Meeting Agenda

- Overview - Steve Scace
- Summary of Response - Clark Maxson
- Industry Experience - Clark Maxson
- NDE Methods - Mike Stark
- NDE Equipment - Dan Schlader (FTI)
- Contingency Plans/PRA - Yehia Khalil
- Future Plans - Steve Scace
- Conclusions - Alan Price

C01

DNC is Committed to Assuring Our Reactor Heads Perform Safely

- *DNC has followed the alloy 600 cracking problem*
- *In 1997, performed a 100% ECT inspection of nozzles*
- *Visual inspection of the Millstone 2 penetrations is impractical due to the insulation configuration.*
- *DNC intends to perform an NDE inspection of the Millstone 2 head penetrations.*
- *DNC inspections will result in an innovative, aggressive, and comprehensive data set.*
- *At startup from 2R14 there will be assurance that the MP2 head will meet all regulatory and performance requirements.*

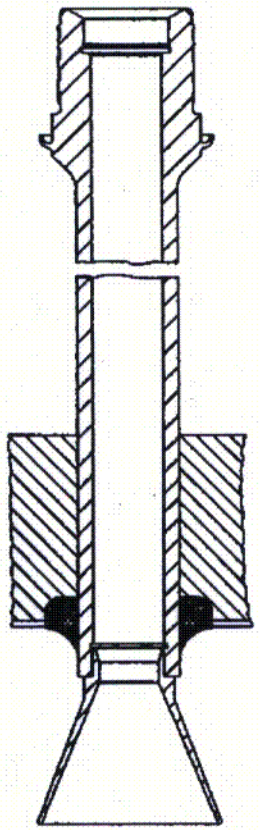
C02

Millstone 2 Features and Inspection Considerations

- *Ranked 29th in the susceptibility out of 69 PWRs*
- *CE designed and fabricated head using Huntington Alloys penetration tubes.*
- *Penetrations do not contain thermal sleeves*
- *Asbestos insulation of vessel head is contoured and close fitting to the head surface.*

C03

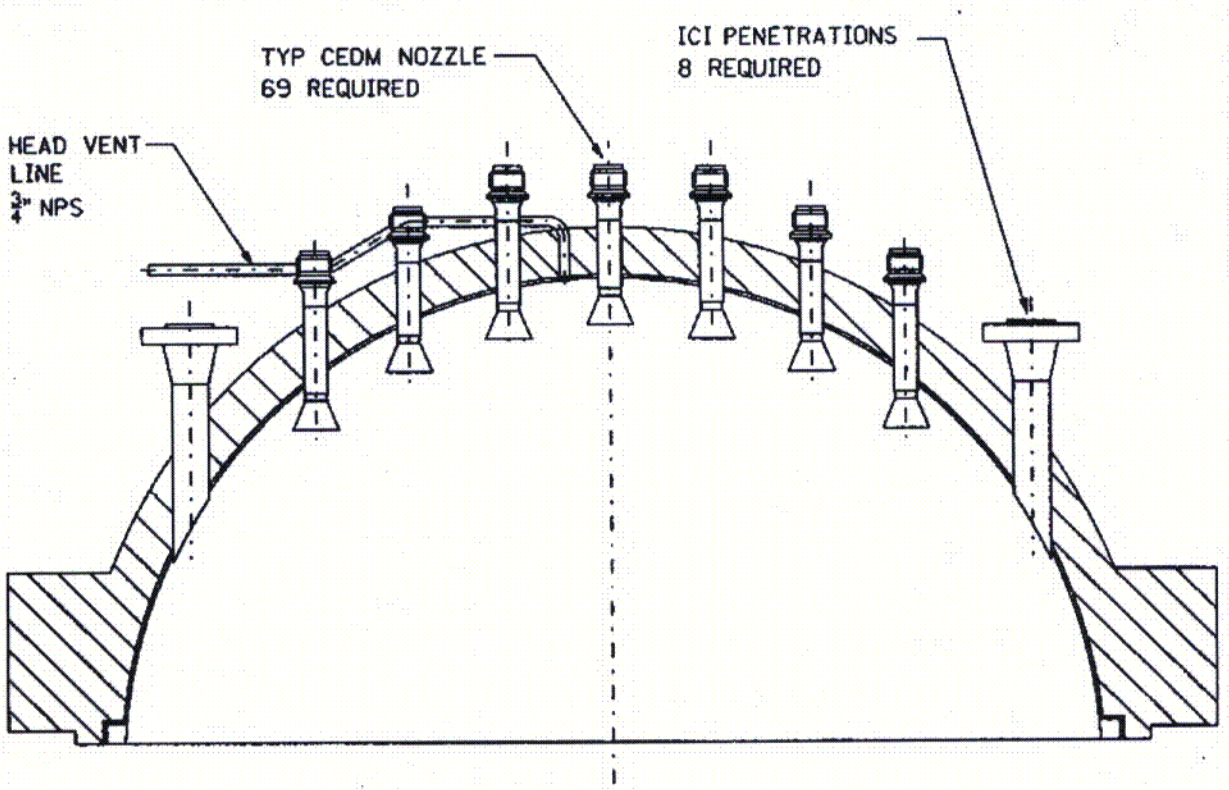
Nozzle Sketch



TYPICAL CEDM NOZZLE

C04

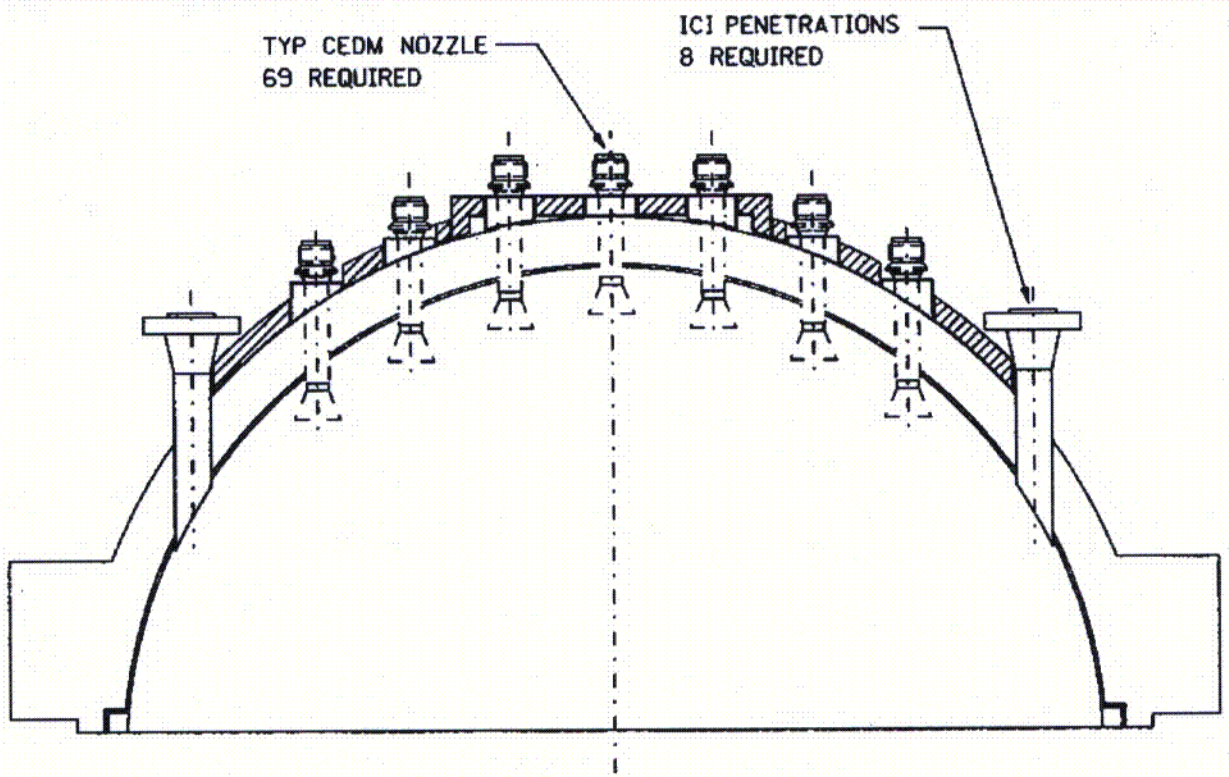
Reactor Head Nozzle Configuration



REACTOR HEAD NOZZLE CONFIGURATION

C05

Insulation Detail



INSULATION DETAIL

C06

Industry Experience Supports a Healthy Reactor Pressure Vessel Head for Millstone Unit 2

- *Millstone 2 is a CE NSSS*
  - *Zero circumferential cracks have been found to date in non B&W NSSS (over 680 nozzles inspected)*
- *CE Fabricated Head with Huntington Nozzles*
  - *Zero leaks have been reported for CE fabricated heads*

C07

Industry Experience Supports a Healthy Reactor Pressure Vessel Head for Millstone Unit 2 (cont'd)

Current Inspection Status
Plants with Effective Visual Inspections Since 12/00

Bulletin 2001-01 Category	B & W Plants					Non B & W Plants				
	Plant Name	Inspected	Leaks	% Leaks	Circ Above	Plant Name	Inspected	Leaks	% Leaks	Circ Above
Plants < 5 EFPY Relative to Oconee	Oconnee 1	69	1	1.4%	0	North Anna 1	65	0	0.0%	0
	Oconee 2	69	4	5.8%	1	Robinson 2	69	0	0.0%	0
	Oconee 3	69	9	13.0%	3	Surry 1	69	2	3.1%	0
	ANO-1	69	1	1.4%	0					
	TMI-1	69	5	7.2%	0					
	Totals ⇒	**345**	**20**	**5.8%**	**4**	**Totals ⇒**	**199**	**2**	**1.0%**	**0**
Plants 5-30 EFPY Relative to Oconee	Crystal River 3	69	1	1.4%	1	Turkey Point 1	65	0	0.00%	0
						Farley 1	69	0	0.00%	0
	Totals ⇒	**69**	**1**	**1.4%**	**1**	Farley 2	69	0	0.00%	0
						Calvert Cliffs 2	8	0	0.00%	0
						St. Luci 1	2	0	0.00%	0
						SONGS 3	34	0	0.00%	0
						Beaver Valley 1	65	0	0.00%	0
						Salem 1	78	0	0.00%	0
						Kewaunee	40	0	0.00%	0
						Prairie Island 1	40	0	0.00%	0
						Totals ⇒	**470**	**0**	**0.00%**	**0**
Plants >30 EFPY Relative to Oconee						McGuire 1	11	0	0.00%	0
						Totals ⇒	**11**	**0**	**0.00%**	**0**
	Totals ⇒	**414**	**21**	**5.1%**	**5**	**Totals ⇒**	**680**	**2**	**0.3%**	**0**
	Leaks are from base and weld metal cracks					*Leaks are from weld metal cracks*				

From11/27/01 MRP Meeting

C08

DNC Has Been Working with Our Vendor to Develop Improved NDE Techniques

- *Lack of thermal sleeves at MP2 allows access for ultrasonic examinations that will:*
  - *Detect axial and circumferential cracks in the tube.*
  - *Assess the area around the tube to verify the structural integrity of the RCS boundary is intact before a breach would be detected visually.*
  - *Gather additional data for Industry to assess the susceptibility of CE designed plants.*

C09

DNC Has Been Working with Our Vendor to Develop Improved NDE Techniques

- *Ultrasonic examination of the nozzle successfully demonstrated the capability to detect:*
  - *Circ flaws in the tube above or below the weld*
  - *Axial flaws in the tube above or below the weld*
  - *Circ flaws over the attachment weld*
  - *Axial flaws over the attachment weld*

C10

DNC Has Been Working with Our Vendor to Develop Improved NDE Techniques

Summary of Demonstration Status

	Circumferential Flaw in Tube (Above or Below Weld)	Axial Flaw in Tube (Above or Below Weld)	Circumferential Flaw Over Weld (Detection of crack tip in Oconee Specimen in required)	Axial Flaw Over Weld (Detection of crack tip in Oconee Specimen required)	Surface Exam of Attachment Weld (Currently no MRP demo available)	Flaw Depth Sizing (Currently no MRP demo available)
Framatome Rotating Ultrasonics	Demonstrated successfully by detecting crack tip in appropriate Oconee Specimen.	Demonstrated successfully by detecting crack tip in appropriate Oconee Specimen	Demonstrated successfully by detecting crack tip in appropriate Oconee Specimen	Demonstrated successfully by detecting crack tip in appropriate Oconee Specimen	Weld metal not addressed	Flaw sizing not addressed.

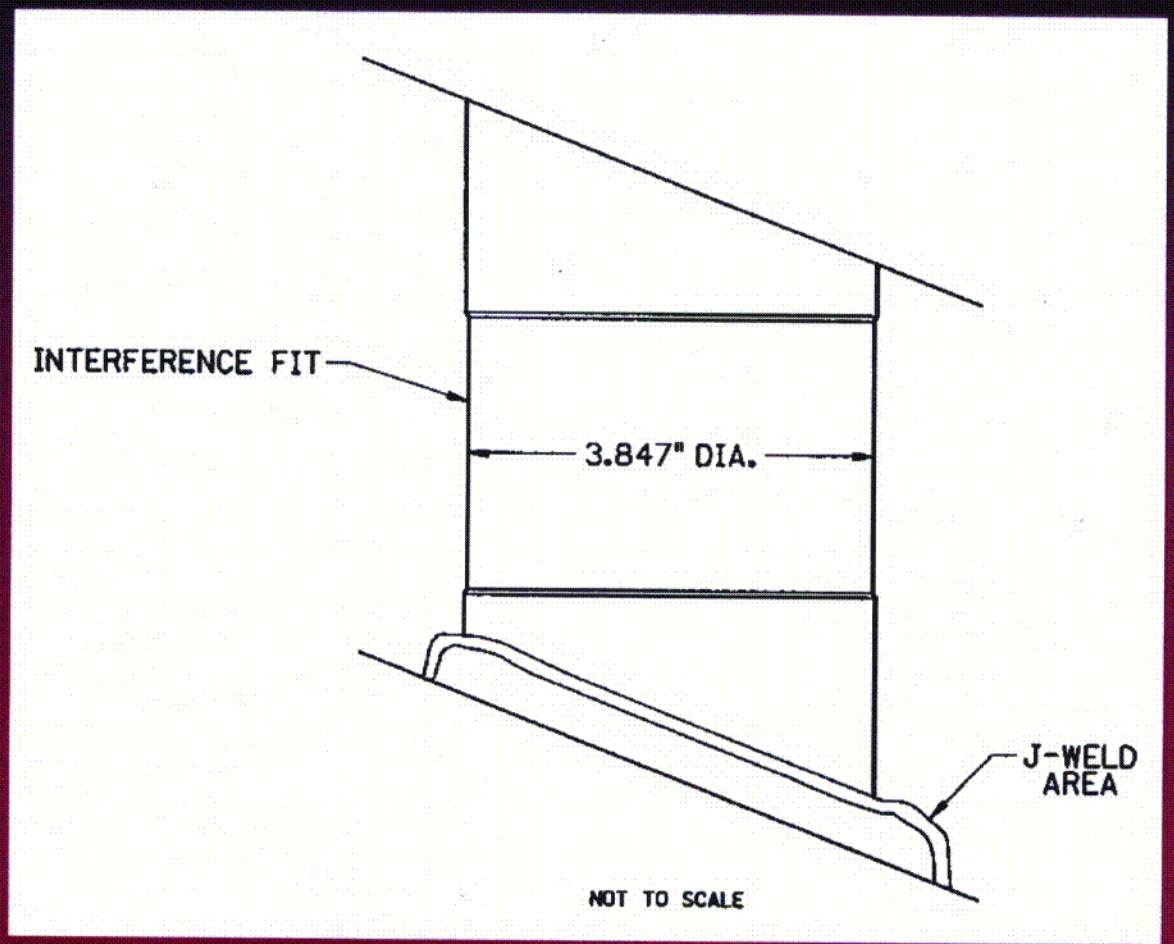
C11

DNC, With FTI, Has Pursued a New NDE Technique to Detect Leakage

- *Methods - UT of the Interference Fit Region*
  - *Demonstrated to Millstone NDE personnel that data taken at various sites can reliably detect the leak path through the interference fit region.*
  - *The ability to review this region ultrasonically enhances our leak detection capabilities before a leak would be detected by a bare head visual examination.*

C12

Interference Fit



C13

DNC, With FTI, Has Pursued a New NDE Technique to Detect Leakage

- *The ultrasonic inspection technique, capturing reflected energy on computerized C-scan displays, can accurately detect a leak path emanating either from the weld to tube interface or above the weld through the interference fit region.*

C14

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DNC Has Been Working with Our Vendor to Develop Better NDE Techniques

- *FTI chosen based on:*
  - *Continuous improvement in examination technique increasing their ability to detect all the flaws anticipated in the tube.*
  - *Continuous improvement in equipment enabling additional data to be obtained by incorporating multiple probe rotating head design.*
  - *Continuous improvement in examination technique to investigate interference fit region for evidence of a leak path.*

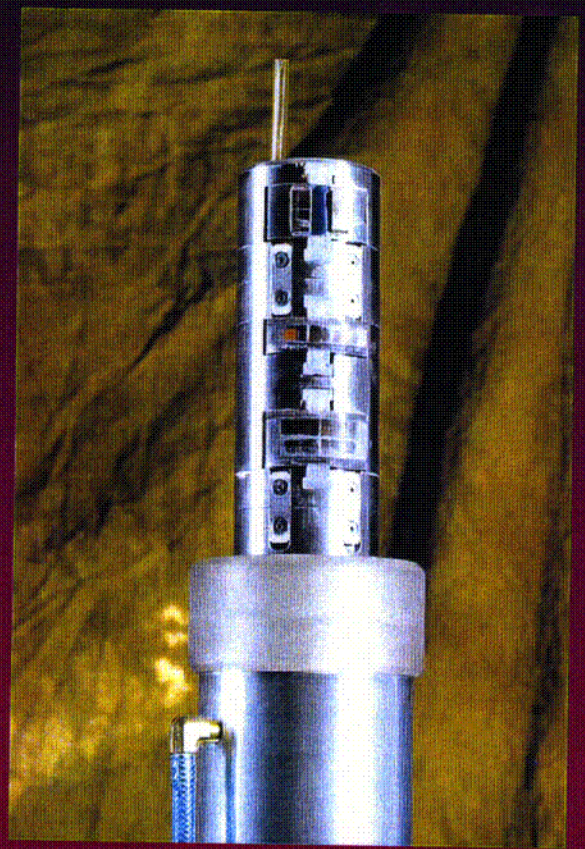
C15

DNC Continues to Work With Our Vendor to Develop New Techniques

- *In Progress NDE Development*
  - *FTI is continuing to make advances in ultrasonic examination techniques that can assess cracks initiating in the weld region.*

C16

Bottom up Rotating UT Inspection Head and Delivery Tool



C17

Rotating UT Head

C18

First of a Kind Inspection Approach Requires Contingency

- *We expect that our MP2 RPV Head is healthy*
- *Our outage plan includes plan for 100% volumetric inspections of RPVHP.*
- *A minimum confidence factor of 90% will be attained similar to the Steam Generator Tube Inspection Standard.*
- *Any indication of PWSCC in any RPVHP requires completion of all penetrations.*
- *A Relief Request for NRC approval is being prepared to address weld repairs if necessary.*

C19

First of a Kind Inspection Approach Requires Contingency

- *Assumes that the UT inspection has identified no unacceptable flaws in "n" RPVHPs*
- *Calculates the upper 90% confidence limit on the number of RPVHPs with potentially unacceptable flaws as a function of "n"*
- *This method is appropriate for the RPVHP inspection since the population size is finite*
- *A random sampling that is consistent with SG Tube inspection will be employed*

C20

First of a Kind Inspection Approach Requires Contingency

- *For a large sample (n>30), 100 (1-a) % confidence limit for P is given by:*

$$[r + 0.5^{*}Z^{2}_{\alpha/2} \pm \{(r + 0.5Z^{2}_{\alpha/2})^{2} - (n + Z^{2}_{\alpha/2})r^{2}/n\}^{1/2}]$$

divided by $(n + Z^{2}_{\alpha/2})$

C21

First of a Kind Inspection Approach Requires Contingency

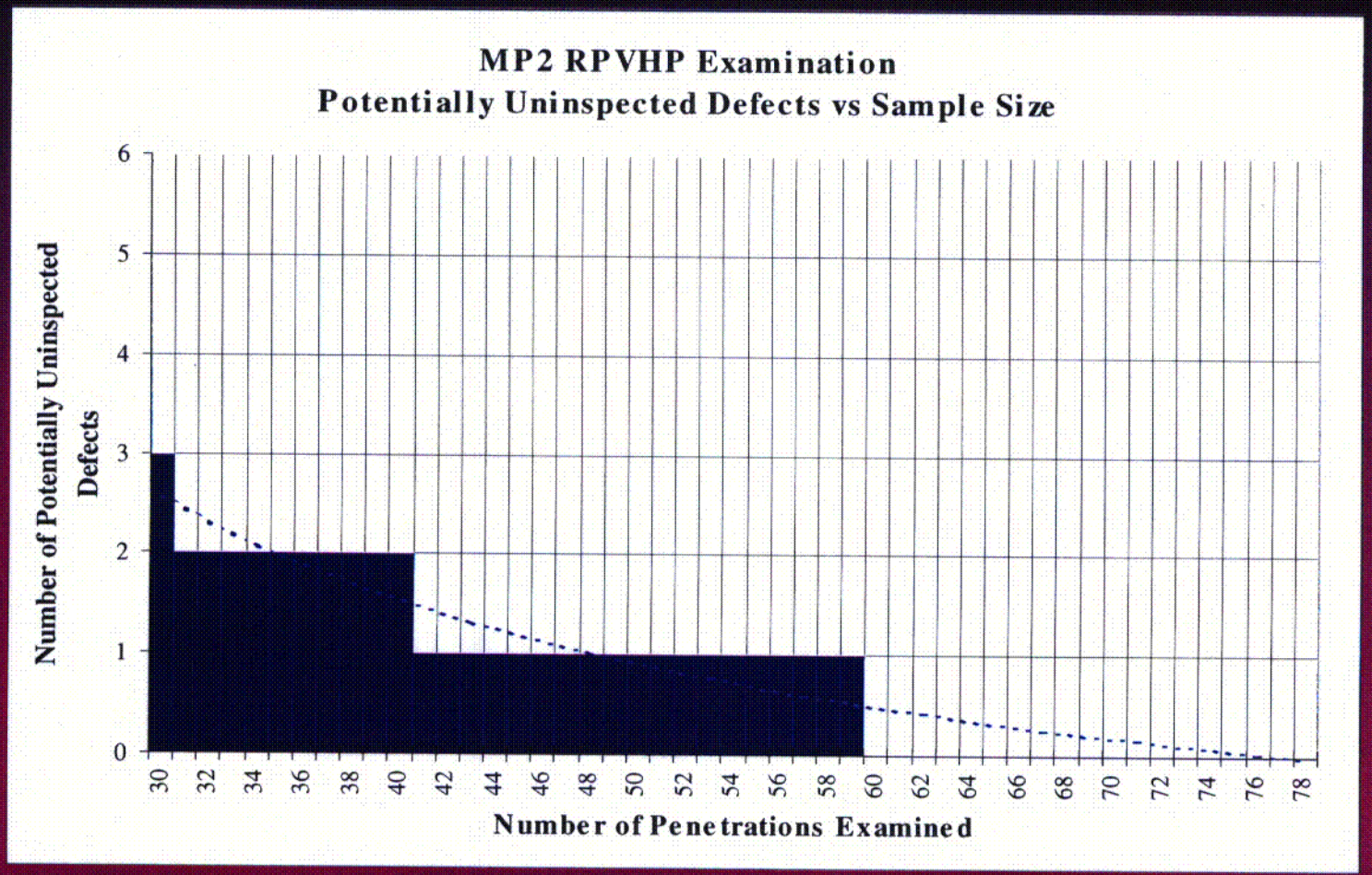
where: r is the number of RPVHPs with unacceptable flaws (in our case we require that r = 0), $Z^2_{?/2}$ is the normal variate exceeded with probability ?/2, and P is the probability of finding a RVHP nozzle with unacceptable flaws . Note that the equation above is for double-sided distribution.

Since we have a finite population with size N = 78, we replace $Z^2_{?/2}$ by

$Z^2_{?/2}$ (N-n)/(N-1) Note: for single-sided distribution replace $Z^2_{?/2}$ with $Z^2_{?}$

C22

Figure 1
Defect Probability vs. Sample Size



C23

DNC Intends to Continue its Efforts for Early Detection and Mitigation of RPVHP PWSCC

- *Develop a design package for removable insulation*
- *Develop inspection plan based on 2002 results*
- *Utilize data and lessons learned from other utilities inspections.*
- *Participate in industry work on replacements with our other Dominion plants, EPRI and Owners Groups.*

C24

Summary

- *Millstone has been aggressive in addressing the Alloy 600 cracking problem.*
- *DNC intends to inspect 100% of the Millstone 2 Reactor Vessel Head penetrations in the next refueling outage.*
- *We have demonstrated effective techniques to detect flaws in RPVHP.*
- *Contingency to stop inspecting will only be employed if we are satisfied that our Reactor Vessel Head can be returned to service safely.*

C25

Dominion Nuclear Connecticut

Millstone Unit 2 Reactor Head Inspection Plan and Contingencies

Thursday, January 24, 2002

Enclosure 3

C26