PROPOSED QUALIFICATION TEST - JOY AXIVANE FAN AND MOTOR
(NUCLEAR) FOR RECIRCULATION SERVICE FOR NUCLEAR CONTAMINATION

PROPOSED QUALIFICATION TEST
JOY AXIVANE FAN AND MOTOR (NUCLEAR)
FOR RECIRCULATION SERVICE FOR NUCLEAR CONTAINMENT

INTRODUCTION

In water moderated nuclear reactors, it is common practice to seal-in air moving devices within the containment shell. These devices are intended to cool-down and to clean-up the containment should an accident, pipe rupture, etc. occur. In this mode, the air moving device would recirculate the containment atmosphere through filter and cooler. It becomes absolutely necessary that these air moving devices display absolute dependability and reliability.

Current specification levels delineate the following conditions to which an air moving device may be subjected under the condition containment accident as follows:

1. Radiation. A maximum dosage of 10^9 Rads of gamma radiation during the design life of the air moving device, the fan/motor combination.

2. Temperature. Short time temperature exposure during the accident condition of 300°F. The duration of this period is anticipated at a maximum of 3-4 hours.

3. Humidity. Short time exposure, 3-4 hours in duration, to 100% relative humidity in a slightly caustic atmosphere.

4. Pressure. Vapor pressures of 70 psia during the 3-4 hour duration of the emergency mode.

5. Normal design operating temperature of 125 to 150°F.

6. Normal air pressure of 18.3 psia.

7. Design life of 40 years.

There is considerable technical design support data on materials for motor installation systems. These indicate that there exists design capability for motors to withstand this containment condition.

Further, there are many applications of axial flow fans described above. However, in these cases, the environments occur individually, rather than in combination. In this light, considerable skepticism exists on the part of engineers and users to accept only the documented information for this critical service. There is a general feeling and opinion that the air moving device must be tested at or near environment conditions to demonstrate its dependability and reliability for this service.

We will outline below a test program that we consider logical and one that should lead conclusively as to the reliability of the proposed air moving device. We will delineate our interpretation of the necessary Pre-conditioning Tests, Fan/Motor Performance Tests, to guarantee the performance level under the ambient condition, and to predict the fan/motor performance level at accident conditions, and the Operation Under a Simulated Accident Condition.

AIR MOVING DEVICE QUALIFICATION TESTING

I. PRE-CONDITIONING TESTS

A. Vibration Test; The motor shall be subject to a vibration spectrum varying from 20 Hz to 500 Hz at levels of approximately 0.3 g for a period of one (1) hour.

B. Electrical Tests; Upon completion of the Vibration Test, the motor shall be tested for:

1. Insulation Resistance. The post test resistance shall meet the minimum recommended industry values, and

2. Dielectric Test. The motor shall receive and pass dielectric test in accordance with current industry practice for motor design rating.

C. Heat-Aging Test; The motor shall be pre-aged prior to being subjected to any combined fan/motor operation. The motor shall be placed in an oven and the temperature raised to 180°C., the limiting insulation temperature (hottest spot temperature) and held constant for a period of not less than one hundred (100) hours.

Upon completion of the Heat-Aging Test, the motor shall be subject to:

1. Electrical tests as per I.B, and

2. Disassembly and visually inspected for degradation.

II. FAN/MOTOR PERFORMANCE TEST

A. Fan/Motor Performance shall be performed in accordance with AMCA Bulletin 210, Figure No. 2, AMCA Standard Test Codes, Air Moving Devices. Performance shall be tested at all the fan motor speeds and at blade settings of -10°, -5°, +5°, and +10° relative to design setting angle.

B. Fan/Motor Sound Power Level shall be determined in accordance with the arrangement outlined in AMCA Bulletin 300, Standard Test Code for Sound Rating, Air Moving Devices. Sound Power Level determination shall be made at all test points as defined in (A) above.

C. Upon completion of the Fan/Motor Performance and Sound Power Level Testing, the motor shall be subjected to Electrical Tests as per I.B above. The results of this inspection and this data shall be recorded and documented.

III. OPERATION UNDER THE SIMULATED ACCIDENT CONDITION

A. The fan/motor combination will then be installed in a duct system equivalent in diameter to the fan. The large diameter system will be provided with a small diameter re-circulation tunnel. The fan shall be operated in basically a block-tight, shut-off condition; all of the developed SHP will be expended into the heating of the air. This operating point shall be selected so that the motor shall develop rated power and that the air moving device shall develop stage design pressure rise. This in the interest of duplicating as nearly as possible design operating conditions.

B. The fan shall be operated in this block-tight condition until the maximum expected containment temperature, 300°F. is reached. At this time, water will be introduced, via a spray nozzle arrangement, and the system will be re-circulated maintaining design temperature and 100% relative humidity. This test shall be run at the maximum pressure permitted by the duct design, anticipated to be 70-80 psia, and shall be run for a period of not less than three (3) hours.

C. Instrumentation shall be installed to measure the pressure, temperature, humidity, mass flow in the recirculated condition and the differential pressure rise across the fan.

D. Upon completion of the 3-4 hour operation under containment condition, the containment ambient will be reduced to the normally expected levels of 20 psia, 150°F. and 100% Relative Humidity, and the fan/motor combination run for a period of three (3) hours.

E. Test measurement shall be made as follows:

1. Recording of motor winding and motor bearing temperatures.

2. Containment temperature.

3. Containment pressure.

4. Containment humidity.

5. Voltage, current and power input into the motor driver.

All of the above noted measurements will be permanently recorded as a matter of record.

F. First Test Inspection. After the completion of the initial simulated accident environment, a complete visual examination shall be made of all of the major components of the air moving device. For the motor, the insulation resistance shall be measured and determined in accordance with recommended practices and the motor shall then receive a dielectric test, again in accordance with current industry practice. The motor will then be disassembled and visually inspected to determine any degradation of any major components.

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G. Upon successfully completing the first test inspection, the fan/motor unit shall be re-assembled and subjected to a second simulated accident environment test. Upon reaching the operating temperature and pressure, the motor shall be stopped and restarted. Restart after a fifteen (15) minute wait interval. Water spray nozzles will continue to operate during the shutdown period. Unit will duplicate temperature-time cycle as outlined in III.D. During and after this test:

1. Test measurements shall be made as per III.E, and

2. Post-test inspection as per III.F.

H. If deemed advisable, additional accident environment testing may be performed in the interest of evaluating the insulation life expectancy.

I. The proposed test arrangement is generally in accordance with attached Sketch No. 1.

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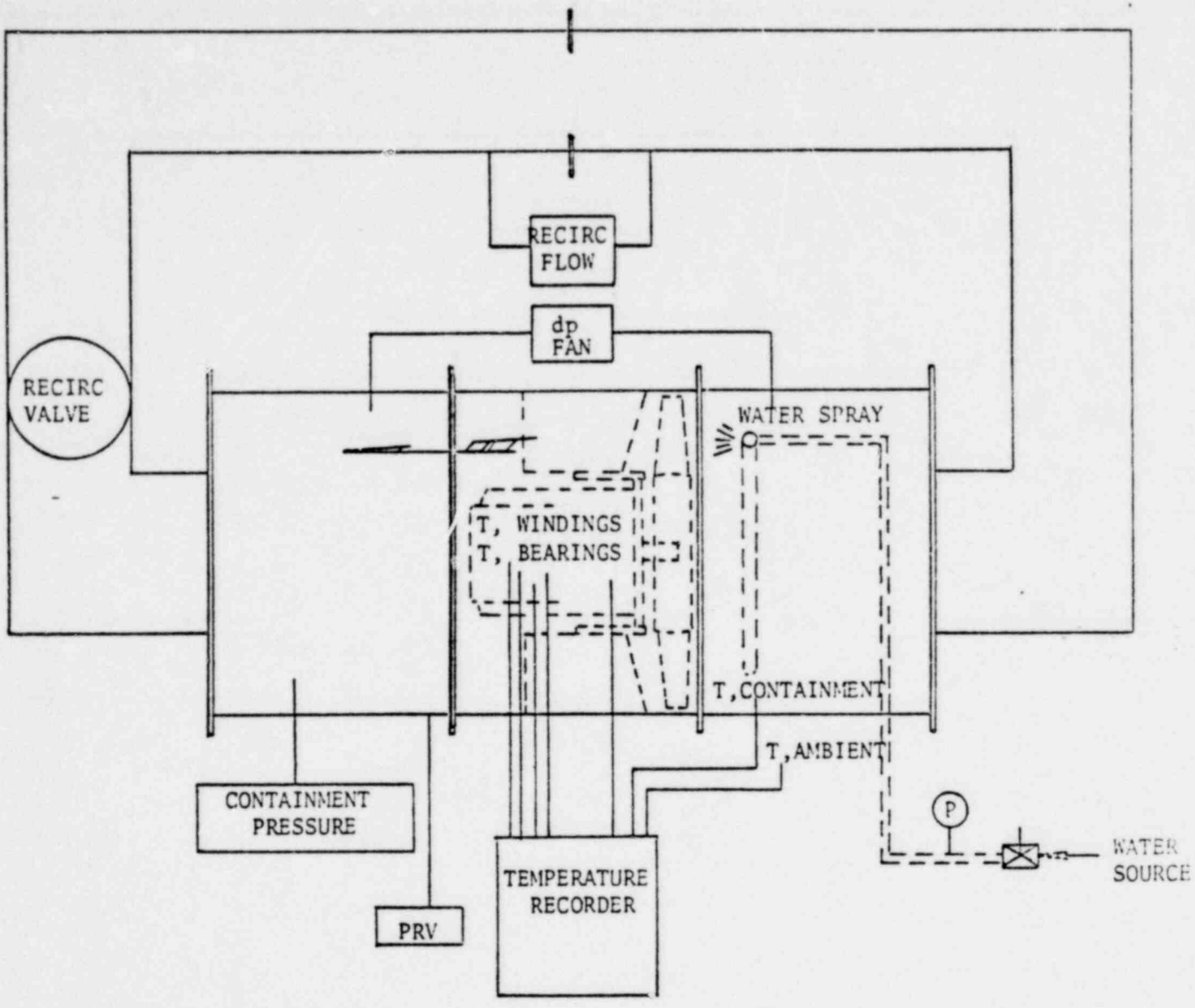

SKETCH NO. 1

ARRANGEMENT SCHEMATIC
PROPOSED FAN/MOTOR TEST FOR OPERATION UNDER
SIMULATED ACCIDENT CONDITION IN CONTAINMENT
FOR NUCLEAR RECIRCULATION SYSTEM

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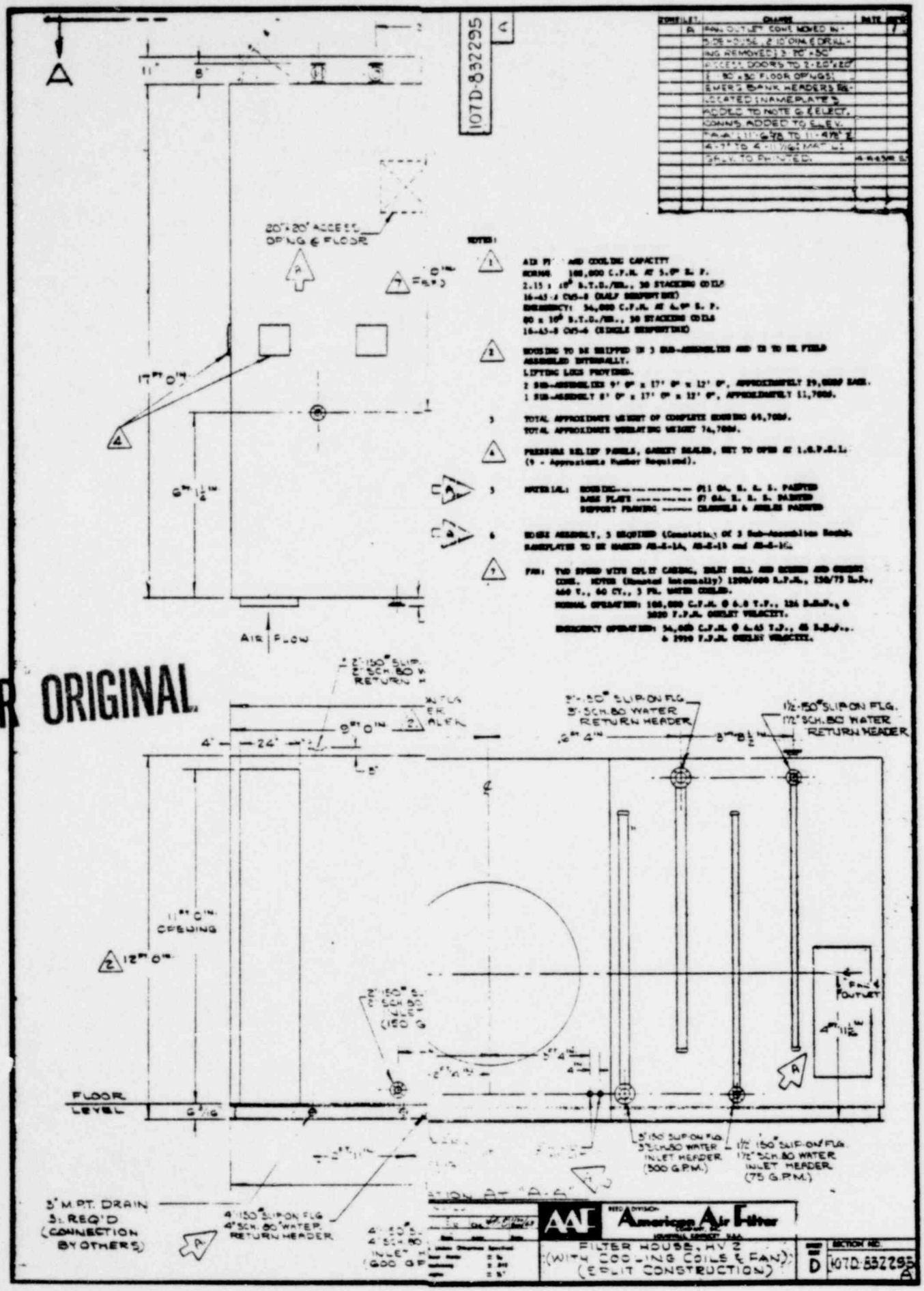

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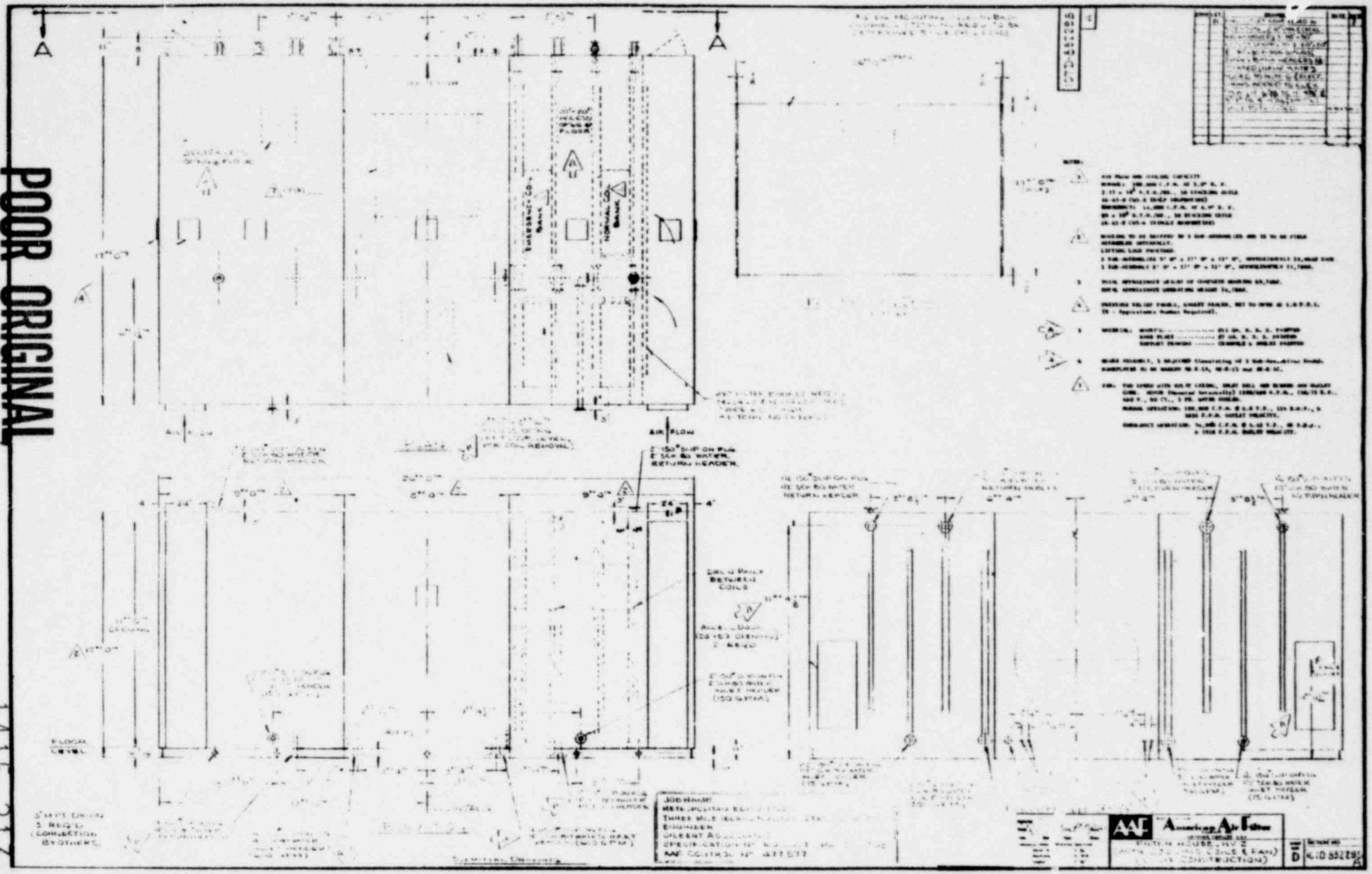

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