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APPROVED BY: (SUPERVISOR) <i>G. E. Deegan</i>		PROGRAM Sodium Reactor Experiment	TWR	
OTHER		PROJECT SRE Operations	DATE 27 August 1958	
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SUBJECT:

SRE Nitrogen Gallery Seal

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I STATEMENT OF PROBLEM

Describe the installation of the nitrogen gallery seal and evaluate the results.

II SUMMARY OF RESULTS AND RECOMMENDATIONS

Overall the leaks noted through the Amercoat-Amphesive seal process are minor. It is recommended that this process be continued to include the primary fill tank vault and completion of the sodium service vault. Periodic renewal be provided when necessary.

III DISCUSSION:

A. Main and Auxiliary Galleries

The concrete blocks were removed and the walls of the gallery were coated with a five coat process of Amercoat.¹ Holes and large cracks were sealed with Plastic Steel (Devcon A).² The first of the five coat Amercoat process consisted of etching the concrete with one part of commercial HCl to two parts of H₂O. The second coat consisted of Amercoat Primer No. 86 diluted with an equal amount of No. 9 Amercoat thinner. The third coat was undiluted Amercoat Primer No. 86. The fourth coat and fifth coat were No. 33HB Amercoat protective coats. The third coat was applied within a few minutes after the second coat. The remaining coats had at least a two hour drying time between coats. These directions were in accord with Amercoat specifications.

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The concrete blocks had an Amercoat treatment previously during construction. Holes and large cracks were treated with Devcon A, the sides and a one foot border on the bottom of the concrete blocks were treated with one coat of Amercoat Primer No. 86 followed by a coat of No. 33 HB Amercoat protective coat. The blocks were then installed.

Excessive leakage at the periphery of the blocks was reduced by an application of rubber tubing wedged between the blocks and into the gap between blocks and gallery walls. The size of the tubing was determined by the width of the gap between the blocks. The tubing was cut concave at the ends where T joints were formed and small tubing was inserted into larger tubing where gap size varied. After the tubing was in place, it was coated with Du Pont Fairprene Cement No. 4.⁴ This material solidifies but does not harden to enable a seal to be maintained without damage to the paint on the blocks.

Numerous leaks⁷ on the floor of the high bay area such as leaks through the blocks, at the pumps, cracks in the floor, through valve extension sleeves, etc., still presented problems.

One of these where the iron framework of the blocks meets the concrete was a major source of trouble. These were cleaned and coated with Amphesive 802² an epoxy based resin which does not shrink on setting. All the known leaks and cracks located on the floor of the main and auxiliary gallery were coated with Amphesive 802. The remaining portion of the floor was given the five coat application of Amercoat mentioned above.

The tubing between the blocks was then covered by the regular neoprene seal and bolted in place as usual.

The valve extension sleeves were opened and the sleeve itself sealed with a cork held in place with lead bricks until expanding rubber plugs can be procured.

B. The Disposable Cold Trap Vault

The disposable cold trap vault plugs were treated with Devcon A,² Amercoat,¹ and Amphesive³ at all accessible areas. This process was incomplete as the south plug was not removed during this shutdown. The walls of the vault were not coated. Tubing was inserted in the gaps between the plugs as they were reinstalled and Amphesive placed on all potential leaks on the top of the blocks. The south plug, however, does not have tubing in the surrounding gap. This job was not fully completed due to lack of time allowed between insertion of the plugs and impending start-up.

C. Primary Fill Tank Vault

The primary fill tank vault was not included in this seal process during this shutdown for the following reasons:

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1. It was not economically justifiable to remove the blocks at this time.
2. This vault does not communicate, via the dehumidifier, with the other vaults which were sealed.
3. Man power shortage.
4. Lack of available time.
5. It appeared feasible to check results of sealing the main and auxiliary galleries prior to attempting to seal the primary fill tank vault.

Evaluation

The purpose of this evaluation is to judge the effectiveness of this gallery seal. The gallery seal was soap tested for leaks under three inches of water pressure measured in the main gallery by a water manometer. The main and auxiliary gallery were connected through the dehumidifier. The cold trap vault was blanked off. The results are indicated on the accompanying diagram furnished by H. F. Donohue.⁸ Five leaks were noted at the neoprene seals between blocks and two leaks noted at the covers of the spare tubes leading to the main gallery from the northeast corner of the reactor. The east hole where one of these tubes emerges revealed a leak at the southwest corner at floor level. The lifting device leak is part of a safety problem and will be stopped when the lifting device is repaired. The valve actuator housing of valves 153, 154, and 155, leaked on the outside, and numerous small leaks were revealed in the pipe trench south of the mass transfer assembly. Some leaks were noted through valve actuator housings in use. The blanked off thermocouple tubes at the auxiliary primary pump leaked and finally the gamma facility leaked around the seal. No leaks were noted through the sealed off valve actuator sleeves or through the sealed floor.

An examination of the above results shows the following :

1. Five leaks uncovered in the total amount of seal length is surprisingly small when considering the variable gap space encountered from block to block and even the single blocks which were unevenly positioned in the gallery.
2. The two leaks at the covers of the spare tubes were found to be leaking through "O" rings on the covers of these tubes. This program did not include them (see Recommendations below).
3. The southwest corner of the east hole (located northeast of the reactor) leaked. This was the only leak found in these holes after applying Amphesive³ and Amercoat.¹

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4. The valve actuator housing leaks and the trench south of the mass transfer assembly leaks were due to the difficulty of applying a uniform coat of paint beneath the pipes. It is an application problem rather than a seal problem.
5. Leaks noted through the valve actuator housings in use and the blanked off thermocouple tubes were not part of this process and as such may be omitted from this evaluation. See Recommendations below.
6. The gamma facility is an "O" ring problem and was not included in this seal process. See Recommendations below.

The leakage attributed to the process is narrowed down to five leaks through the gaps between the blocks, one leak in the spare main gallery access tube hole, leaks about the three valve actuator housing south of the main primary pump, and leaks in the trench south of the mass transfer assembly. The last two can be attributed to poor application. The first two cannot be pinned down to any specific cause.

Some chipping has been noted at corners of angle iron where rough treatment has been noted, i. e., such as iron plates falling on edges or using the edges as fulcrums for levers to pry heavy items.

In general the leaks noted through the Amercoat-Amphesive seal process are very small.

Cracks Versus Seepage

The following formula¹⁰, was used in determining the amount of air which would seep through the walls of the galleries at one inch of water pressure.

$$q = \frac{f \cdot A \cdot AP}{t}$$

q = quantity of flow in ft³/day

f = permeability coefficient 45 to 270 x 10⁻⁵ ft⁴/lb day

A = surface area exposed to gas

AP = pressure difference in lb/ft²

t = thickness of concrete

The amount of flow expected through the walls and ceiling of the main and auxiliary galleries alone was 9.7 x 10⁻³ cfm for the maximum value of the permeability coefficient at a measured pressure of one inch of water.

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TABLE I

<u>d</u>	<u>f</u>	<u>N_R</u>	<u>P₁² - P₂² Calculated</u>	<u>P₁² - P₂² Measured</u>
1"	.044	14,080	6.0x10 ³ lb/ft ² ABS	
3/4"	.0475	18,800	2.7x10 ⁴	2.5x10 ⁴ lb/ft ² ABS
1/2"	.055	28,050	2.4x10 ⁵	
1/4"	.071	56,400	9.9x10 ⁶	

where:

d is the diameter of a hole through concrete

f is the friction factor of concrete corresponding to N_R

N_R is Reynolds number

P₁ is upstream pressure in lbs/ft² ABS

P₂ is downstream pressure in lbs/ft² ABS

This value differs from the measured value of 12 cfm by a factor of 1000 and eliminates gas seepage through the walls as an answer to this problem.

An application of elementary fluid mechanics¹¹ to this problem to estimate the size of a hole which would correspond to the value found resulted in Table I.

Table I indicates that a hole of 3/4" in diameter or the equivalent would correspond to the leak rate measured in the main and auxiliary galleries. No leak of this size was found where the seal was applied, although several minor leaks were located as noted above.

Recommendations

This process be continued to include the primary fill tank vault and completion of the cold trap vault.

Additional methods for restraining the neoprene strips against the gaps between the blocks be investigated.

A more effective application of Amphesive 802 around the 153, 154, and 155 valve actuator housing and in the pipe trench south of the mass transfer assembly be performed.

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The leak noted in the spare gallery access sleeve hole be stopped with Amphesive 802.

Leaks noted in the valve actuator housings in use should have the gaskets tightened first. The gasket should be replaced if this fails.

The leakage past the "O" rings in the spare gallery access tube cover be stopped with Weldwood Contact Cement⁵. These are never used.

The small leaks in the gamma facility be curtailed with grease as this is removed frequently.

A close examination of the main and auxiliary gallery walls² be performed for evidence of cracks. These cracks be sealed with Devcon².

The leaks through the spare thermocouple tubes present no problem. Periodic toughing up with Amphesive 802 be performed to keep new leaks at a minimum. Floor paint may be renewed by a coat of Amercoat 33 HB as necessary.

Conclusion

Seepage at this time is not of major importance. It may become so in the future as more and more water is removed from the concrete¹². Eliminating the floor leaks as noted above concomitant with a good survey of the walls of the galleries for the purpose of sealing all cracks will provide an effective seal.

IV. REFERENCES

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