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CONFIDENTIAL 11 August 1958

MEMORANDUM FOR THE RECORD

SUBJECT: Full Scale Test of the Portable Hydrogen Generator

1. On 5 July 1958 the following individuals assembled at the [redacted] 25X1
[redacted] for the full scale test and demonstration of the 25X1
portable hydrogen generator:

25X1

ED Personnel:

[redacted]

2. Success Achieved

The test was the first for the full scale unit and with this in mind it is difficult to characterize the generation as anything less than outstandingly successful. There were certain time consuming operations which should be worked out before the unit could be considered operational. These however are in the preparatory operations prior to generation. Once generation was begun the reaction was self-sustaining at a controlled rate. Actual generation time for the 3500 cubic feet of hydrogen was 25 minutes.

It should be emphasized that the generator, even in its present stage, met all of its requirements.

(1) total weight of generator shall be less than 500 pounds:
actual weights are

$NaBH_4$	100
$CoCl_2$	50
NaOH	2
Generator and Auxiliary equipment	50
	202

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(2) one man portable and operable:
the components are packaged in weights of 50 lbs. or less. The entire operation was run through by one [redacted] employee and 25X1
once generation was begun the balloon was handled essentially by

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[redacted] alone with no further attention being given to the generator at all. 25X1

(3) self-sustaining, self-controlled reaction in less than 1 hour: as was pointed out earlier, this requirement was met

(4) non-metallic:
with the exception of the pump needed to inflate the air mat, the unit is non-metallic

(5) enough hydrogen to provide 250 pounds of lift:
Inasmuch as this reaction repeated ly goes to 95% plus completion it is felt that this requirement was satisfied although a direct measurement of the lift was not possible due to difficulties with the inflation ducting and subsequent loss of gas. The reaction was followed by a thermocouple however and the temperature rise confirmed near complete reaction.

3. Sequence of Events

0945
The generator, airpump, and unweighted sack were laid out at the site.

0950-1005
The generator air mat was pumped up with air.

1005-1015
The sack was filled with 15 pounds of rocks.

1015-1025
The weighted sack was tied to the bottom of the generator.

1030-1040
The generator was moved into the water and the filling tubes adjusted.

1040-1130
The generator fills unattended. The filling tubes were tied off at 1130.

1050-1130
The ground cloth and balloon were laid out and the base of the balloon tied down.

1130-1230
Lunch

1240-1245
The NaOH was added to the generator.

1245-1300
100 pounds of $NaBH_4$ was added to the generator and the solution sloshed.

1305
The temperature of the generator pool was taken ($82^{\circ}F$) and the appropriate quantity of $CoCl_2$ (8.6 pounds) decided on

1305-1325
The inflation tubing adapter was fastened to the generator outlet.

1325-1340
The $CoCl_2$ solution was made up.

1340-1410
The system was flushed with nitrogen.

1410-1415
The inflation tubing was fastened to the inflation tubing adapter.

1417-1419
The $CoCl_2$ was added to the generator.

1420
The $CoCl_2$ entry tube was tied off.

1420-1445
Generation.

A leak developed along the edge of the generator where one of the supporting rods had been replaced.
The field expedient inflation tube adapter failed at 1430.
The temperature rise was $50^{\circ}F$.
Foam rose to a height just six inches below the top of the generator.

4. Comments and Recommendations

Looking over the time sequence it is evident that there are several rather time consuming operations that should be improved on: Also there are some operations which could or should be eliminated. They are discussed below:

(a) It has been suggested that the pump used for the air mat be replaced by a small pressure battle. The volume of air required is small (less than 10 cubic feet STP) and could probably be provided in a lightweight fiberglass sphere with metal liner. The diffusion problem over a period of time should be looked at here. Also, the metal will present somewhat of a radar target. Since the agent will be bringing in tools and equipment (e.g. radio) of metal, however, the strict non-metal requirement for the generator is probably not too realistic anyway.

(b) The filling operation should be speeded up. This might be done by better or more efficient inlets or weighting the unit. Since the filling procedes unattended once the process has begun, however, and the operator can occupy himself in other preparatory operations (e.g. putting in the ground anchor, laying out the balloon, tying the balloon down, unpacking the borohydride and catalept, preparing the NaOH solution, etc.) it is not too critical that the time on this filling operation be reduced greatly below the present 50 minutes.

(c) The addition of the $NaBH_4$ is not an easy procedure and should be improved. Not only is it time consuming, but the possibility of spilling andlosing the chemical exists.

(d) The attachment of the inflation tubing to the generator is most unsatisfactory. A better system should be devised. Also, it would probably be a good idea to provide an inflation tube with both more length and strength.

(e) The flushing out with nitrogen was simply a precautionary measure and largely an unnecessary one - even for a first test. The air trapped above the generator is so small that the period during which an explosive mixture exists is extremely small. Also, since the gas is wet the static problem is largely eliminated.

(f) It was remarked that an integral duct was not the best type for this application.

(g) Handling the balloon would probably be made easier by use of a reefing sleeve. 25X1

5. Future Work

has been directed to submit an extension proposal to cover the costs of writing a final report and operations manual. The films of the operation are being processed now and when this is completed can review them and decide what if any modifications should be made on the generator. Also the question of whether a second full scale test should be run has not been settled. 25X1

It is the feeling of the undersigned that despite the outstanding success achieved on the first full scale run that the unit is still a very marginal unit as far as any operational use is concerned. This for a number of reasons and they are enumerated below:

(a) the generator and chemicals weigh 202 pounds and constitute a considerable bulk. The balloon weighs 47 pounds. The total weight involved is then 249 pounds. Moreover this does not include packaging and when packaging in a manner satisfactory for cashing is figured in, a total weight of at least 500 pounds is involved. This is a considerable weight to bring in.

(b) [redacted] able job 25X1
The undersigned estimates that the bulk to be buried is in excess of 25 cubic feet.

(c) a pool of water approximately 3 feet deep must be found in order to conduct the operation. This means a transportation problem of carrying 500 pounds of bulky materials some distance. The time involved is obviously a problem here also for once the moving has begun the items are exposed to possible detection and the longer the time elapsed the more serious this will probably become.

(d) weather is a critical problem. Somehow a forecast of the winds must be obtained and [redacted] can not be expected to obtain this 25X1
himself. Conceivably this can be radioed in but this is a rather unsatisfactory procedure unless the agent has all the gear at the site and ready to begin operations on short notice. This would bring up the problem of exposure cited in (c) above however. Even if exposure were not a concern, the problem of forecasting winds in a denied area is risky to say the least.

(e) handling the balloon by one man is no simple problem under very light wind conditions and is virtually impossible under gusty conditions. Therefore even if everything up to the point of generation went satisfactorily, the remaining problem of a successful launch is a serious one.

In view of the operational problems described above, it is the recommendation of the undersigned that this project be terminated as soon as is practicable. A total of $44,000 has already been expended on this program and a further expenditure of some $6,000 more might be justified in order to put the project in satisfactory shape.

If it is decided to run a second full scale test, it is the recommendation of the undersigned that this be done at the low temperature condition (i.e. a water temperature of 45°F) as the catalept requirement is much greater here and the generation problems might not be the same as those experienced in the test just completed.

[redacted]

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