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March 7, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Dear Mr. Denton:

Experience at McGuire and other ice condenser containment nuclear plants has shown that ice loss due to sublimation represents a potential impact on plant availability. In order to improve the long-term availability of the McGuire and Catawba units, Duke has developed a sublimation shielding material. Following NRC review and approval, this material will be used to reduce sublimation in the three rows of baskets nearest to the crane wall.

An overall description of the sublimation shielding material development program is provided in Attachment 1. A substantial analysis and test program has been completed by Duke.

Westinghouse, under an EPRI contract, initially evaluated the concept of using an appropriate shielding material. Attachment 2 describes the EPRI test results that evaluated chemical compatibility, radiation effects, and heat transfer performance. A summary of the results, in Section 5 of the report, support the assumption that the long-term peak containment pressure will not be affected by the use of shielding material. The blowdown test, also, verified that shielding material raises the short-term pressure peak less than 3 psi.

This small increase in short-term peak pressure for the lower containment compartments, however, was recognized as a potential problem. Duke contracted with Westinghouse to perform a short-term containment analysis assuming three rows were wrapped with the shielding material. The results, outlined in Attachment 3, show that the peak short-term pressure in lower containment compartments remains below the design pressure of 15 psig.

Because the methyl cellulose material could eventually flow with meltout to the containment sump and be recirculated during containment spray actuation, Duke contracted with Westinghouse to perform a test on the effects of sublimation shielding material on containment spray systems (see Attachment 4). The results of this report concluded that methyl cellulose is an acceptable material that is not detrimental to the performance of the spray system components. Foam produced during the test, however, was identified as a potential problem. The test was expanded to test an anti-foaming agent and the results indicated a Dow Corning emulsion, DC 1520, was successful in suppressing the tendency of the methyl cellulose to foam during the spray test. The anti-foaming agent will be installed in the lower plenum of the ice condenser.

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To facilitate installation a loosely woven nylon mesh netting with a melting temperature of greater than 250°F will be incorporated in the 3.5 mil methyl cellulose shielding material. The nylon will be confined to the basket and will have an open area of at least 64% as determined acceptable in WCAP-8110.

The attached analysis and test documentation packages reinforce our own safety evaluation that the proposed ice condenser sublimation shielding material will not affect the safe operation of Catawba Nuclear Station, but will improve plant availability. In order to maximize the benefits from this effort, we would like to incorporate the sublimation shielding material in the initial ice loading for Catawba Unit 1.

The necessary changes to the Catawba FSAR are identified in Attachment 5. It is requested that the Staff review and approve these changes as soon as possible.

Very truly yours,

Hal B. Tucker

ROS/php

Attachments

cc: Mr. James P. O'Reilly, Regional Administrator
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Attachment 1

Ice Sublimation Shielding Material Development

I. Introduction

All operating ice condenser nuclear power plants are experiencing a common heat and mass transfer process called ice sublimation. A 2.5×10^6 lb. ice inventory, which is stored in 1944 cylindrical perforated sheet metal baskets one foot in diameter and 48 feet high, is continuously being depleted. The two main mechanisms causing this sublimation are: (1) the formation of convective air currents from heat conduction through the ice bed boundaries, causing ice to redistribute as frost onto cooled surfaces; and (2) the loss of saturated ice bed air as leakage out through the lower inlet doors, which is replaced by dry air from the upper plenum area.

A promising method of eliminating ice sublimation is to seal the ice in a vapor barrier medium, such as a plastic film. The plastic film would necessarily (1) be water soluble (or disintegrate in water or steam); (2) be chemically compatible with the reactor coolant system; (3) not adversely affect heat transfer surfaces or properties; and, (4) be structured to fit inside an ice basket and be capable of withstanding the mechanics of ice loading. A methyl cellulose film laminated onto a loosely woven nylon mesh has been selected per the criteria noted above.

To install the sublimation shielding material it was necessary to develop tooling to remove existing basket cruciforms and develop a suitable replacement cruciform system (see attached sketch).

II. Sublimation Shielding Material Selection/Qualification Testing

A. Material - Methyl Cellulose

1. Duke Power chemistry department and Westinghouse (under an EPRI contract) evaluated various materials criteria.

   a. Adequately soluble in borated water (sodium tetraborate and boric acid).

   b. Acceptable halogen levels considering dilutions and p^H.

   c. Compatible with reactor coolant system materials and components.

2. Material Availability.

   a. Liquid

   b. Film

3. Scale Modeled Blowdown Pressure Testing - Acceptable.

4. Shielding Effectiveness - Testing at Catawba Indicates:

   a. Film - effective.

   b. Liquid spray/water solvent - not effective.

   c. Liquid spray/volatile solvents - not presently available for testing.

5. Restrictions:

   a. Limited to three radial rows based on need and stack up of conservative assumptions for analysis. (See Westinghouse analysis results indicating pressure response to DBA.)

   b. Antifoam agent - Dow Corning 1520 found effective to suppress tendency to form foam during spray loop testing. DC1520 concentration required is 400 to 625 ppm per 2.1 lbs. methyl cellulose in 1000 lbs. of borated water. (See Westinghouse spray test, less data.)

B. Material Reinforcement. 2 mil methyl cellulose material was found difficult to install due to tendency of tear/puncture (approximately 100 sharp protrusions per basket) propagation. A mesh material laminated with 3.5 mil methyl cellulose was developed as follows:

1. Nylon Monofiliment Material.

   a. Chemically acceptable in ice baskets.

   b. Stable up to 250°F.

   c. Available.

2. Mesh open area - 64% or greater acceptable based on Westinghouse testing.

III. Installation Scenario

A. Existing Cruciforms Removed.

B. Install Film/Bag into Basket - Secure with Special Equipment. Developed to Facilitate Film Installation - 648 Baskets (present maximum).

C. Inflate Bag to Basket Contour.

D. Install Suspension Type Replacement Cruciforms.

E. Load Borated Ice.

F. Secure Bag Top to Suspension Cruciform System.

G. Secure Suspension Cruciform System.

H. Weigh Baskets.

J. Install Dow Corning 1520 Antifoam as Follows:

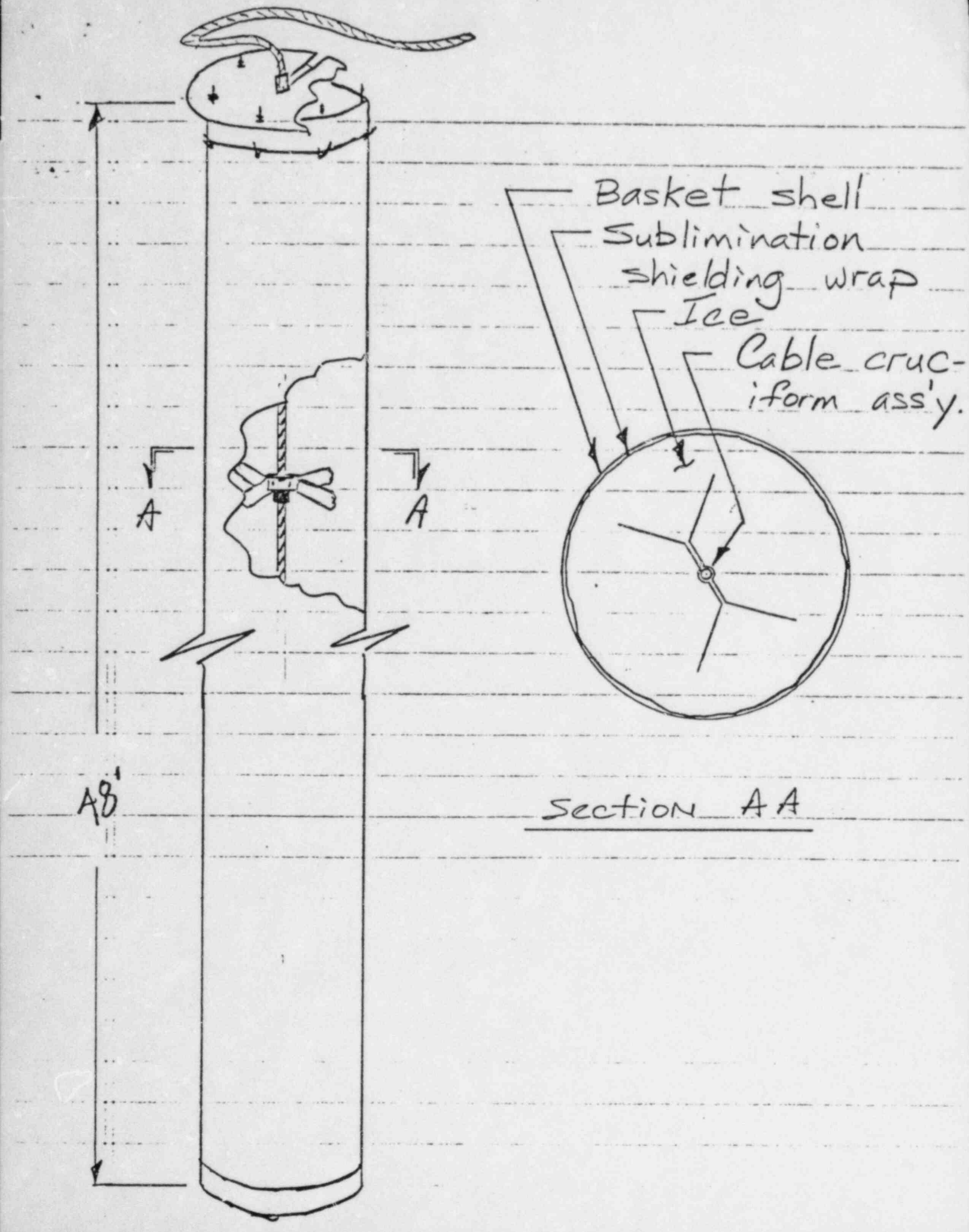
1. Determine amount/install equal portions per bay (1/24 total).

2. Solidify antifoam agent in forms/molds.

3. Install in wire baskets.

4. Install/secure in lower plenum.

IV. Verify Ice Weight (and Antifoam Volume/Weight) at Presently Specified Intervals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A
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Basket shell
Sublimination shielding wrap
Ice
Cable cruciform ass'y.

Section AA

ATTACHMENT 2

STEAM PRESSURE SUPPRESSION CHARACTERISTICS OF WATER-SOLUBLE PLASTIC MEMBRANE SHIELDED ICE FOR ICE CONDENSER CONTAINMENT NUCLEAR POWER PLANTS

EPRI RESEARCH PROJECT 2125-1 FINAL REPORT

A technical review of this final report has been made by the project manager and his designees and, in the opinion of the reviewers, the basic concept of ice condenser sublimation control which was investigated and which is reported herein, is considered to be patentable. Accordingly, it is not possible to identify specific portions of the report as containing subject matter "which may disclose inventions or discoveries which may be required to be reported under this Agreement."