UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MARCH 7 1980

Docket No. 50-293

MEMORANDUM FOR: T. A. Ippolito, Chief, Operating Reactors Branch #3, DOR

FROM: J. N. Hannon, Project Manager, Operating Reactors Branch #3, DOR

SUBJECT: MEETING SUMMARY

A meeting was held with representatives from BECo (the licensee) and GE in Bethesda, Maryland on February 29, 1980. The purpose of the meeting was to discuss the recently discovered Pilgrim Core Spray Sparger cracks, associated analysis, and plans for resuming power operation at the Pilgrim Station after the current refueling outage. A list of meeting attendees, agenda, and slides used during the presentation are enclosed.

The preliminary conclusion of GE and BECo is that the observed cracks are most probably caused by intergrannular stress corrosion. GE/BECo believe that the cracks could affect the sparger flow distribution, but that structural integrity should be maintained such that water delivery would not be compromised. Therefore, BECo is planning to operate the next cycle with no credit being taken for the core spray distribution (i.e., core spray heat transfer), only for core spray reflood. This will require a revised ECCS analysis, which has been initiated. It is anticipated that the ECCS analysis, with no credit for core spray heat transfer, may result in a MAPLHGR limit reduction.

BECo stated that concerns in the following areas motivated their decision to proceed with the ECCS reanalysis, rather than some other course of action:

Outage Economics (procurement, lead times)

Available Technology for Sparger Replacement (hardware, tools, etc.)

Radiation Exposure

The staff stated that if the ECCS reanalysis course is pursued, the reanalysis should reflect the current plant status, and address other phenomena that may change as a result of the loss of core spray heat transfer. In addition, the question of fragmentation needs to be developed further, with particular emphasis on the potential for flow blockage, nozzle breakage, and loose parts monitoring during reactor operation.

The meeting was concluded with BECo proposing another meeting in March to discuss further details as they are developed. The current outage schedule was not firm, although the return to power operation for Pilgrim Station is expected to be delayed.

J N Hannon

J. N. Hannon, Project Manager
Operating Reactors Branch #3
Division of Operating Reactors

Enclosures

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OELD
OI&E (3)
S. Sheppard
Project Manager
ACRS (16)
NRC Participants
TERA
J. R. Buchanan

MEETING WITH BOSTON EDISON COMPANY

RE: C/S SPARGER

February 29, 1980

NRC
John Hannon, DOR/ORB#3
Bill Mills, IE/ROI
Robert Aelmann, IE/ROI
S. D. Reyvolds, Region I, NRC
Phil Grant, DOR/EEB
George Knighton, DOR/EEB
C. P. Woodhead, NRC/OELD
F. B. Lotton, DSS/SEPB
T. A. Ippolito, DOR/ORB#3
K. P. Roberts, NRC Resident Inspector Pilgrim
D. V. Kehoe, NRC, Project Inspector 'grim
R. W. Klecker, NRC/DOR/EB
H. Walker, NRC/DOR/EB
H. F. Conrad, NRC/MTEB/DSS
S. J. Norwicki, DOR/ORB#2

GE
J. H. Oates
J. P. Higgins
J. F. Kilty
R. G. Furgeson
L. M. Zull
Robert E. Legate, Engineer

JCP&L Co.
Jim Knubel
T. M. Crimmins, Jr.

BOSTON EDISON
Jack Fulton
G. Carl Andognini

BOSTON EDISON CO.

PILGRIM STATION

CORE SPRAY

AGENDA

I. INTRODUCTION • JACK FULTON, BECO
   - REASON FOR MEETING
   - BECO ATTENDEES
   - GE ATTENDEES

II. PILGRIM CORE SPRAY INSPECTION SUMMARY • JACK FULTON

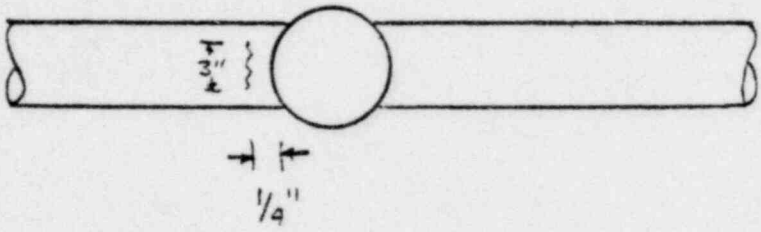
III. PILGRIM SPARGER • BOB LEGATE, GE
   - DESIGN & FABRICATION
   - INSTALLATION HISTORY
   - PERFORMANCE HISTORY

IV. POTENTIAL CAUSES OF CRACKS • PAT HIGGINS, GE

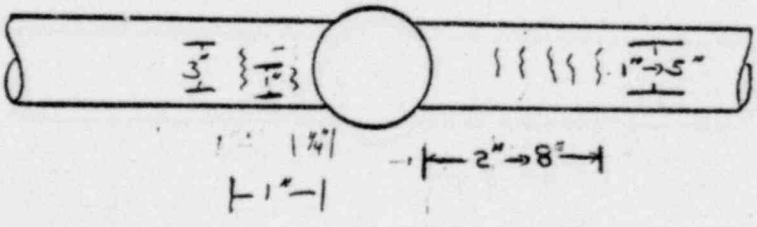
V. PILGRIM SPARGER STRUCTURAL INTEGRITY WITH CRACKS • BOB LEGATE, GE

VI. PILGRIM LOCA ANALYSIS • LARRY ZULL, GE

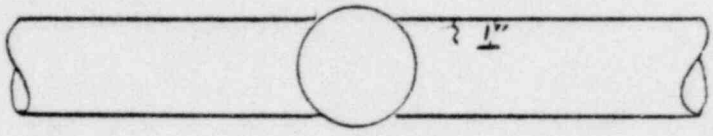
VII. CONCLUSIONS • CARL ANDOGNINI, BECO



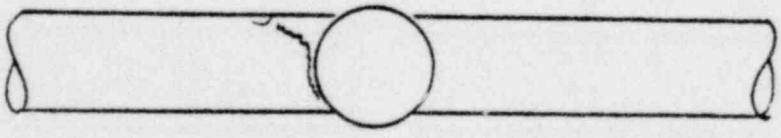
UPPER SPARGER
175° AZIMUTH



UPPER SPARGER
5° AZIMUTH



LOWER SPARGER
185° AZIMUTH

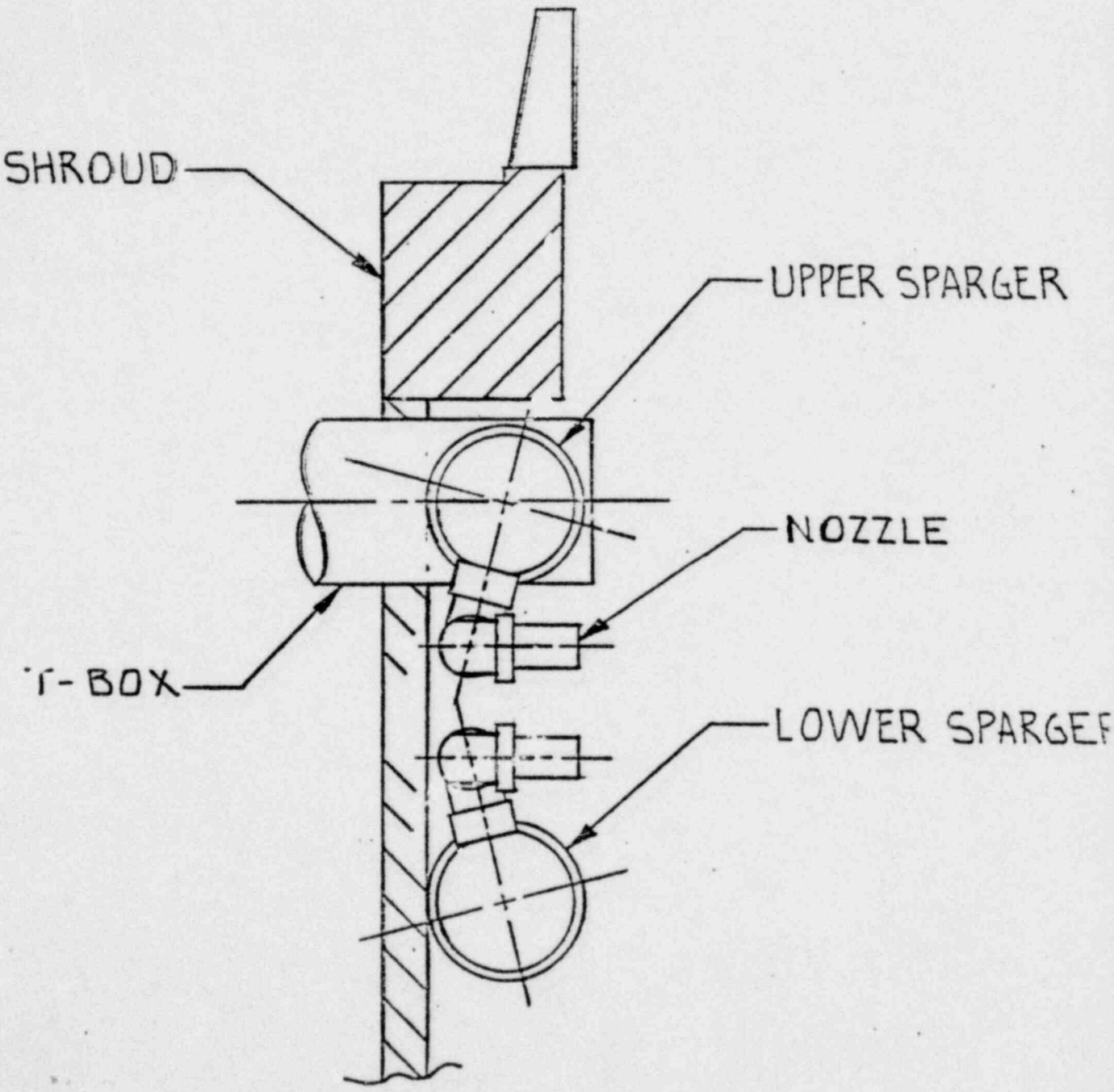


8" long

LOWER SPARGER

355° AZIMUTH

CORE SPRAY SPARGER
ELEVATION VIEW



CORE SPRAY SPARGERS

HEADER ARMS

3 1/2" SCH 40 - TYPE 304 STAINLESS STEEL

T-BOX

5" SCH 40 - TYPE 304 STAINLESS STEEL

NOZZLES

1" HALF COUPLINGS
2 EACH 1" 90° S.R. ELBOWS
INTERNAL CLOSE NIPPLE/ORIFICE
ALTERNATING NOZZLE OPENINGS
(1) OPEN ELBOW
(2) 1HH12 90° NOZZLES

TOTAL NOZZLES = 112 PER SPARGER

FITTING MATERIALS ALL TYPE 304 STAINLESS STEEL

FABRICATION HISTORY

- COLD FORMED

  BEND RADIUS 94 1/4 INCH
  (APPROXIMATELY 2.1% STRAIN)

- .NO SOLUTION HEAT TREAT

- COLD SPRUNG (ASSUMED)

TOTAL > 2.1% STRAIN

SPARGER MOUNTING

- T-BOX WELDED TO UPPER SHROUD
  (VIA EXTERNAL THERMAL SLEEVE)

- EACH ARM SUPPORTED BY 3 BRACKETS

- BRACKETS WELDED TO SHROUD

- SPARGER PIPE TO BRACKET CLEARANCE
  FOR DIFFERENTIAL THERMAL EXPANSION

PERFORMANCE HISTORY

- FIRST CRITICAL - JUNE 72
- NO INADVERTANT CORE SPRAY INJECTIONS
- PLANT NORMAL OPERATION - STRESSES NEGLIGABLE
- CONSIDERED
  - IMPINGEMENT - FLOW PAST SPARGERS
  - SEISMIC - RIDGID STRUCTURE
  - INSTALLATION - RADIAL MISMATCH
  - PRESSURE
  - THERMAL MISMATCH
  - WEIGHT
  - FLOW INDUCED VIBRATION
- CORE SPRAY MAINTENANCE FLOW
  - DURING EACH REFUELING
  - MAX. $\Delta T = 130^{\circ}F$
- FOUND INDICATIONS ON INNER BEND RADIUS FEB. 80

PILGRIM CORE SPRAY SPARGER
CRACKING EVALUATION

- POSSIBLE CAUSES
  - HIGH CYCLE FATIGUE
  - LOW CYCLE FATIGUE
  - OVERLOAD
  - STRESS CORROSION
- OPERATION
  - SERVICE STRESSES ARE LOW
  - FATIGUE USAGE VERY LOW
  - CRACK OBSERVATIONS SIMILAR TO IGSCC IN 304 PIPING
- FABRICATION/INSTALLATION
  - COLD FORMING (> 2% STRAIN)
  - WELDING TO TEE BOX
  - PROBABLE ADDITIONAL STRAIN DURING INSTALLATION
- MATERIAL SUSCEPTIBILITY
  - SENSITIZATION + WELD RESIDUAL STRESS
  - HIGH LEVEL OF COLD DEFORMATION

MOST PROBABLE
CAUSE OF CRACKING
- IGSCC -

CRACK DETECTION

- CRACK INITIATION/GROWTH
  - INNER SPARGER BEND RADIUS IN HIGH LEVEL OF RESIDUAL TENSION
  - THEREFORE, CRACKS MOST LIKELY AT INNER SPARGER BEND SURFACES
  - IGSCC IN TYPE 304 STAINLESS STEEL PIPE WELD HAZ's HAVE TYPICAL LENGTH TO DEPTH RATIOS OF 5:1
  - FOR THIN WALLED PILGRIM SPARGER - CRACKS > 2-INCH (EVEN IF I.D. INITIATED) SHOULD BE VISUALLY DETECTABLE

WELD HAZ OF SPARGER
TO TEE BOX JOINT
MOST LIKELY LOCATION

STRUCTURAL INTEGRITY OF A SPARGER WITH CRACKS

- STRESSES LITTLE AFFECTED FOR NORMAL PLANT OPERATION

  EXCEPT - SECONDARY BENDING STRESSES DUE TO INSTALLATION RADIAL MISMATCH WILL INCREASE WITH DECREASE IN SECTION MODULUS-- BUT IS DEFLECTION LIMITED.

- SPARGERS SECURELY ATTACHED TO SHROUD

  EXCEPT - SPARGER ENDS (APPROX.) 1 1/2" OUTSIDE END BRACKET. NOT A LOSSE PART CONCERN

- STRESSES LOW FOR CORE SPRAY INJECTION EVENT

  - AXIAL LOAD FROM P & BRACKET FRICTION
  - SECONDARY BENDING FROM CHANGE IN BEND RADIUS
  - TORSION DUE TO NOZZLE FLOW
  - WEIGHT-FULL OF WATER

CONCLUSIONS

- SPARGER FLOW DISTRIBUTION MAY BE AFFECTED

BUT

- CORE SPRAY WATER WILL BE DELIVERED TO SHROUD INTERIOR

- SPARGER SHOULD RETAIN STRUCTURAL CONTINUITY

EFFECT OF CORE SPRAY SPARGER CRACKS ON PILGRIM LOCA ANALYSIS

- CURRENT LICENSING BASIS
  - MAPLHGR DETERMINED BY LIMITING LARGE BREAK ACCIDENT

    $4.34\ FT^2$ BREAK SIZE
    LOCATION - RECIRCULATION SUCTION LINE
    SINGLE FAILURE - LPCI INJECTION VALUE
    SYSTEMS REMAINING - ADS, HPCI, 2 CORE SPRAY
  - FULL CORE SPRAY HEAT TRANSFER ASSUMED IN ANALYSIS
- DEGRADED CORE SPRAY
  - CRACKS IN CORE SPRAY SPARGER COULD RESULT IN DEGRADATION OF CORE SPRAY DISTRIBUTION
    - ALL ASSEMBLIES MAY NOT RECEIVE RATED SPRAY
    - CORE SPRAY HEAT TRANSFER EFFECTIVENESS WOULD BE REDUCED
    - WORSE CASE
      - NO CORE SPRAY HEAT TRANSFER CREDIT
      - CORE SPRAY SYSTEM WATER ENTERS SHROUD AND ADDED TO WATER INVENTORY IN VESSEL
      - RESULT - APPROXIMATELY 10% MAPLHGR REDUCTION
- SMALL BREAK WILL ALSO BE ANALYZED - EXPECTED TO BE LESS LIMITING THAN LARGE BREAK
- FOR ALL ACCIDENTS, SPRAY DISTRIBUTION IS NOT REQUIRED FOR LONG-TERM CORE COOLING