

# TVA Watts Bar Nuclear Plant

## Dog Bone Seal Failure, Installation, and Inspection



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Presented to: FSRUG

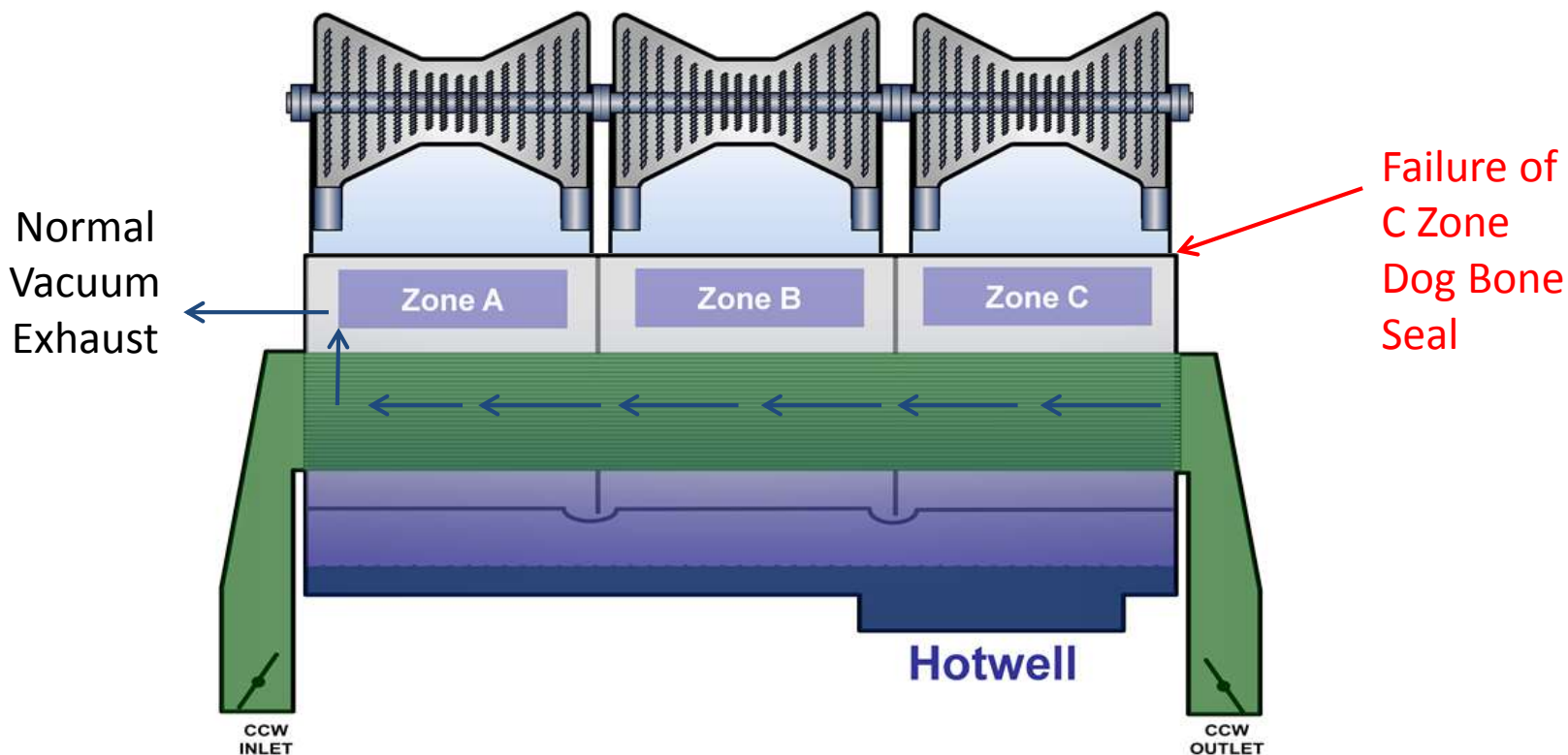
January 28, 2016

# Dog Bone Seal Failure

- Watts Bar
  - 2 unit, 4 Loop Westinghouse PWR.
  - TVA designed Secondary Side
  - Ingersol Rand Main Condenser
- WBN1 was manually tripped at 10:32 a.m. on 02/21/15 in anticipation of an automatic turbine and reactor trip due to low condenser vacuum.

# Dog Bone Seal Failure

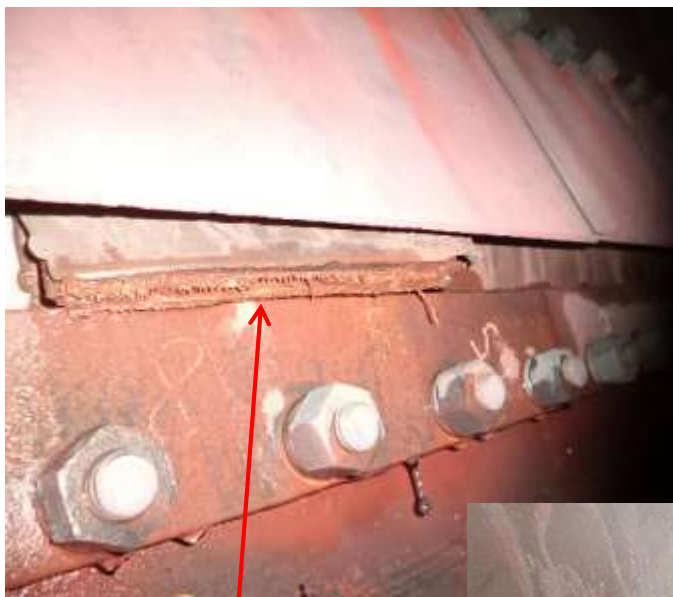
## Main Condenser Design



27

3 Cascading Condenser Zones  
27,410 115ft-long Tubes

# Dog Bone Seal Failure



Horizontal Tear  
along the  
clamping bar



Vertical Tear  
along the  
vulcanized splice

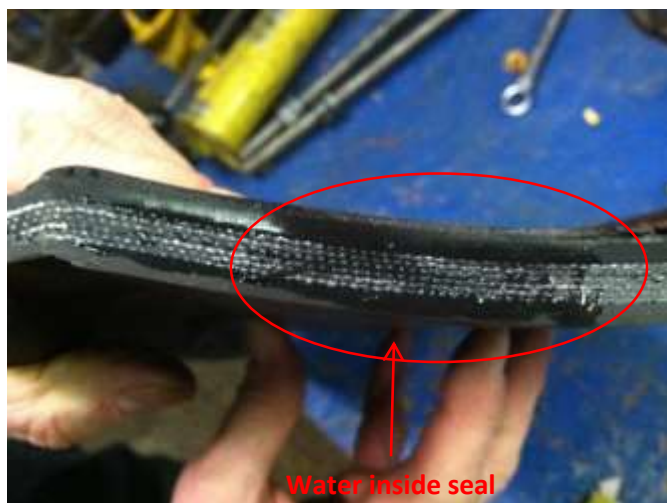


# Dog Bone Seal Failure

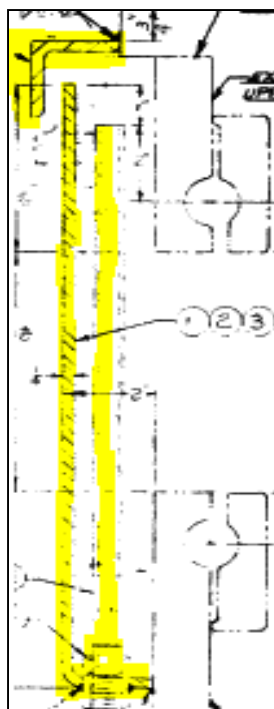


# Dog Bone Water Seal

- In-service for the life of the failed seal
- Interior Durometer readings were normal.
- Recommended to only use for air in-leakage troubleshooting.
- Water seal is shut off for new seal



Dog Bone  
Water Seal



Water Seal Side



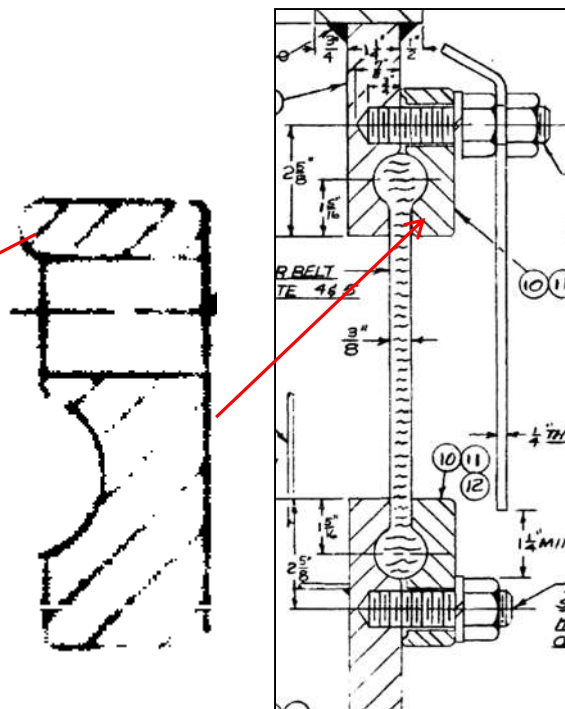
Condenser Side



# Dog Bone Seal Clamps



Seal, Clamp, Shield  
Side View



Clamping bar design is to hold on the bulb of the seal. Minimal pressure should be on the belt center.

# Dog Bone Seal Splice Thickness



A Zone  
Thickness not  
measured during  
failure analysis

- C Zone Splice
- B Zone Splice
- A Zone Splice



# Dog Bone Seal Splice

Failed  
Seal  
Splice



- Single steps instead of multistep
- Prepared ends do not meet.

First Cut



New  
Seal  
Splice

Second Cut



# Dog Bone Seal Splice

## After Vulcanization

Original Seal Cap Strip



Indicates insufficient compression during vulcanization

Replacement Seal Cap Strip



Smooth transition between cap strip and seal surface

# Dog Bone Seal Inspections

- Visual Inspections of splice and locations on each wall each refueling outage
  - Cracks
  - Blisters
  - Delamination
  - Bulging
- Durometer readings of 4 walls and splice each refueling outage
- Future: Microwave scanning of splice inspecting for voids.

# Dog Bone Seal



Questions???