U. S. Atomic Energy Commission

Docket No. 50-286

Exhibit B-9

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

NINTH SUPPLEMENT TO: PRELIMINARY SAFETY ANALYSIS REPORT

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PREFACE

Supplement 9 to the Indian Point Nuclear Generating Unit No. 3 Preliminary Safety Analysis Report consists of two parts. The first is a description of the research and development program for charcoal filter performance in removing radioactive methyl iodide from the containment atmosphere. The second part contains replacement pages for Supplement 7 to the report and should be inserted in the text, replacing the existing pages where appropriate.

CHARCOAL FILTER TESTING PROGRAM

Introduction

A comprehensive description of the charcoal filter system designed for the decontamination of the containment atmosphere with respect to organic iodides was presented in the answer to Question 5 of Supplement 7. This answer included a detailed review of the available literature on work performed with iodine impregnated carbons, showing the effects of many variables on the probability of isotopic iodine exchange between the vapor methyl iodide and the carbon bed. Among the variables studied were bed depth, air/steam flow velocity, carbon particle size, quantity of iodine impregnant, specific radioactivity of methyl iodide, and relative humidity. The latter variable is still under discussion and is the subject of the following paragraphs.

To further delineate the effects of moisture on the efficiency of methyl iodide decontamination under the specific conditions of this application, additional testing is planned. The scope and objectives of this testing program are summarized in this section.

Background

The effects of water on carbon bed performance are an important consideration, since it is postulated the reactor containment atmosphere will be at near 100 percent relative humidity during the post accident period. It has been reported that the bed performance for methyl iodide decontamination will be significantly reduced at the conditions of near 100 percent relative humidity. This conclusion, however, is not clearly substantiated by the available test data, nor is it supported by a careful examination of the carbon properties for water adsorption at the test conditions. Indeed, a clear distinction has not been made between tests conducted at high humidity conditions and those with test beds flooded with water.

The water content of a granular carbon, as used in this application, will vary according to the relative humidity of the air stream as shown by the typical isotherm in Figure 1. At 100 percent relative humidity and 20°C, the water content for a high activity carbon (1400 m^2/gm) will be approximately 57 percent, based on the dry carbon weight. The water content will vary with the total surface area of the particular carbon examined. Figure 2 shows this relationship, for 100 percent relative humidity and 100°C, and indicates the values for several commercial carbons. It is noted that the water adsorbed at 100°C is about 10 percent less than that adsorbed at 20°C, for the same carbon.

By comparison, the pore volume of the several carbons, as given in Supplement 7, determined by the BET nitrogen adsorption technique, is as follows:

NACAR G601	0.9 ml/gm
MSA 85851	0.9
BC 727	0.9
PCB	0.6
SS 207B	0.6
Norit RCX	0.6
MSA 24207	0.6
BC 239	0.6

Thus, if the available pore volume were filled with water, the water content would be 0.9 gm/gm dry carbon for the high activity carbons. As the water content of a carbon bed increases above the isotherm value, pore flooding occurs, followed by wetting of the granule exterior surface and filling of the void between granules. An upper limit for water content of a completely flooded bed is about 2 gm/gm.

The characterization of test carbon bed performance in terms of its water content is important since it reflects whether or not the carbon is exposed to the high relative humidity or to a supersaturated air stream containing

WATER ADSORPTION ISOTHERM FOR COCONUT SHELL CARBON

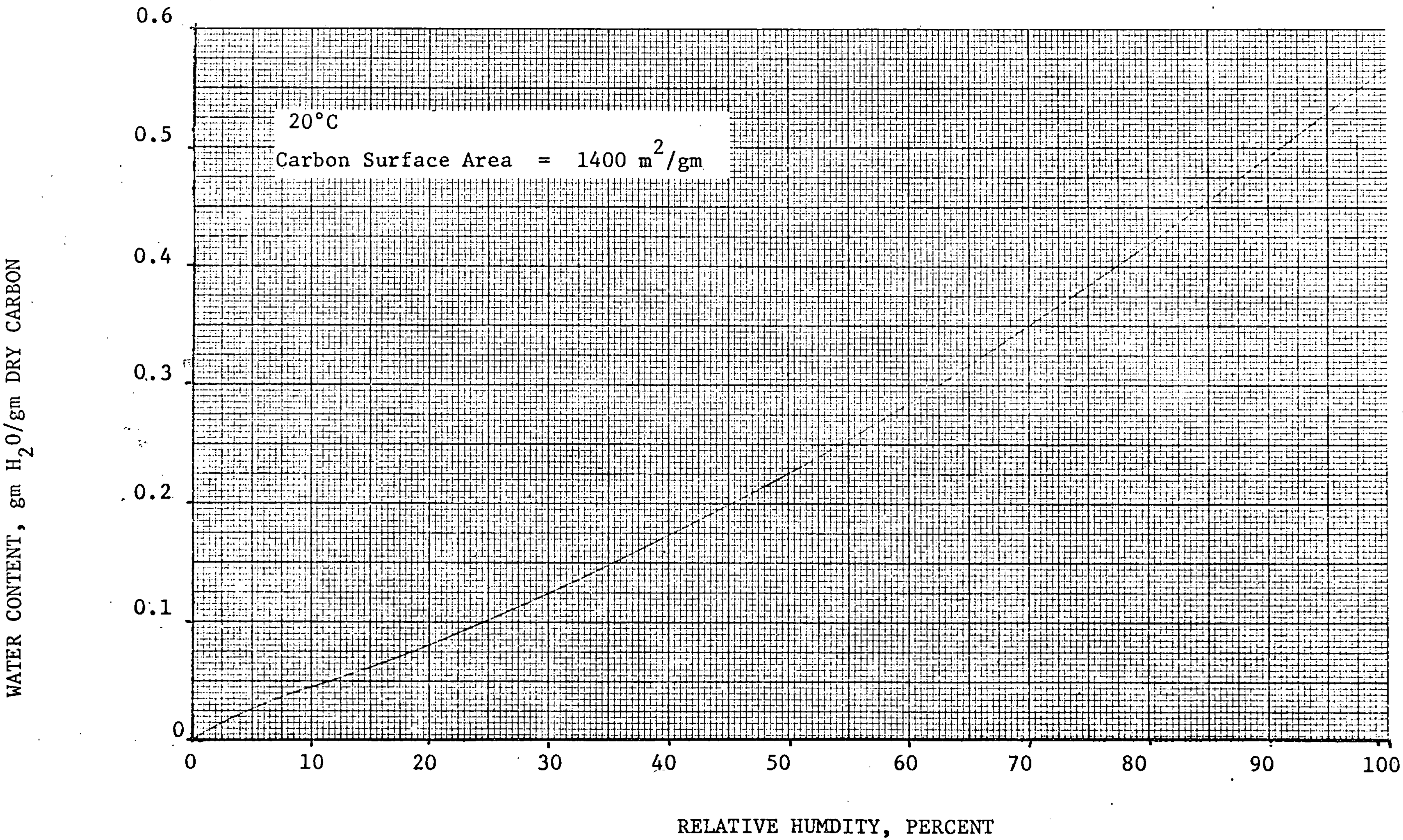

Figure 1
Supplement 9

MAXIMUM WATER ADSORPTION CAPACITY OF CARBONS 100% RH 100°C

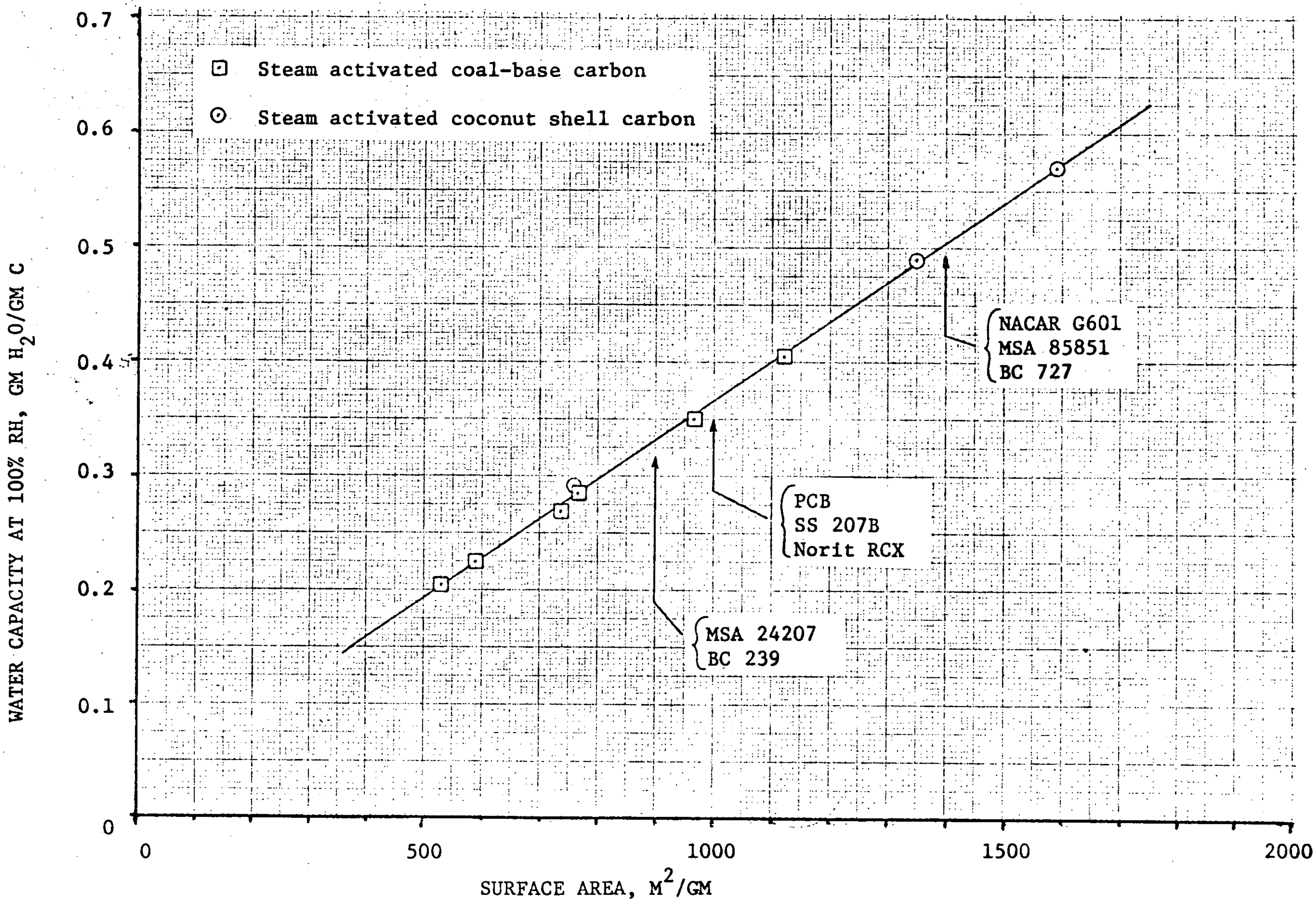

FIGURE 2
SUPPLEMENT 9

moisture droplets. Moreover, for very high moisture contents, > 1 gm/gm, as has been reported for some tests, it is apparent that the collected water was not afforded a means to drain from the test bed, thereby compounding several effects on the methyl iodide decontamination performance. A partially flooded bed will reduce the air/steam flow area and thereby decrease the residence time, leading to a reduction in bed performance.

With a properly oriented carbon bed, which permits upward or downward flow of the air/steam mixture, bed flooding is not expected to occur since the excess water can drain, leaving the flood areas unaffected. Tests have been conducted with vertical air flow and bed performance has remained high at conditions of 100 percent relative humidity, and even at supersaturated conditions.

Planned Test Program

Since test data exist which have been interpreted to reflect low performance at high relative humidity conditions, without clarification of the effects due to flooding, additional tests are being planned. There tests will supplement the existing data and are expected to illustrate more clearly the effects of moisture on bed performance. Arrangements are being made by Westinghouse to have the tests conducted at the Oak Ridge National Laboratories by Messrs. R. E. Adams and R. D. Ackley, who have considerable experience in the evaluation of impregnated carbons for this application.

The test program will consist of a series of tests aimed specifically toward the effects of moisture. The test equipment will be constructed for operation at ∿ 270°F, 55 psia, with a steam/air superficial velocity of 40 fpm, and at 90 to 100 percent relative humidity.

The following specific objectives are sought:

1. To show the relationship of filter performance with moisture content when moisture is derived solely from water vapor adsorption in a saturated and near-saturated atmosphere.

2. To determine whether sufficient dewatering of a flooded filter can be achieved under saturated conditions to restore useful trapping efficiency for methyl iodide.

The carbon test bed will be 3 inches in diameter, 2 inches depth, and will be confined between punched plate retainers as used in the plant filter cell construction. The carbon bed will be oriented such that either downflow or upflow of the air/steam mixture can be maintained during a test.

Except as noted below, all tests will be conducted with a methyl iodide concentration of 6 mg/m^3, which simulates the conservative estimate of methyl iodide in the reactor containment under accident conditions. The carbon to be employed in these tests will be MSA-85851 or equivalent.

The program as planned will consist of the following tests:

1. A series of six tests will be conducted to define the effects of humidity on methyl iodide decontamination efficiency over the range 90 - 100 percent relative humidity. Air/steam flow is to be downward.

2. Two tests will be run at near 100 percent relative humidity, as in 1, except the air/steam flow will be upward.

3. Three tests will be conducted to study the effect of flooding and recovery on methyl iodide decontamination. In these tests, the charcoal bed will be initially flooded, then purged of excess water with air at 100 percent relative humidity, then the methyl iodide efficiency determined. The air flow will be downward in these tests.

4. The flooding and recovery tests will be repeated, as in 3., except the air flow will be upward. Three tests will be run.

5. As a comparison with tests run previously at ORNL (see ORNL-4040 and -4180), two tests will be conducted with wire mesh screen retaining the carbon bed, in place of the punched metal plate.

6. Also as a comparison to previous work, the air stream methyl iodide concentration will be increased from 6 mg/m^3 to 80 mg/m^3 in two tests.

The tets program as outlined will require approximately 5 months to complete. Results are expected during the early part of the third Quarter of 1969.

Application to Design

The results of the testing program will influence the design of the Indian Point Unit 3 filter system in the following way.

First, it will be ascertained that under 100% humid conditions, but with liquid entrainment excluded, the filter medium can provide the needed exchange efficiency. As shown in Supplement 7, Section 5, an efficiency of 50% is more than adequate to meet the dose objectives of the system. (By reference to Figures 5.4-1 and 5.4-2 in that section it is seen that the proposed system incorporating 60 installed filter cells will reduce the organic iodine dose to 126 rem in 2 hours at the site boundary, and to 136 rem in 30 days at the low population zone boundary. Both results are based on 3 of 5 filter banks operating and 50% overall efficiency of exchange per pass. When added to the corresponding inorganic iodine doses with conservative allowance for spray absorption, the 300 rem limit of 10 CFR 100 is met in both instances.) If the test results show that the effect of 100% relative humidity alone prevents the system from meeting or exceeding this required performance, design provisions will be made to reduce the relative humidity of the influent air-steam mixture.

It is visualized that this would be accomplished by electric or steam heating elements contacted by the atmosphere entering the filters.

Second, the post-flooding recovery characteristics of the filter will be examined. If the efficiency of the bed is acceptable at 100% humidity but cannot be shown to recover after flooding, a possible design alternative would be to isolate the filter system in a pressure-tight enclosure until after the initial phase of the accident. At the sacrifice of a small increase in dose (less than 20 rem), the filter could thus be protected from an influx of liquid water during the first hour of the post accident period, during which most of the condensation and runoff of primary water in the containment will have occurred. A second alternative would be to provide downflow through all filter beds, instead of mixed upflow and downflow as in the presently conceived filters. This choice would be indicated, for example, if the tests showed recovery to be substantially favored by downflow where gravity and viscous drag were acting together to aid dewatering. A third alternative would be to employ a preheater to induce dewatering by evaporation. The choice of one of these methods would be based on economics and layout considerations after the recovery characteristics are evaluated. It is re-emphasized, however, that should the tests show that recovery will occur by natural effects, i.e., without heating, pressure isolation, or special flow orientation, it will be preferrable to waive these provisions in the interest of simplicity and ease of surveillance. Preliminary design of the air handling system will proceed in such a way as to preclude none of the above alternatives until completion of the test evaluation.

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