance, the maximum leak rate approach 6.75 gpm of which = 1.0 gpm might be considered "normal." Thus, the leakage around the hinge pin plug was on the order of 5.5-6.0 gpm and consequently no undo significance need be attached to this event.

# W. LEAK KHIES IN GPM

20  
19  
18  
17  
16  
15  
14  
13  
12  
11  
10  
9  
8  
7  
6  
5  
4  
3  
2  
1  
0



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NO. 341-T6 DIETZGEN GRAPH PAPER  
ONE MONTH BY DAYS

# DATE VS TORUS LEVEL JULY

## Notes

- ① Pumped approx. 4000 gal to tank truck (read)
- ② Pumped add'l 4000 gal (approx) to Tank Truck (red)
- ③ Recalibrated Torus level indicator transmitter was found indicating too high by about .7"
- ④ Pumped approx. 3500 gal to Tank Truck (green)

