EYS

Commissioners' Technical Assistants Brief

Wednesday, November 14, 2001
1:00 P.M. - 2:00 P.M.
Room: 18th Floor Commissioners, Conference Room

Purpose:
1) To discuss updated results of the staff's review of responses to Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles."
2) To discuss the basis for proposed Order(s).

Success: Commissioners' Technical Assistants understand the results of the staff's review and basis for the proposed Order(s).

Introduction:	Larry Burkhart	5 mins.
Discussion of updated results of the staff's review:	Allen Hiser	15 mins.
Discussion of Basis for Order(s):	Larry Burkhart	15 mins.

6-5

PLANTS WITH CRACKING/LEAKAGE HISTORY (BIN 1) AND HIGH SUSCEPTIBILITY PLANTS (BIN 2)

EX 4

Plants	Last Inspection		Next Inspection				CCDP* (IPE)	Response Acceptable ?
	Date	Method	Date		Method			
Oconee 1	11/2000	Qual. Visual - 100%	03/2002	OK	Qual. Visual - 100%	OK	1E-2 3.5E-3 (Response)	YES
Oconee 2	04/2001	Qual. Visual - 100%	[redacted]	OK	Qual. Visual - 100%	OK	1E-2 3.5E-3 (Response)	YES
Oconee 3	2/2001	Qual. Visual - 100%	11/2001	OK	Qual. Visual - 100%	OK	1E-2 3.5E-3 (Response)	YES
ANO-1	03/2001	Qual. Visual - 100%	[redacted]	OK	Qual. Visual - 100%	OK	3E-3	YES
Robinson	04/2001	Qual. Visual - 100%	[redacted]	OK	Qual. Visual - 100%	OK	2E-2	YES
TMI-1	09/1999	Qual. Visual - 100%	10/2001	OK	Qual. Visual - 100%	OK	7.5E-3	YES
Surry 1	Spr 2000	GL 88-05 & GL 97-01	Ongoing	OK	Qual. Visual - 100%**	OK★	5.3E-3	YES★
Surry 2	Fall 2000	GL 88-05 & GL 97-01	Prior to 12/31/01***	OK★	Qual. Visual - 100%**	OK★	5.3E-3	YES★
North Anna 1	02/1996	ID NDE - 31%	09/01 (completed)	OK	Qual. Visual (100%) & ECT/UT**	OK★	6.6E-3	YES★
North Anna 2	Spr 2001	GL 88-05 & GL 97-01	Ongoing	OK	Qual. Visual - 100%**	OK★	6.6E-3	YES★
D.C. Cook 2	09/1994	ID NDE - 91%	1/19/2002	NO	Remote Visual & ECT/UT	NO	4.7E-3	NO
Davis-Besse	03/2000	Eff. Visual - 65%	04/2002	NO	Qual. Visual - 100%	OK	6.9E-3	NO

* Conditional core damage probability.

** Licensee stated its intention to submit information to "qualify" the visual inspection.

*** Licensee stated its intention to perform "qualified" inspection of 100% of VHP nozzles prior to 12/31/01.

★ Pending acceptability of licensee's supplemental response.

As of 11/14/01

PLANTS HAVING MODERATE SUSCEPTIBILITY TO PWSCC

Plant	Ranking (EFPY)	Next Inspection			Response Acceptable?
		Date	Method		
ANO-2	17.1	April 2002	Eff Visual, Vol, Surface (100%) in Spring 2002★	OK★	YES★
Beaver Valley 1	11.5	Sept. 2001	Eff. Visual (100%) in Sept. 2001	OK	YES
Beaver Valley 2	16.5	Feb. 2002	Eff. Visual (100%) in Feb. 2002	OK	YES
Calvert Cliffs 1	9.8	Feb. 2002	Eff. Visual (100%) or Qual. Vol., Feb. 2002	OK	YES
Calvert Cliffs 2	10.2	[redacted]	Eff. Visual (100%) or Qual. Vol. [redacted]	OK	YES
Crystal River 3	5.9	Oct. 2001	Eff. Visual (100%) in Fall 2001	OK	YES
Diablo Canyon 1	20.8	May 2002	Eff. Visual (100%) in May 2002★	OK★	YES★
Diablo Canyon 2	16.1	[redacted]	Eff. Visual (100%) in [redacted]	OK★	YES★
Farley 1	6.9	Oct. 2001	Eff. Visual (All) in Oct. 2001	OK	YES
Farley 2	8.3	[redacted]	Eff. Visual (All) or Qual Vol. [redacted]	OK	YES
Fort Calhoun	17.9	Apr./May 2002	Eff. Visual (100%) in Spring 2002	OK	YES
Kewaunee	21.9	Oct. 2001	Eff. Visual (100%) in Fall 2001	OK	YES
Prairie Island 1	26.7	[redacted]	Eff. Visual (All) in [redacted]	OK	YES
Prairie Island 2	26.8	Feb. 2002	Eff. Visual (All) in Feb. 2002	OK	YES
Salem 1	13.8	[redacted]	Eff. Visual (All) in [redacted]	OK	YES
Salem 2	17.4	Apr. 2002	Eff. Visual (All) in Apr. 2002	OK	YES
San Onofre 2	10.7	May 2002	Eff. Visual (All) or Qual Vol., May 2002	OK	YES
San Onofre 3	10.8	[redacted]	Eff. Visual (All) or Qual Vol., [redacted]	OK	YES
St. Lucie 1	10.3	[redacted]	Eff. Visual (100%) in [redacted]	OK	YES
St. Lucie 2	11.3	Nov. 2001	Eff. Visual (100%) in Nov. 2001	OK	YES
Turkey Point 3	6.3	Oct. 2001	Eff. Visual (100%) in October 2001	OK	YES
Turkey Point 4	6.4	Mar. 2002	Eff. Visual (100%) in Spring 2002	OK	YES
Waterford 3	7.8	Mar. 2002	Eff. Visual (100%) in Spring 2002	OK	YES
Ginna	15.0	Mar. 2002	Not Specified (notify 1/02)**	?	?
Millstone 2	14.3	Feb. 2002	Not Specified (notify 1/02)**	?	?
Point Beach 1	11.5	[redacted]	Eff. Visual (100%) in [redacted]	?	?
Point Beach 2	9.6	April 2002	Eff. Visual (100%) in Spring 2002*	?	?
Indian Point 2	26.6	[redacted]	GLs 88-05 & 97-01***	NO	NO
Indian Point 3	14.5	[redacted]	GLs 88-05 & 97-01***	NO	NO
Palo Verde 1	17.0	[redacted]	None (Vol. in [redacted]***	NO	NO
Palo Verde 2	17.7	May 2002	None (Vol. in [redacted]***	NO	NO
Palo Verde 3	17.3	Sept. 2001	None (Vol. in [redacted]*	NO	NO

* Documented reservations regarding achieving 100% inspection.

** Licensee stated its intention to provide more information to the staff regarding the scope and schedule of inspection.

*** Licensee stated that it would reconsider its position regarding scope of inspection and would provide feedback to the staff.

★ Pending acceptability of licensee's supplemental response.

As of 11/14/01

PLANTS THAT HAVE PERFORMED "BARE METAL" VISUAL INSPECTIONS

Plants	Most Recent Inspection				
	Date	Method & Scope	Summary of Cracked or Leaking CRDM Nozzles		
			Total Number	Circumferential Nozzle Cracks	Number Repaired
Oconee 1	11/2000	Qualified Visual - 100%	1★	0	1
Oconee 3	02/2001	Qualified Visual - 100%	9	3★★	3
	11/2001	Qualified Visual - 100%	4 (3)	TBD	TBD
ANO-1	03/2001	Qualified Visual - 100%	1	0	1
Oconee 2	04/2001	Qualified Visual - 100%	5	1	5
Robinson	04/2001	Qualified Visual - 100%	0	0	0
North Anna 1	09/2001	Qualified Visual - 100%★★★	8	0	0
Crystal River 3	10/2001	Effective Visual - 100%★★★★	1	1	1
TMI-1	10/2001	Qualified Visual - 100%	8★	0	6
Surry 1 (in progress)	10/2001	Qualified Visual - 100%★★★	10	TBD	5
North Anna 2 (in progress)	10/2001	Qualified Visual - 100%★★★	1 (3)	TBD	TBD

★ Thermocouple nozzles also cracked/leaking: Oconee 1 (5 out of 8), TMI 1 (8 out of 8)

★★ The size of 2 out of 3 circumferential flaws were identified from destructive examination.

★★★ Pending acceptability of licensee's supplemental response

★★★★ The highest ranked MODERATE susceptibility plant.

Moderate susceptibility plants that have completed effective visual examinations in Fall 2001 with no evidence of boric acid deposits: Beaver Valley 1, Farley 1, Kewaunee, and Turkey Point 3

As of 11/14/01

DAVIS BESSE

- **Previous Inspections**

10th RFO 1996 - Visual Examination of 65 out of 69 CRDMs (94%)
- 4 CRDMs (center head) not examined since licensee evaluation showed insufficient interference gap

11th RFO 1998 - Visual Examination of 50 out of 69 CRDMs (72%)
- 19 Obscured by boric acid from leaking motor tube flanges and Not Examined (includes 4 CRDMs with insufficient gap and 15 new nozzles obscured)
- Staff review of documentation (video) does not support effective examination

12th RFO 2000 - Visual Examination of 45 out of 69 CRDMs (65%)
- 24 Obscured by boric acid and Not Examined (includes 4 CRDMs with insufficient gap and 15 obscured in 1998)
- Staff review of documentation (video) does not support effective examination

- **Planned Future Inspections**

Qualified Visual Examination April 2002
- Some form of qualified NDE (UT, ECT, PT) for 4 CRDMs with insufficient gap; supplemental response with details by January 29, 2002
- RAI Response Submitted October 31, 2001 - Still Under Staff Review

D. C. COOK UNIT 2

- **Previous Inspections**

  Fall 1994 - eddy current examination (ECT) of inside diameter only of 71 of the 78 VHP nozzles

  Three axial indications in one CRDM; repaired in 1996

- **Planned Future Inspections**

  Remote visual inspection with ECT and UT at next RFO - January 19, 2002

  Planned inspection in January 2002 is more than 7 years from the prior inspection (plant did not operate for about 33 months -- September 1997 to June 2000)

SURRY UNIT 2

- **Previous Inspections**

  Fall 2000 - inspection performed with the insulation on the head (e.g., not a bare metal inspection as described in Bulletin 2001-01)

  Would not have been effective in detecting boric acid deposits from VHP nozzle leaks

  Inspection of Surry Unit 1 (on-going) has identified 10 cracked/leaking nozzles and a need to repair 5 nozzles

- **Planned Future Inspections**

  Bulletin response - Qualified visual examination at the next RFO - March 2002

  Telecon on November 2 - will shutdown for examination before December 31, 2001

  - Licensee has not submitted supplemental plant-specific information to demonstrate qualification of the visual examination method

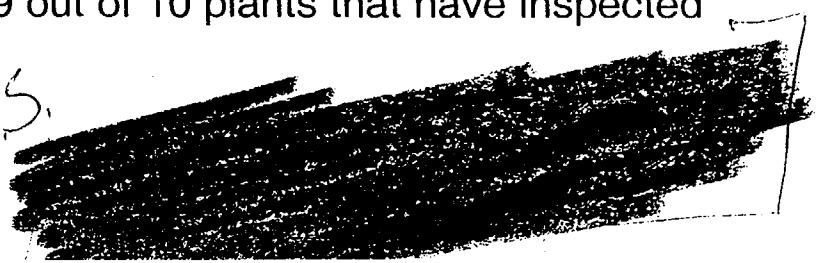
RECOMMENDED ORDERS
REGARDING RESPONSES TO BULLETIN 2001-01

- Staff recommends issuance of orders for two plants based on an insufficient inspection history and the relatively high likelihood of cracking at those plants

- A potentially hazardous condition exists (i.e., it is reasonable to assume that the reactor coolant pressure boundary is compromised at these facilities)

- Licensees have not provided sufficient basis to continue to operate without performing the recommended inspections by December 31, 2001

- December 31, 2001, is a reasonable date for requiring inspections:
  - Results of inspections have not revealed conditions of incipient failure, but findings are precursors that could lead to failure if undetected and uncorrected,
  - There are large uncertainties surrounding this crack initiation and growth phenomenon, and
  - The extent of VHP cracking already observed at 9 out of 10 plants that have inspected



DAVIS-BESSE

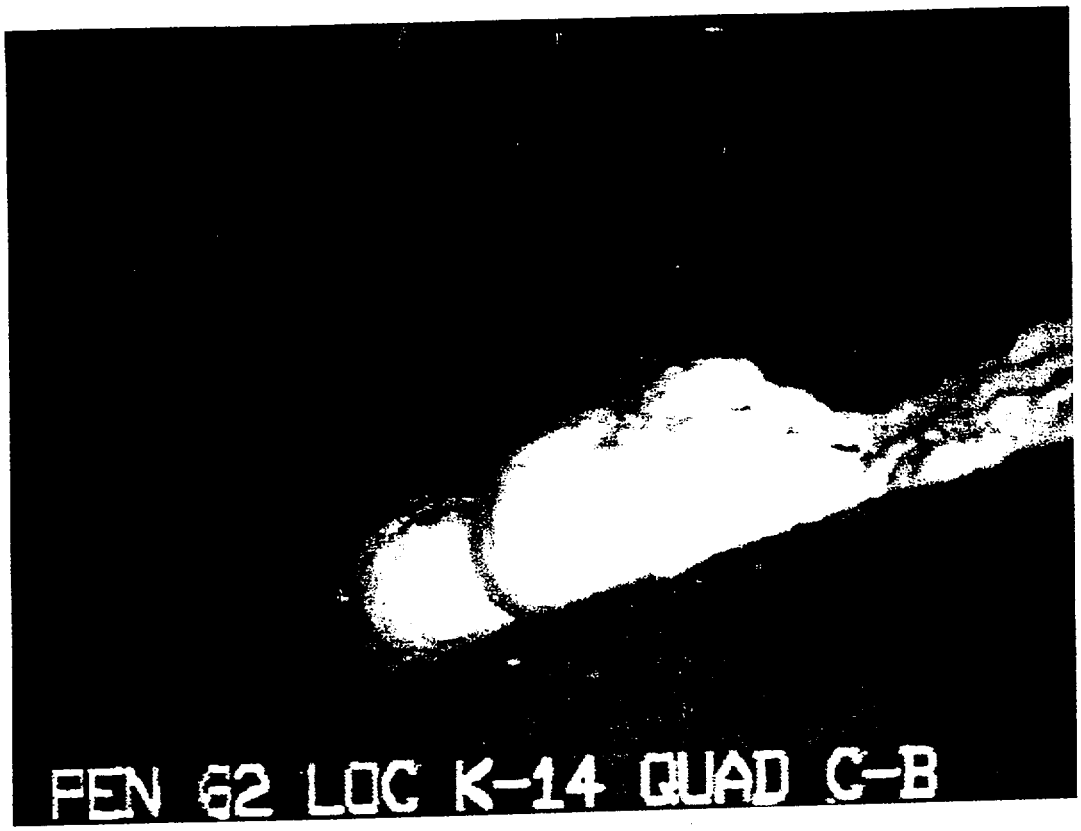
- Proposed to shutdown in late March 2002 (at next RFO) to perform inspections:
  - High-susceptibility plant
  - The licensee has never performed a qualified visual inspection of all of the VHP nozzles (prior two inspections were not effective to detect the very small boric acid deposits)
  - 9 of 10 similarly-ranked plants have found VHP nozzle cracking
  - All six of the other B&W plant have found VHP nozzle cracking (Davis-Besse is the only B&W plant that has not inspected)
  - 3 of 6 B&W plants have found circumferential cracking
  - Risk implications:
    - Loss of defense in depth
    - Loss of safety margins
    - Monitored using performance measurement strategies
    - Probable violation of quantitative guidelines (if failure frequency > 0.04 per year)
    - Failure to comply with Regulations and Technical Specifications

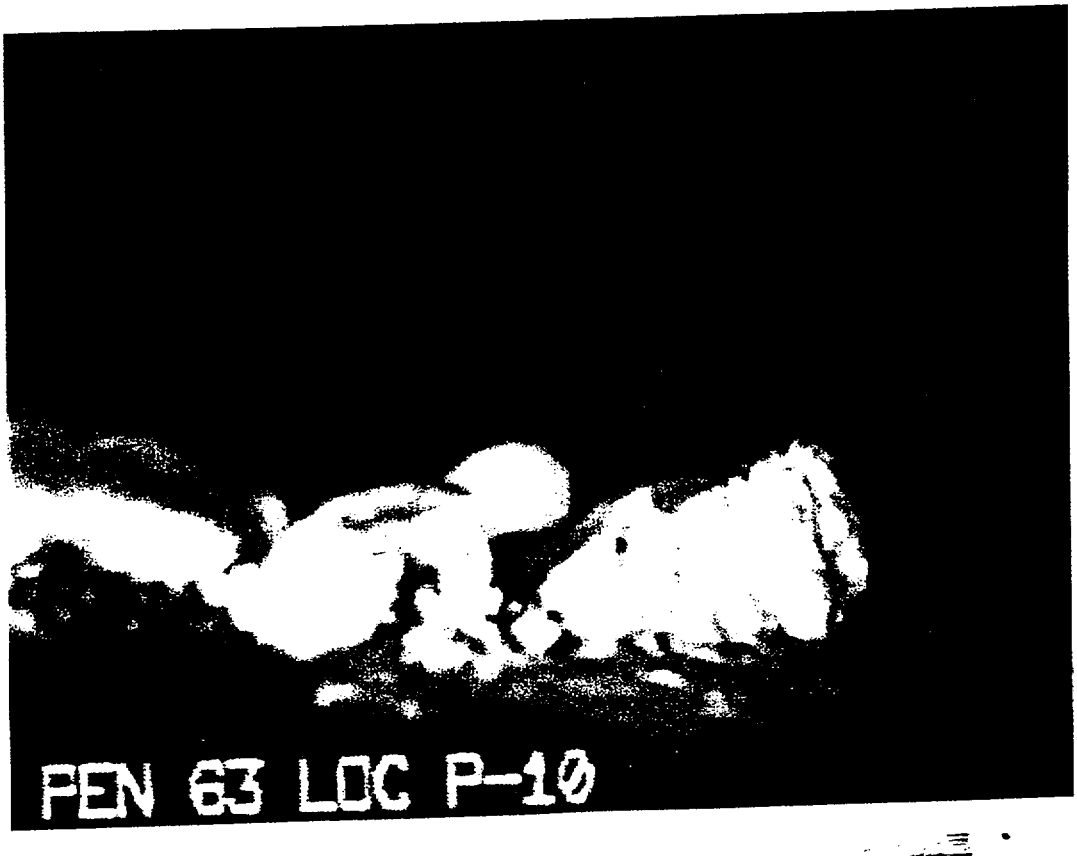
- Order would be immediately effective:
  - Require plant shutdown by December 31, 2001
  - Require demonstration, by inspection, of reasonable assurance that all of the VHPs are free of significant defects (cracks) that exceed the requirements of the ASME Code
  - Prohibit power operation until the licensee demonstrates acceptability of the results of the inspection to the staff

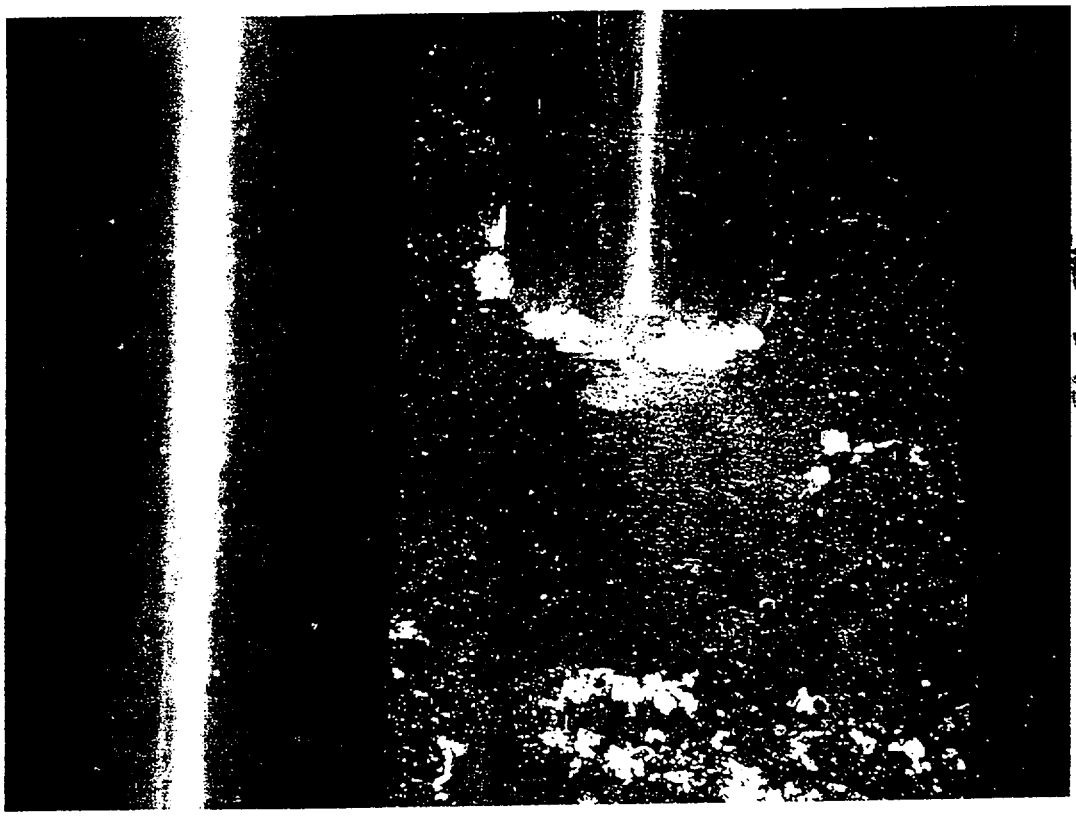
D. C. COOK

- Originally proposed to conduct inspection in 2001. Due to a forced outage earlier in the year, the licensee delayed the refueling outage and inspections until January 2002.
  - Experienced VHP cracking (axial) in 1994
  - It is reasonable to assume the plant continues to experience cracking
  - The licensee did not commit to appropriate examination, a "qualified" visual inspection
  - Risk implications:
    - Loss of defense in depth
    - Loss of safety margins
    - Monitored using performance measurement strategies
    - Probable violation of quantitative guidelines (if failure frequency > 0.03 per year)
    - Failure to comply with Regulations and Technical Specifications

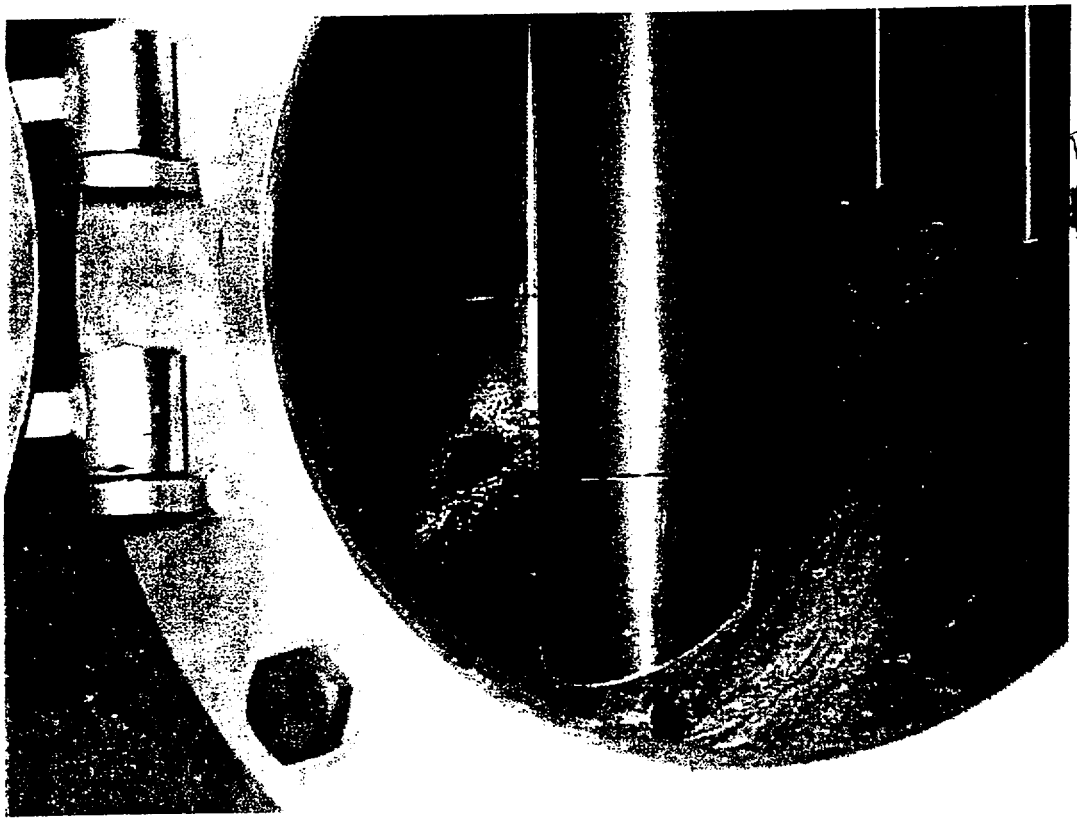
- Order will be immediately effective:
  - Require plant shutdown by December 31, 2001
  - Require demonstration, by inspection, of reasonable assurance that all of the VHPs are free of significant defects (cracks) that exceed the requirements of the ASME Code
  - Prohibit power operation until the licensee demonstrates acceptability of the results of the inspection to the staff


PEN 62 LOC K-14 QUAD C-B

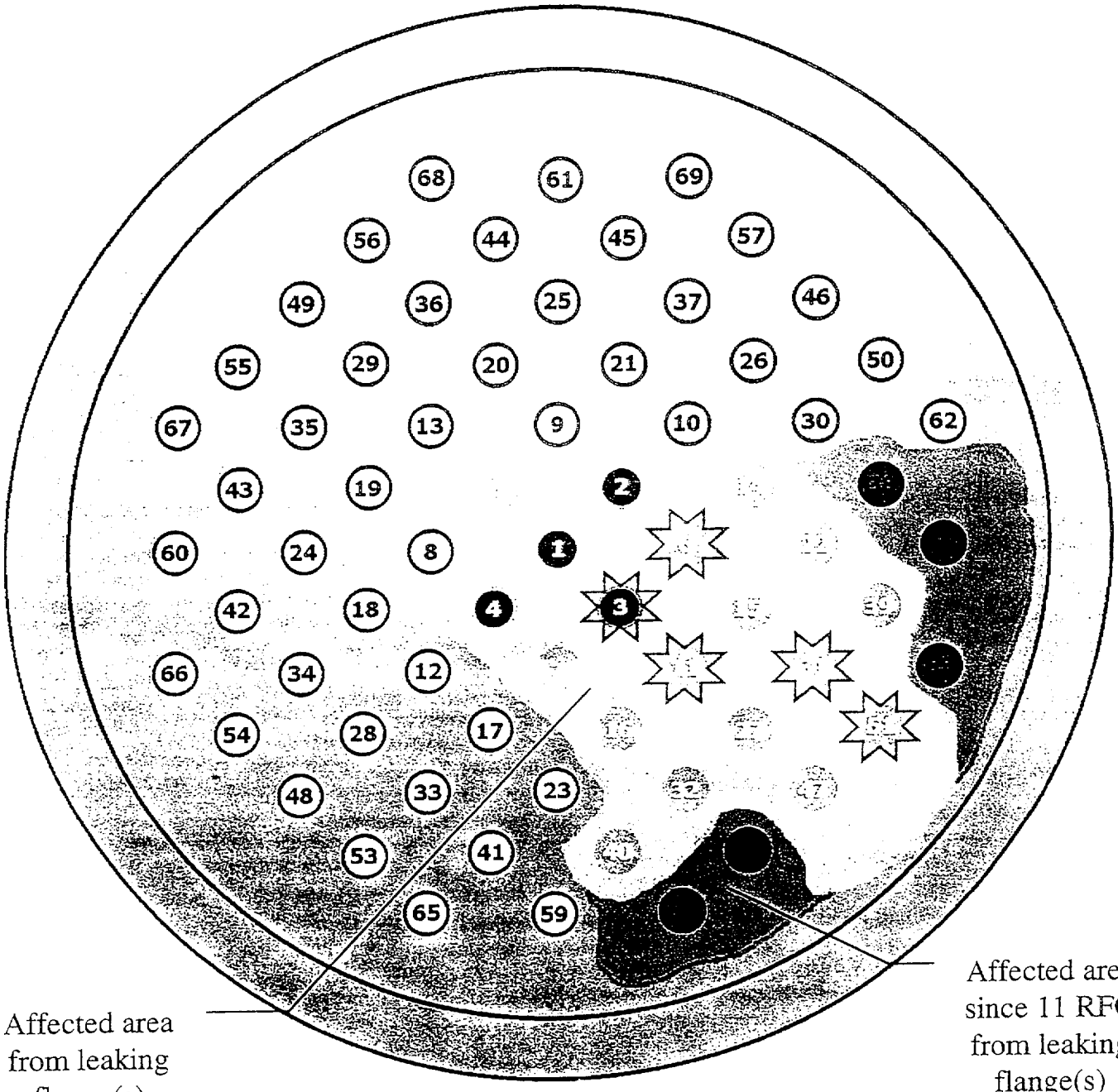

PEN 63 LOC P-10



EXS



RPV Head 11 & 12 RFO Inspection Results



Affected area from leaking flange(s)

Affected area since 11 RFO from leaking flange(s)

61 - No leakage identified

4 - Evaluated not to have sufficient gap to exhibit leakage

3 - Insufficient gap with leaking flange

5 - Nozzle obscured by boron

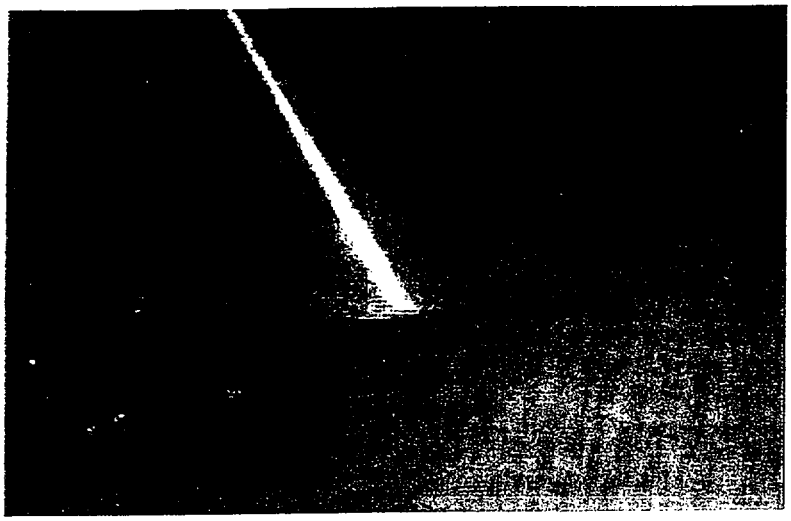
5 - Nozzle obscured by boron with leaking flange

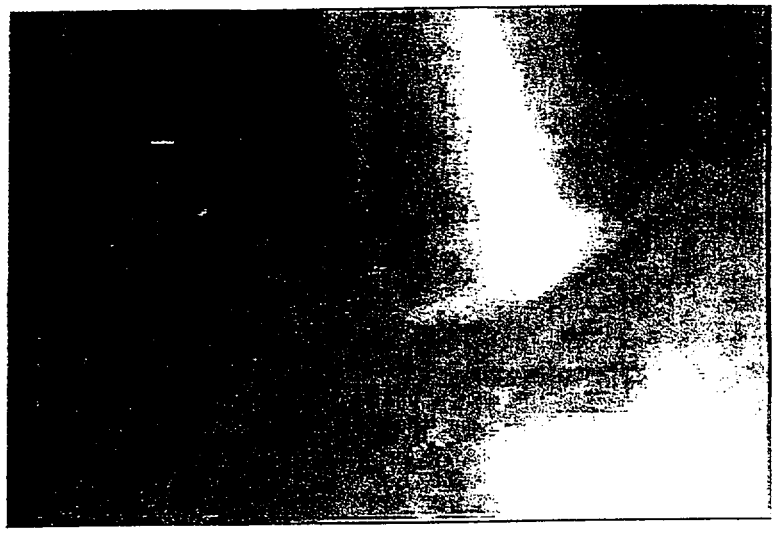
- Newly affected, since 11 RFO, by leaking flange(s)

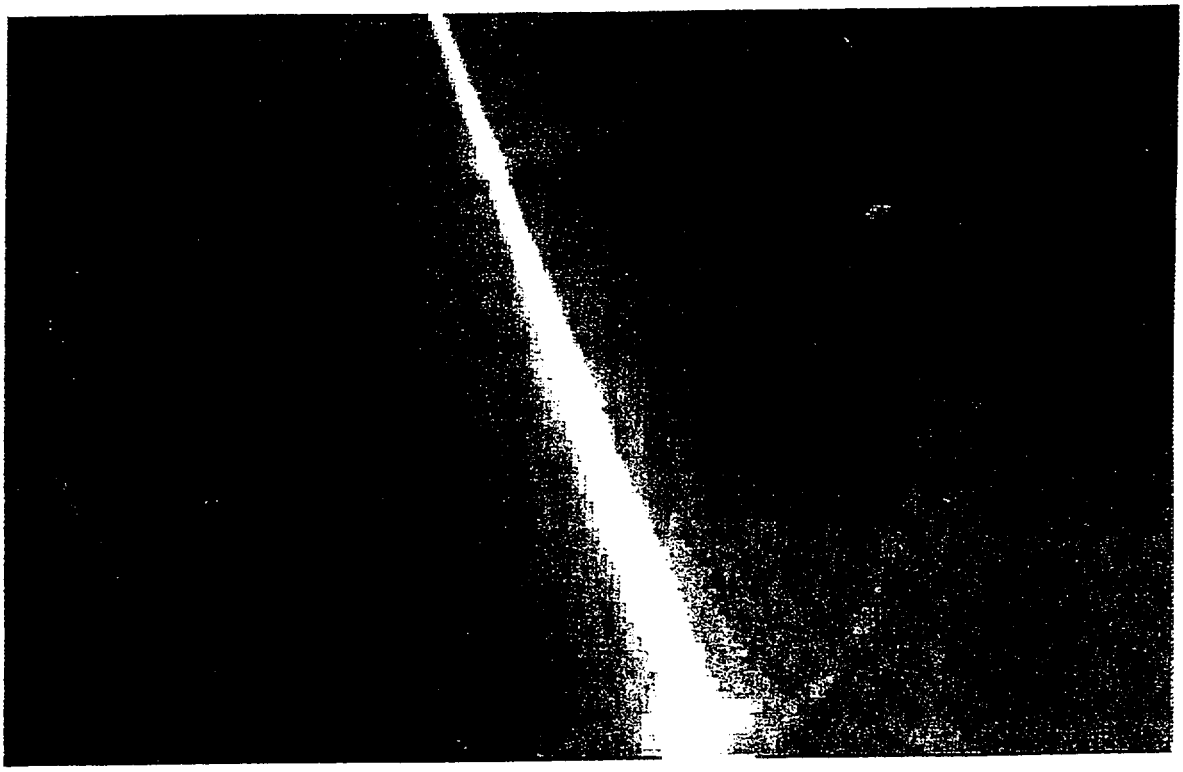
Spring 1996 Inspection

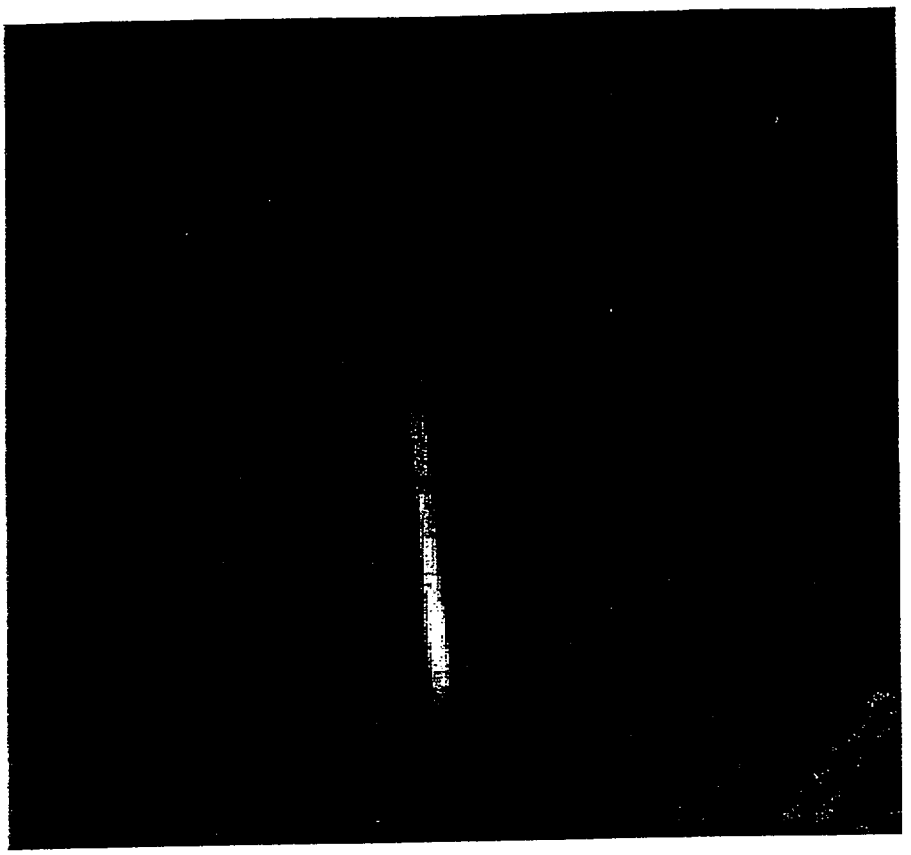
1996 Inspections

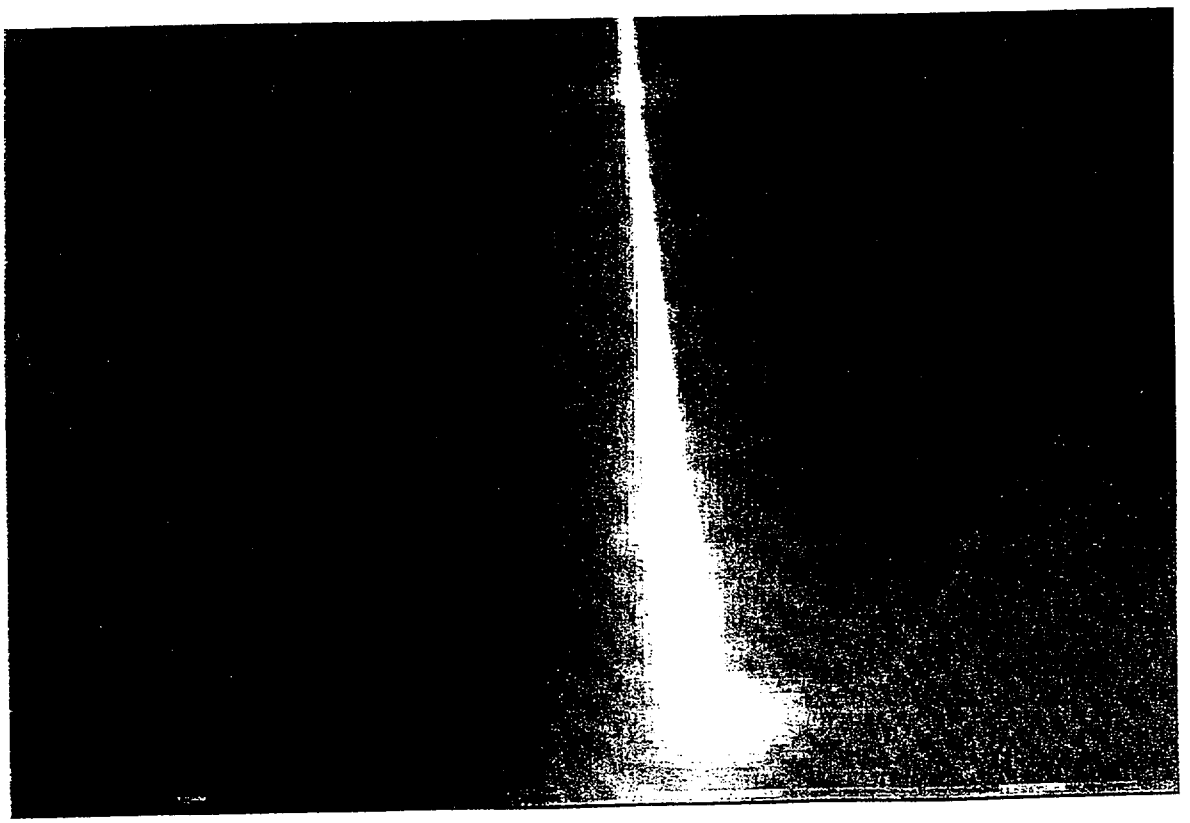
The following pictures are representative of the head in the Spring 1996 Outage. The head was relatively clean and afforded a generally good inspection.



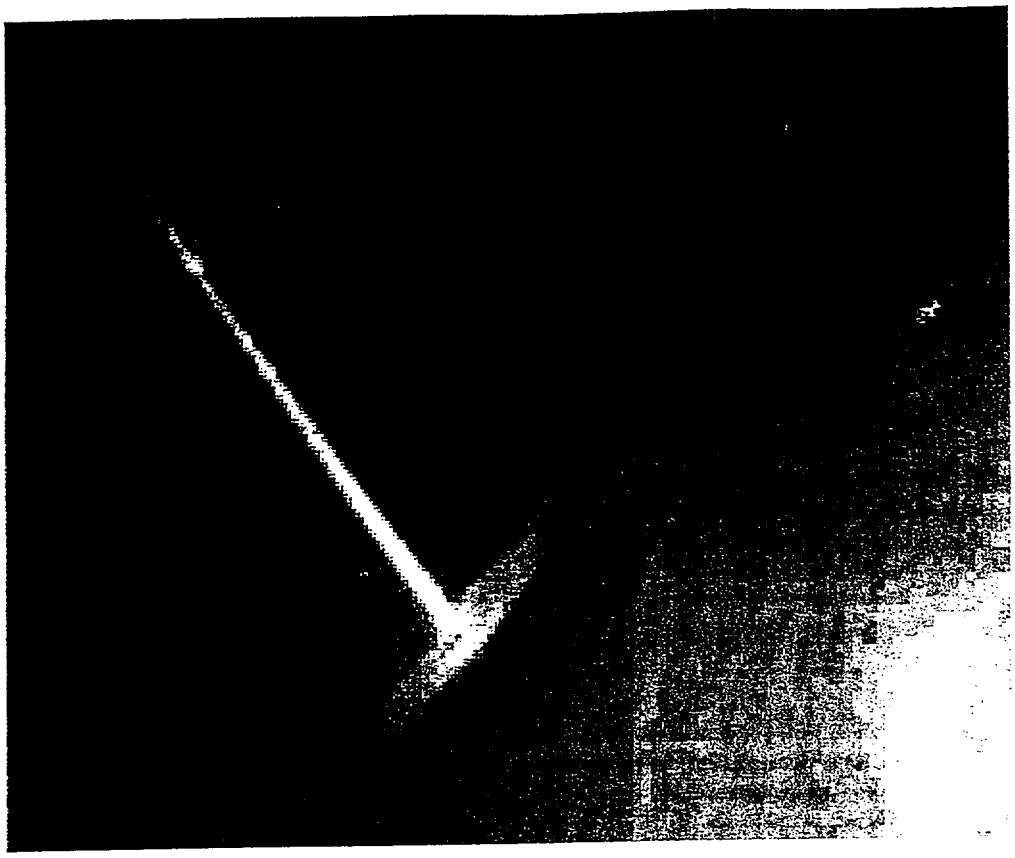




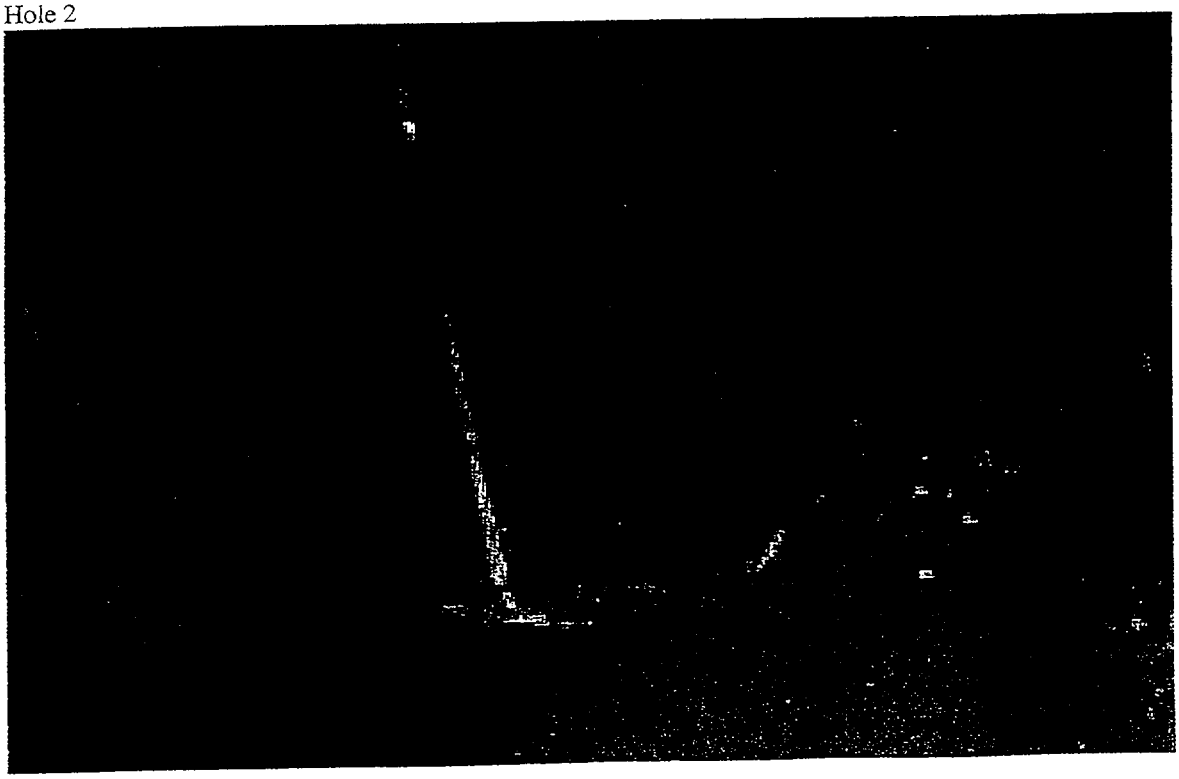




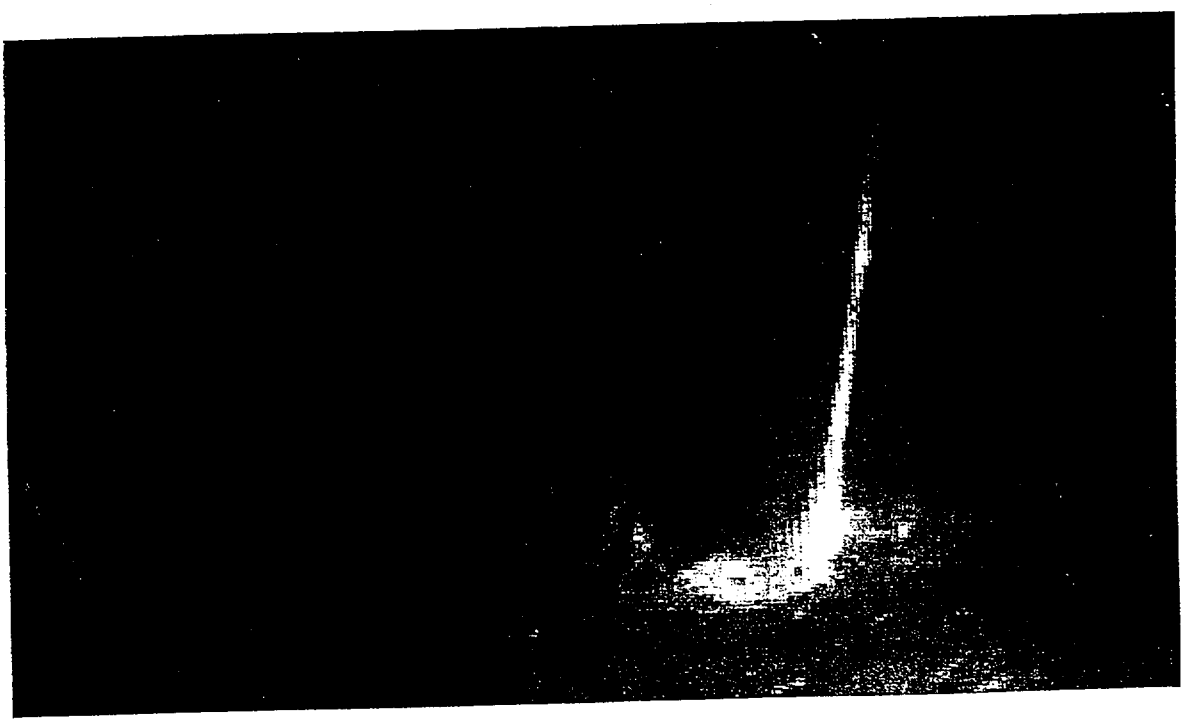
Some boron piles were observed at the top of the head in the vicinity of previous leaking flanges. Because of its location on the head, it could not be removed by mechanical cleaning but was verified to not be active or wet and therefore did not pose a threat to the head from a corrosion standpoint. Additionally, since these drives are not credited with leaking, that further ratifies that the boron is from previous flange leakage. The boron was heaviest beneath the mirror insulation seams.

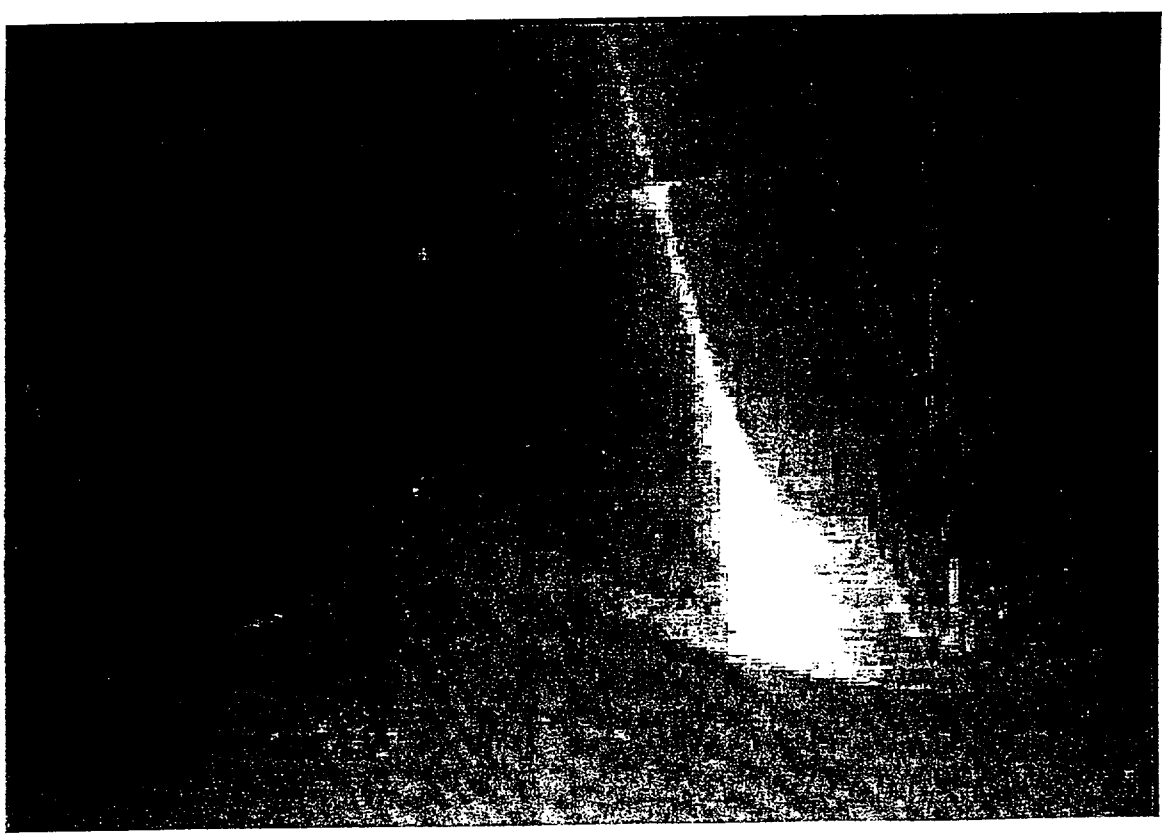


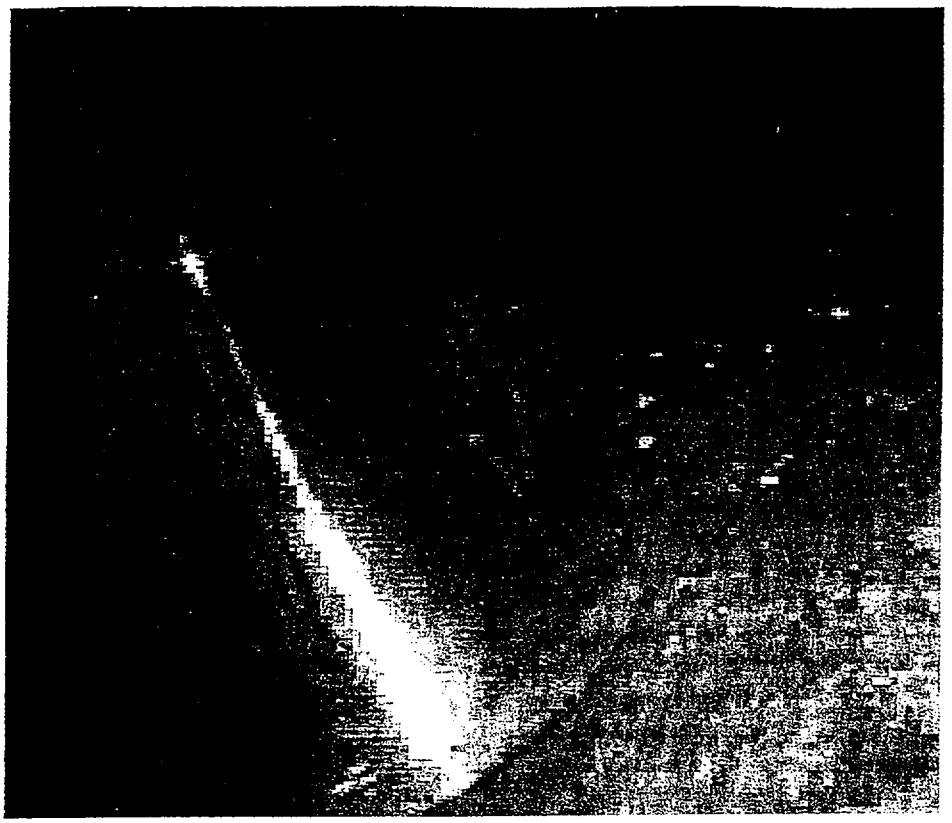
Hole 2

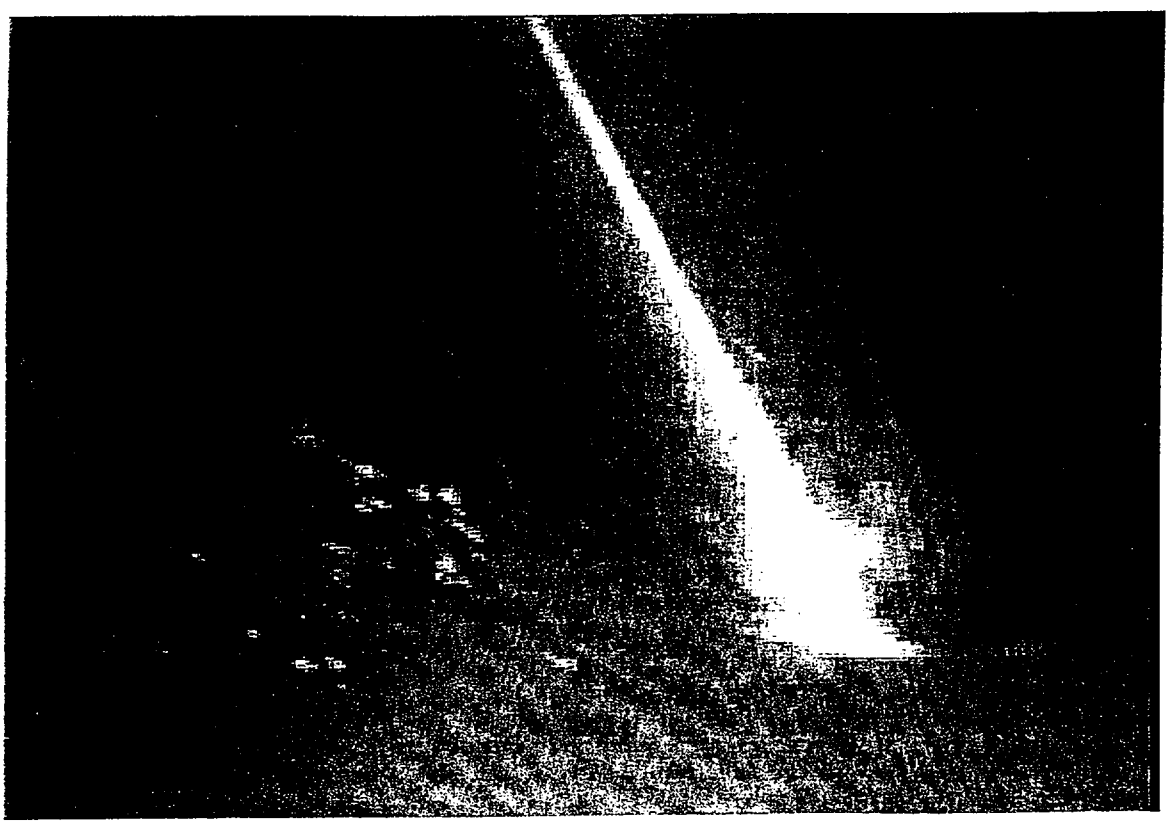


1996 Inspections





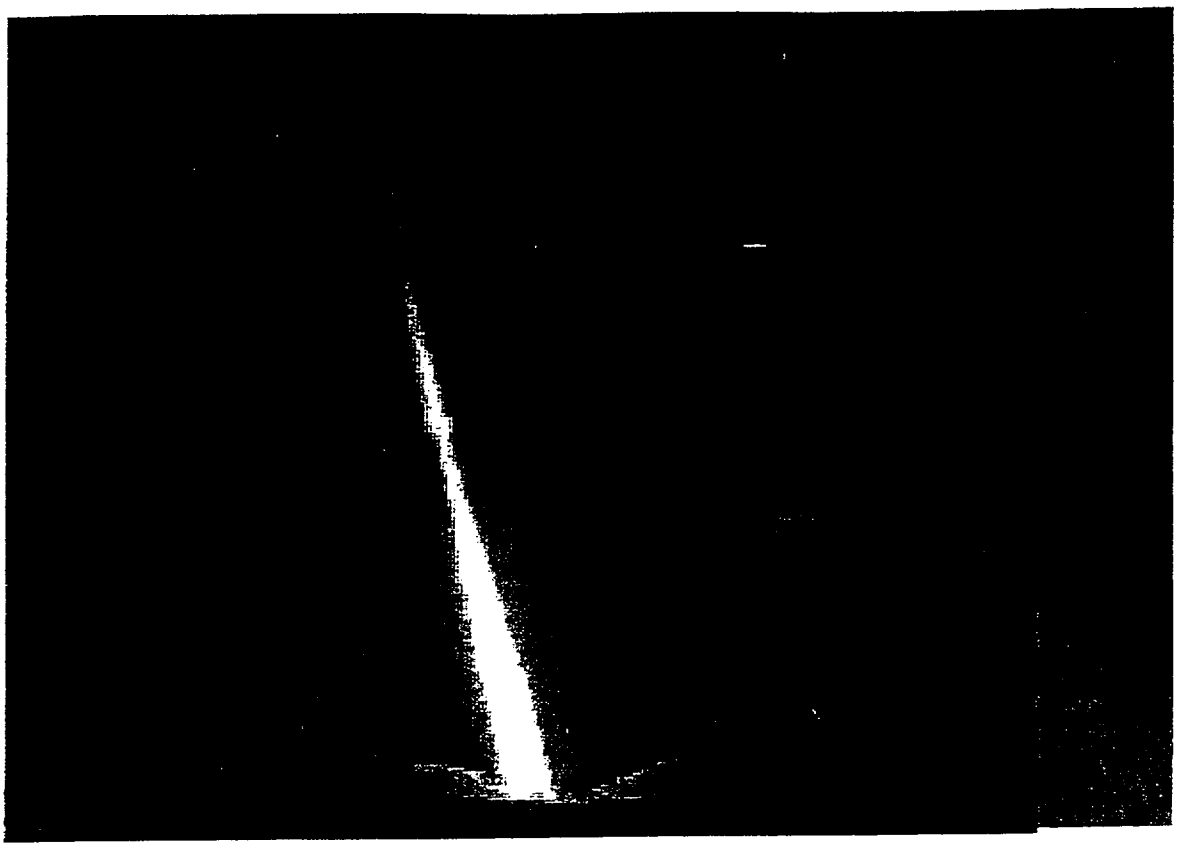


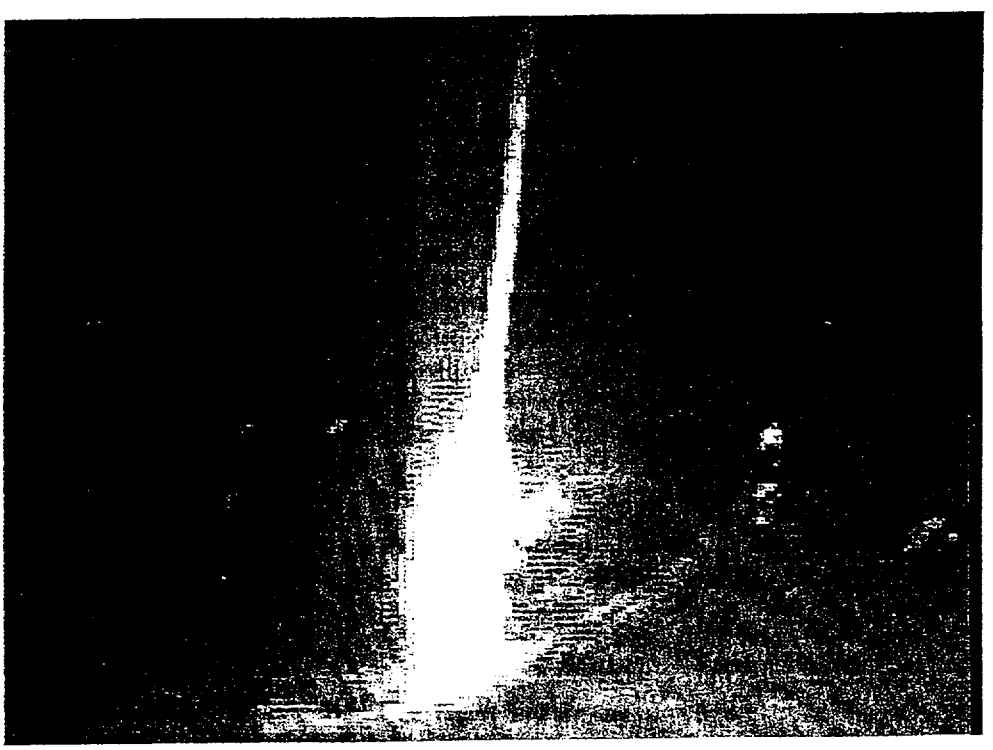


Hole 44-45

1996 Inspections

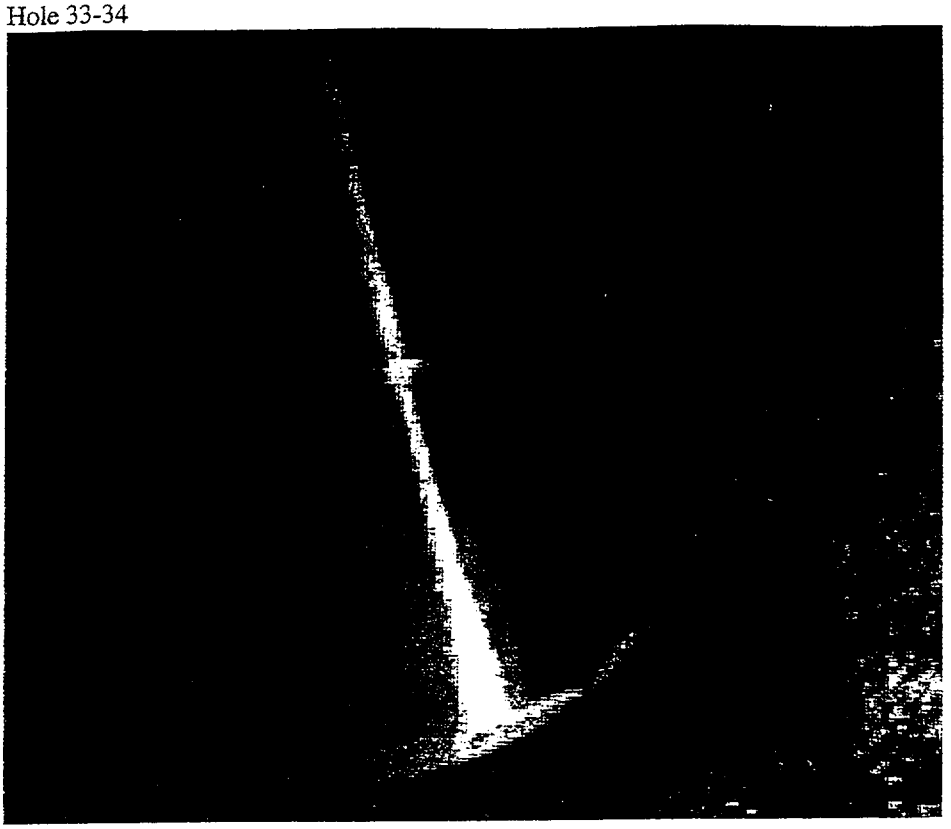
Hole 37-38

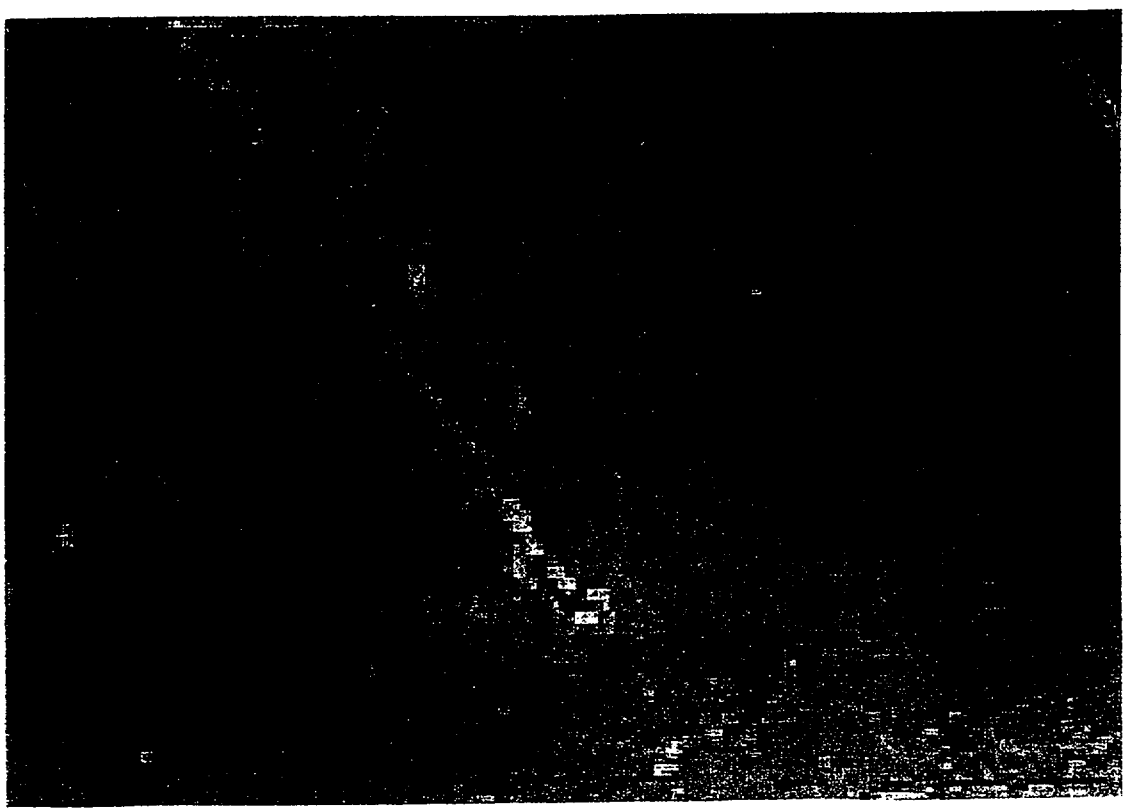


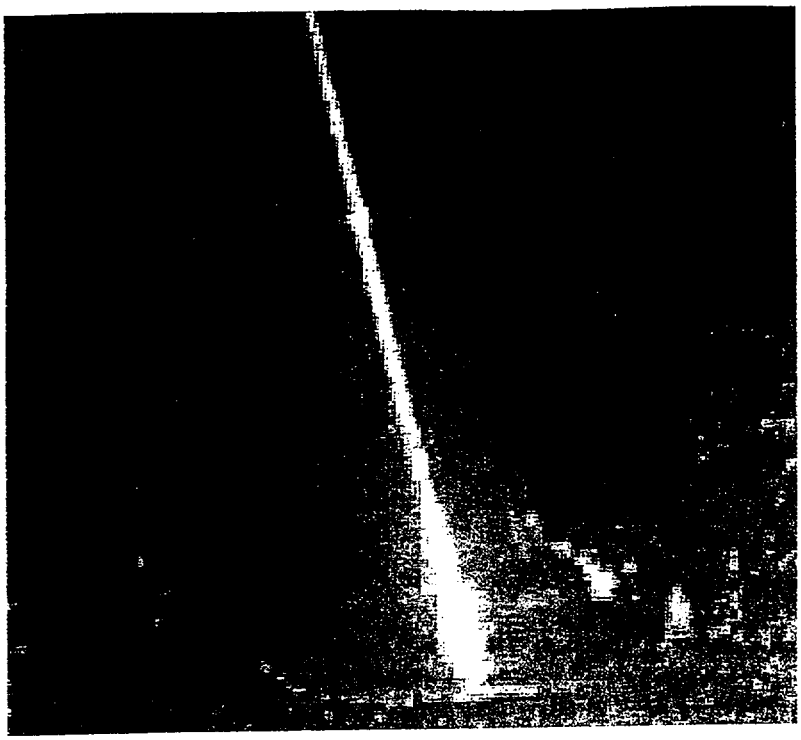


1996 Inspections

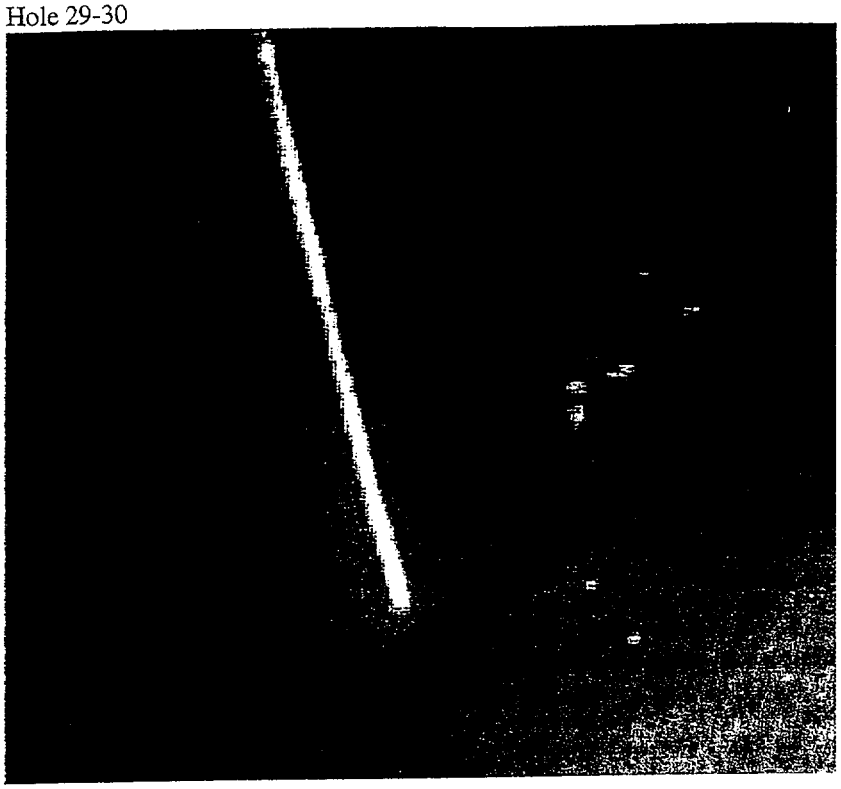
Hole 33-34



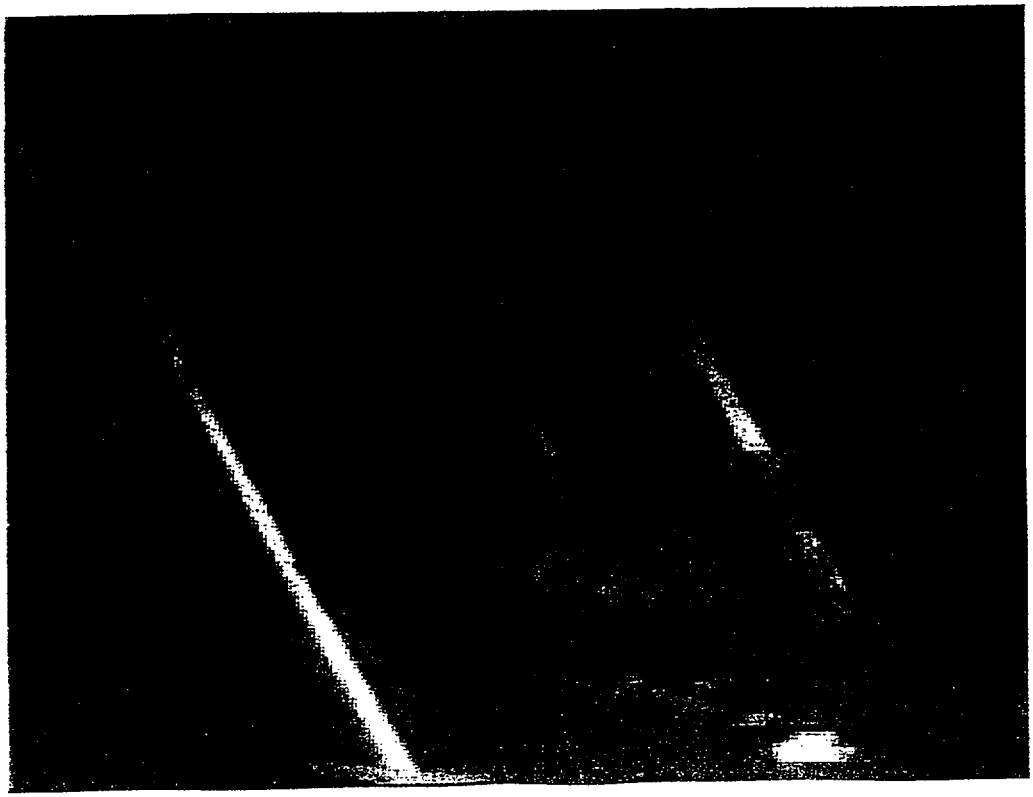




Hole 29-30

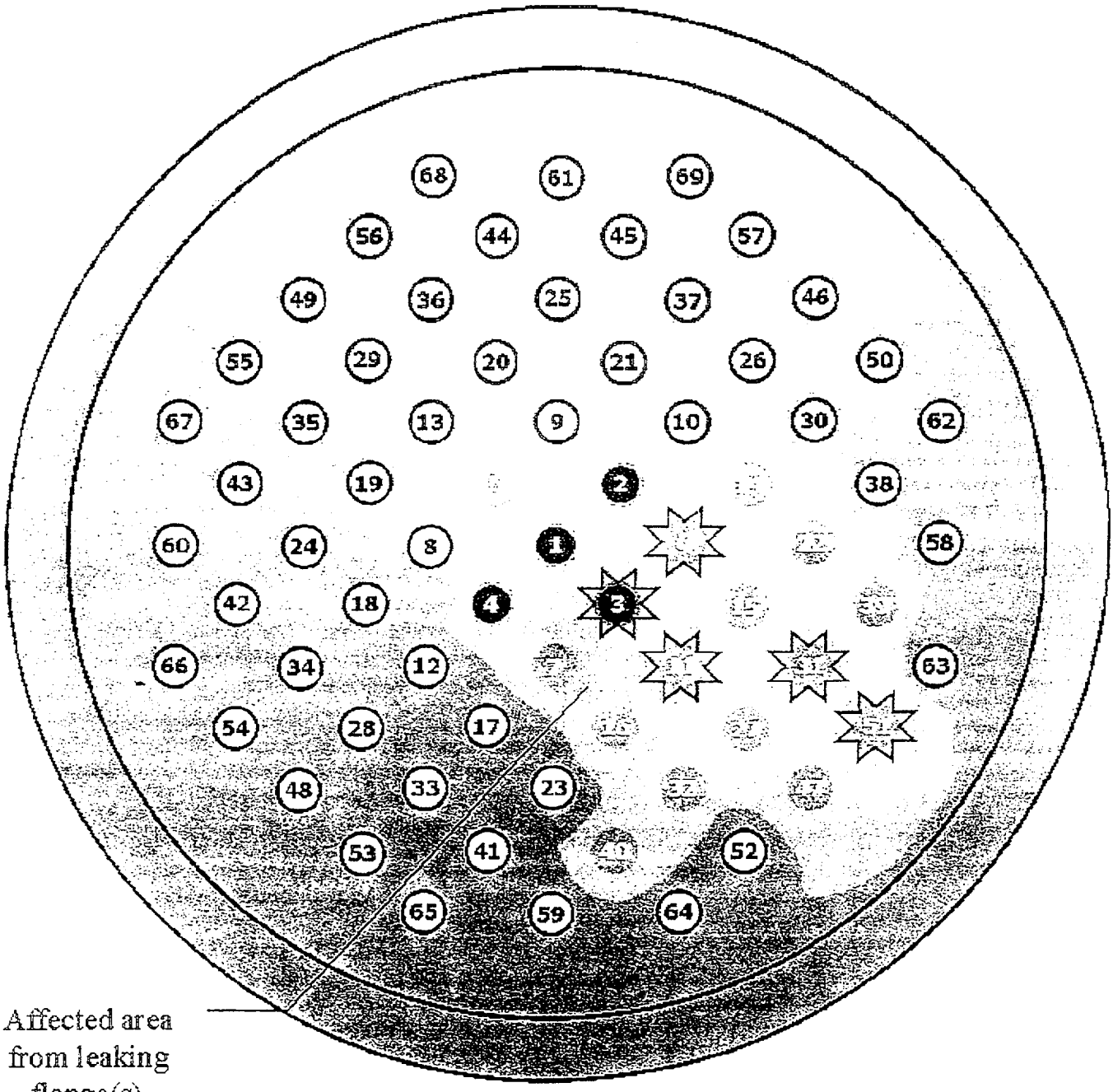


The boron deposits uphill of the CRDM drive below and to the right was reviewed from several angles and definite trails of born could be seen streaming from above the mirror insulation. This coupled with no boron on the bottom (downhill) edge of the CRDM penetration and the fact that boron will grow but not flow uphill allowed us to call this penetration as a non-leaker.



Spring 1998
Inspection

RPV Head 11 RFO Inspection Results



61 - No leakage identified

- Evaluated not to have sufficient gap to exhibit leakage

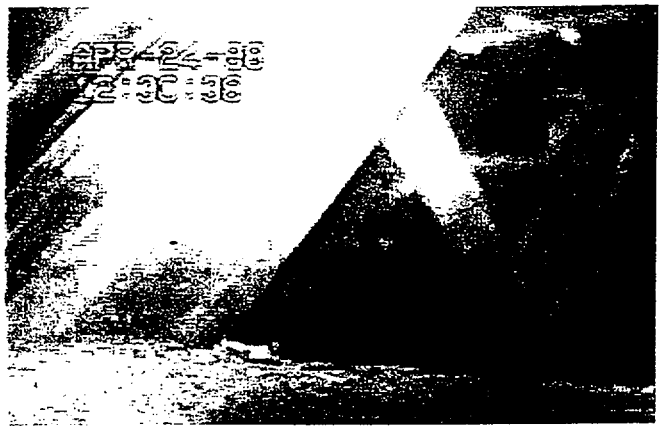
- Insufficient gap with leaking flange

- Nozzle obscured by boron

- Nozzle obscured by boron with leaking flange

No.53

NO. 65



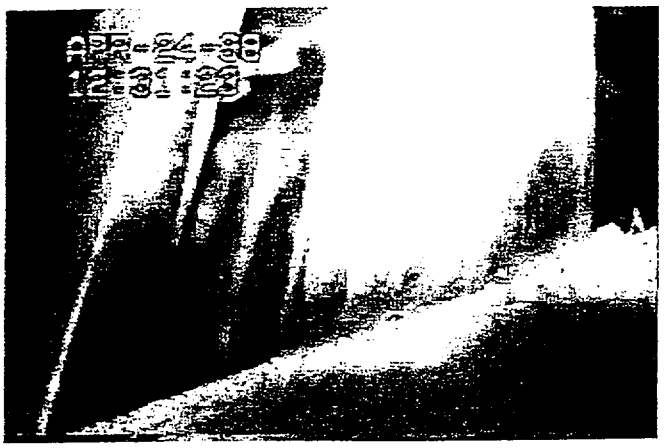
The following pictures are from access hole #9. They were clipped from video taken in the Spring of 1998. Although much more boron dusting was present in 1998 than in 1996, a good video inspection was able to be performed for those 50 drives that were not obscured by boron from leaking CRDM flanges. Although much more video can be viewed, these attached pictures are representative of the condition of the drives and the heads. We attempted to capture in still photographs all of the outer most drives since they are the most susceptible to circumferential cracking based upon finite element analysis which showed them to have the highest stresses on the uphill and downhill slopes of the penetration.

What can also be seen in many of the photos is the staining of the underside of the mirror insulation by boron trails. This corresponds to the boron found on top of the mirror insulation in the vicinity of the leaking CRDM flanges.

N0. 41

No. 33

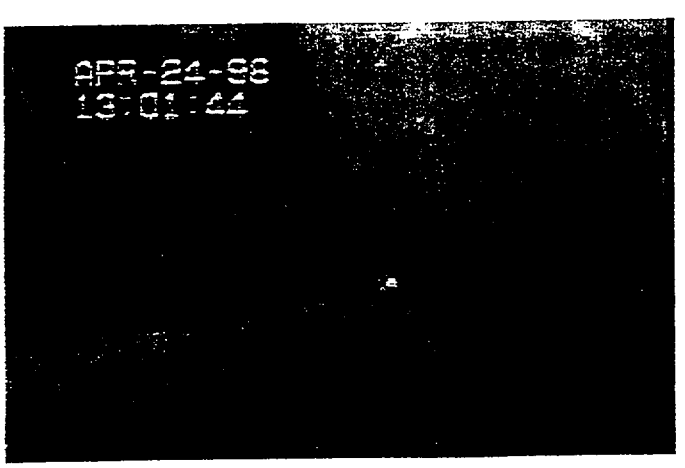
No.48



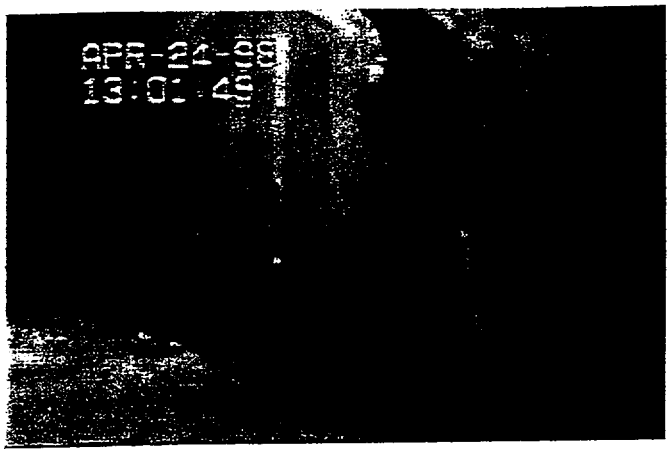
No. 65

The two pictures to the left are examples of some drives where we had to view them from several angles to ascertain that the boron adjacent to the drives was actually boron that flowed or tumbled down from higher up on the head and came to rest against the uphill side of the CRDM nozzle. Sometimes this was ascertained by comparing the pictures at the left to video of the vacuuming that was performed later which showed the boron to very loose and not a crystalline mass. Additionally, there were no boron deposits on the downhill penetration seam, which is contrary, to what industry experience has shown us to be true at plants that have identified leakers. Because of the tight tolerances of the penetrations, any leakage through the penetration will encircle the drive with the largest accumulation being on the downhill edge because of gravity flow to that location.

No. 69

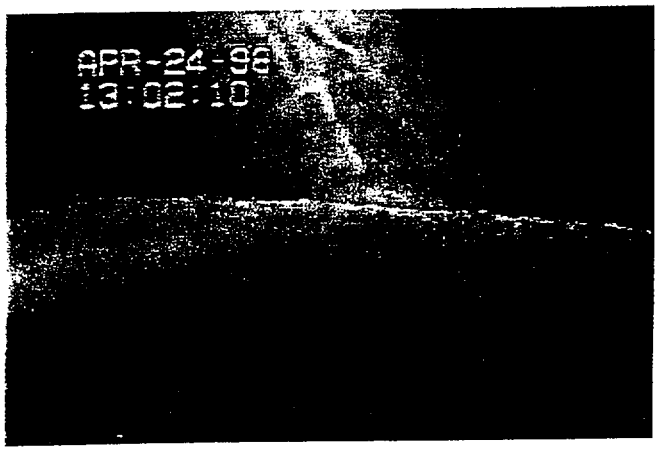


No. 62

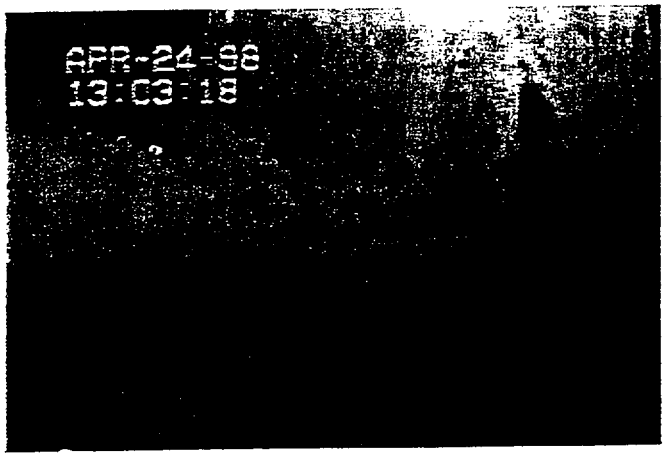


No. 38

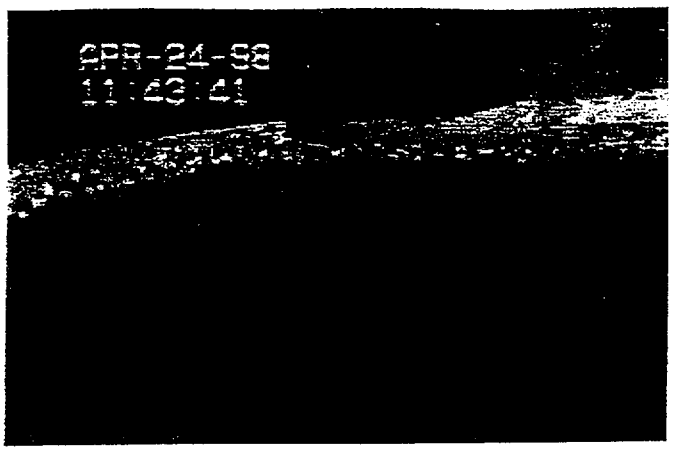
Note the loose boron clumps to the left which were not in the immediate vicinity of the nozzle penetrations. These clumps appeared to have accumulated further up on the head and then rolled or tumbled to their resting spots as shown. Note also the boron traces around the mirror insulation penetrations.



No. 50

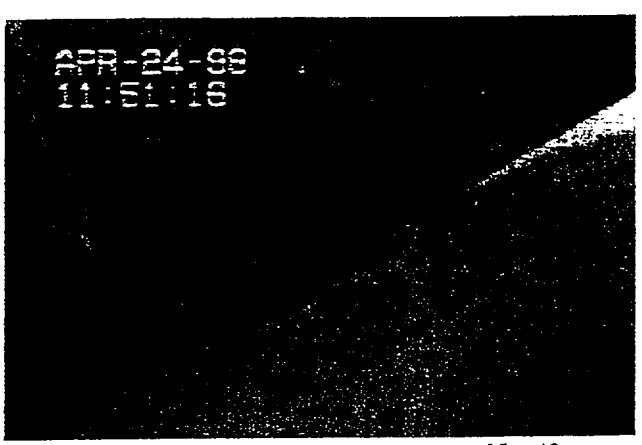


No. 58

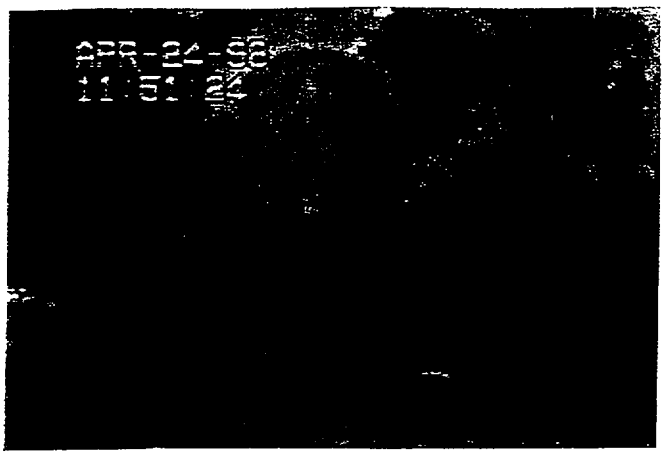


No. 63

No.35

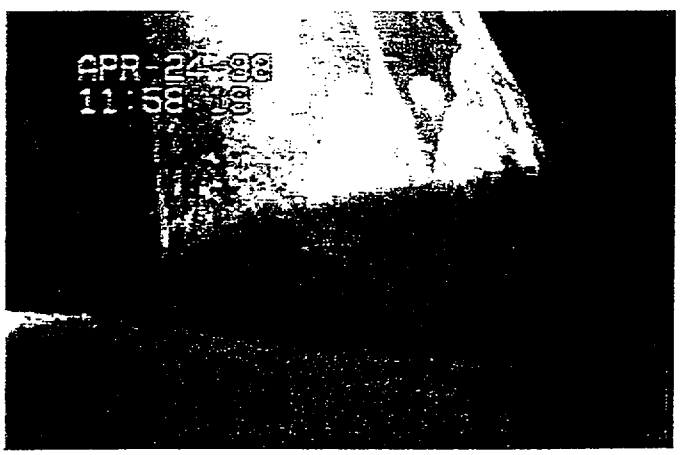


No. 42

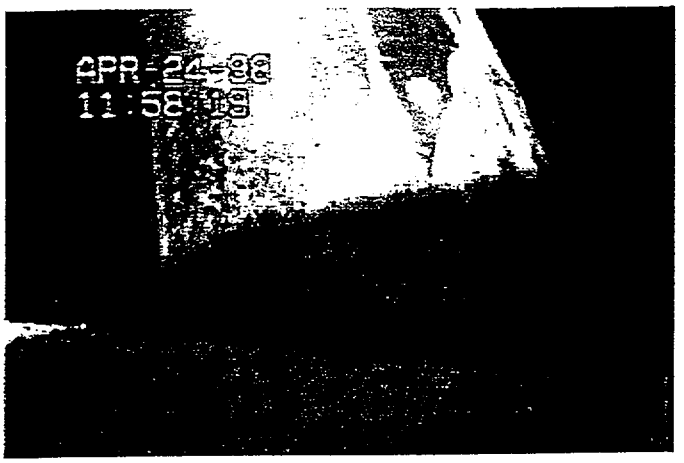


No. 13

No. 43



No. 60

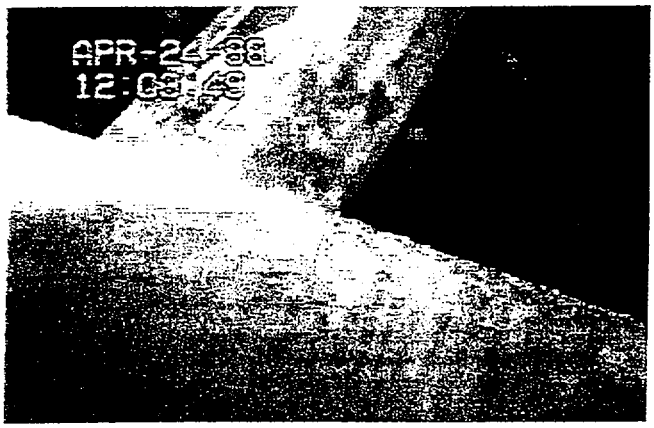


No. 24

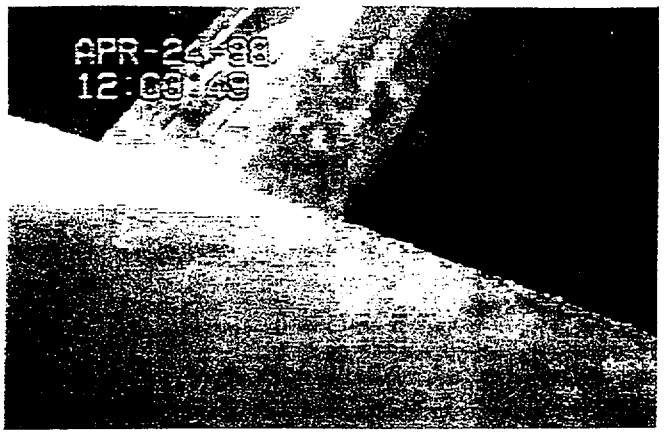
No.43

No. 67

No. 48, 54, 66



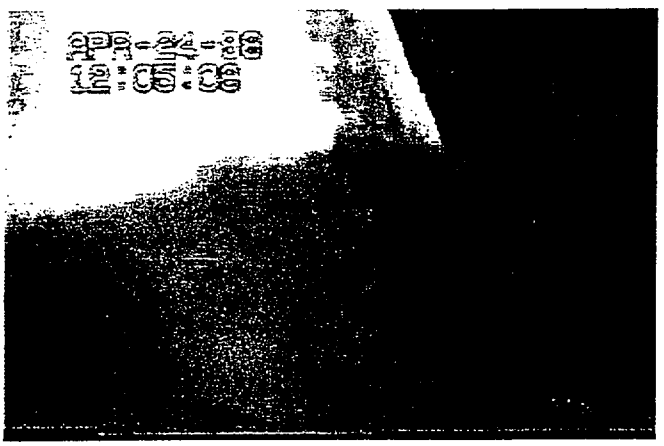
No. 67



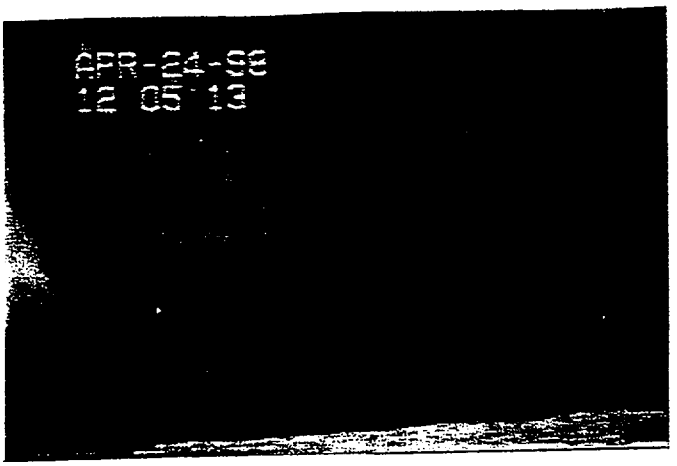
CRDM Penetrations as viewed from inspection opening #7

No. 56

No. 29



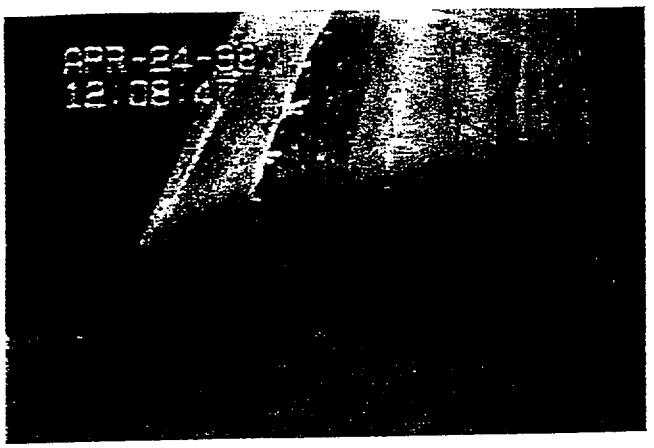
No49 side



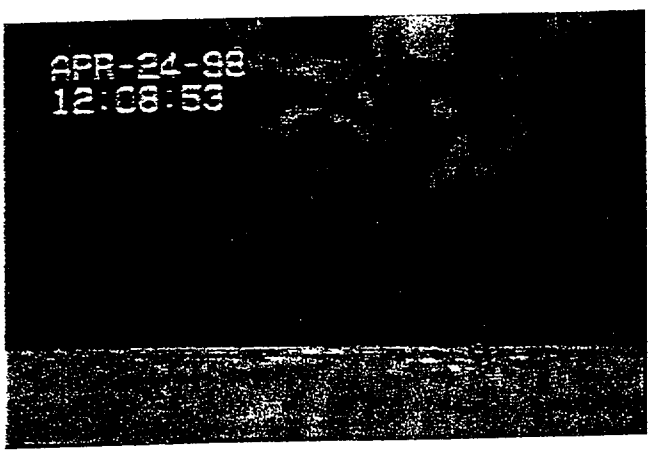
No. 55

No. 49 front

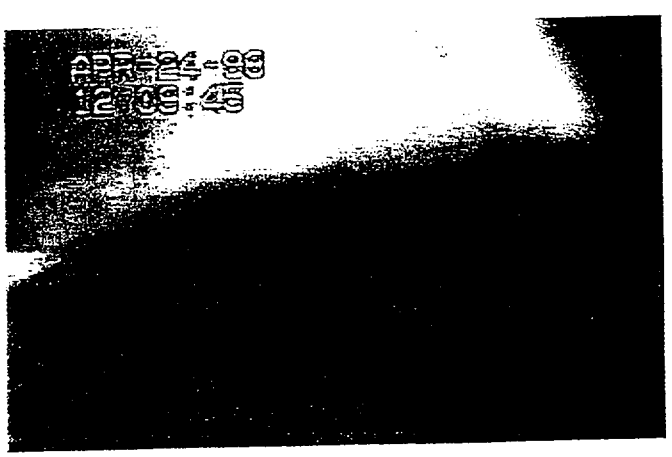
No.36



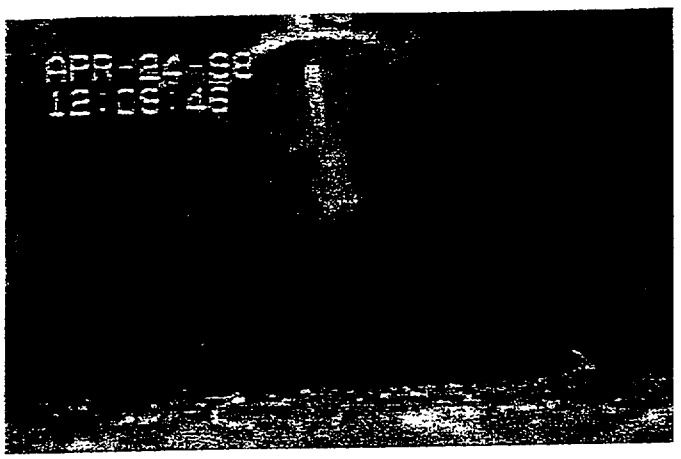
No. 68



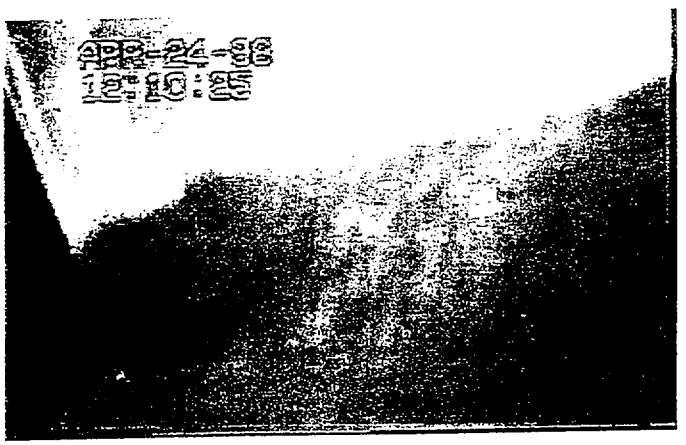
No. 44



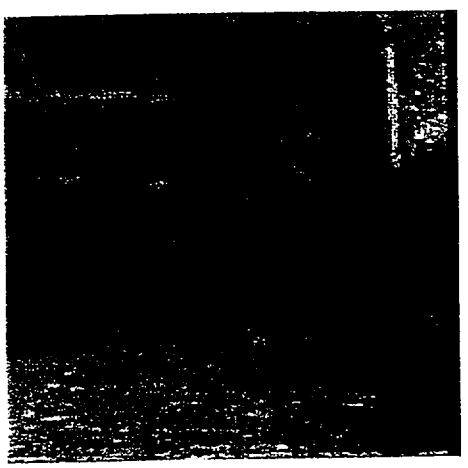
No. 61



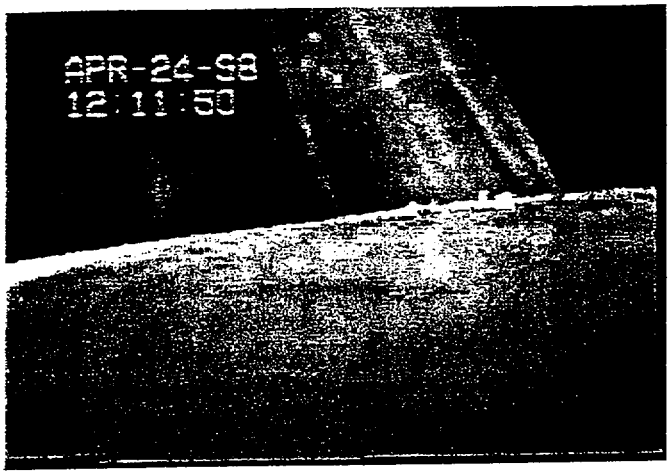
No. 25



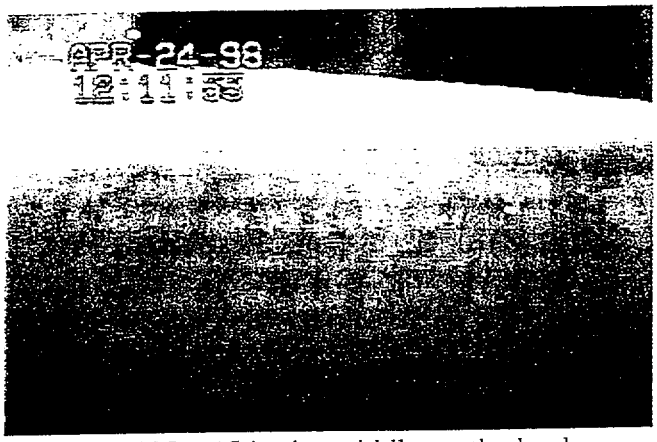
No. 61



No. 25

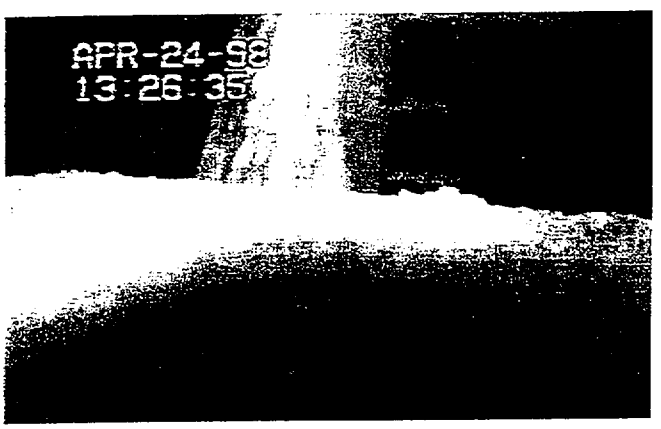


No. 68



No. 69 and No. 45 in the middle on the back

No. 57

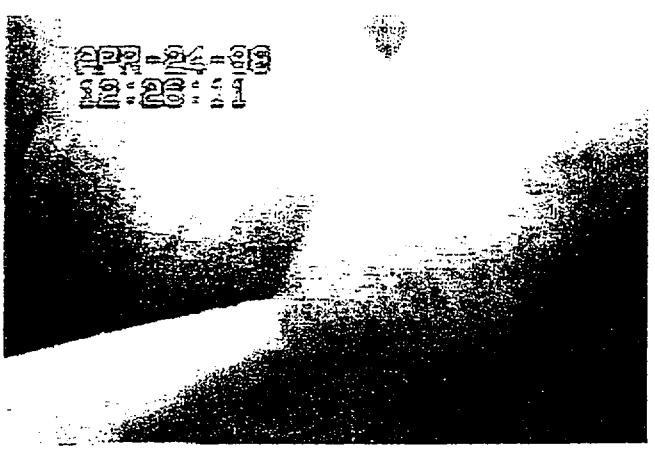


No. 46

No. 57

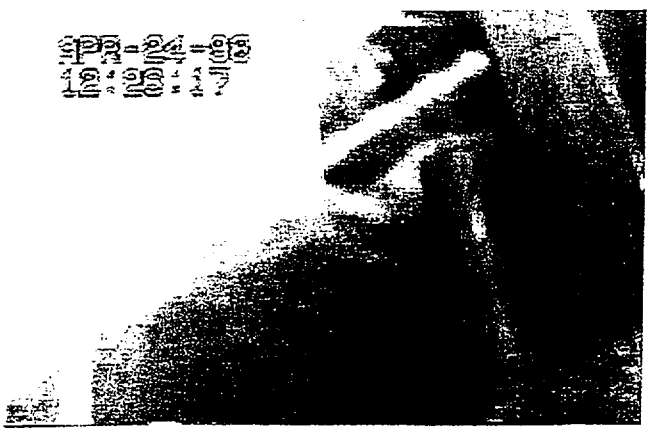
No. 37

No. 26

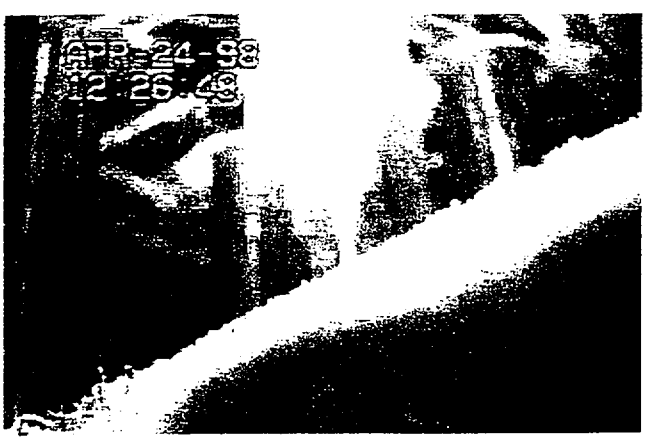


No. 48

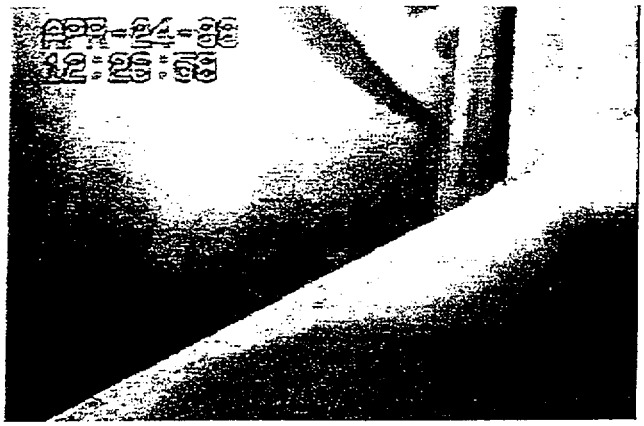
No. 34



Same as above No. 34 on the right



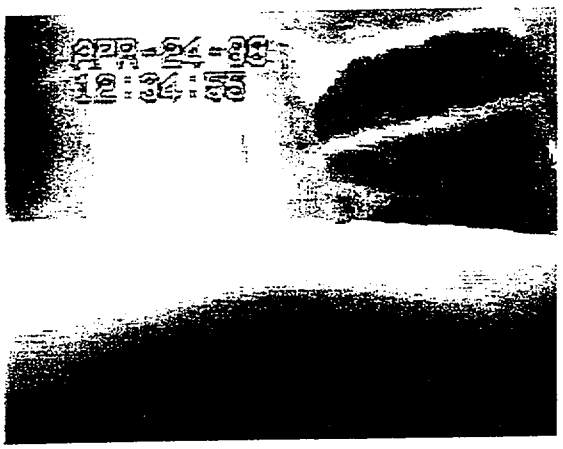
No. 28



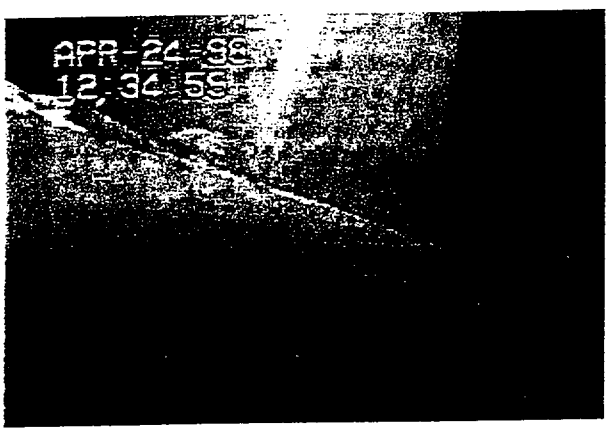
No. 48

No. 66

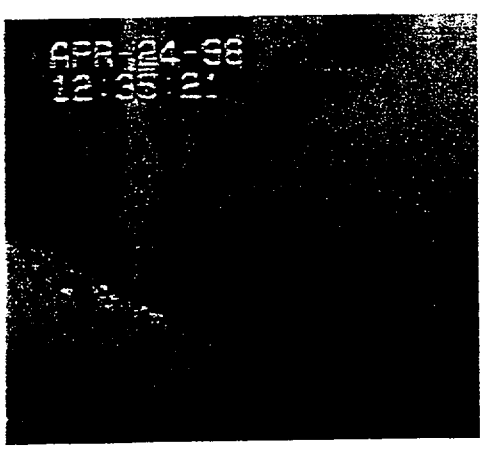
No. 18



No. 59



No. 59

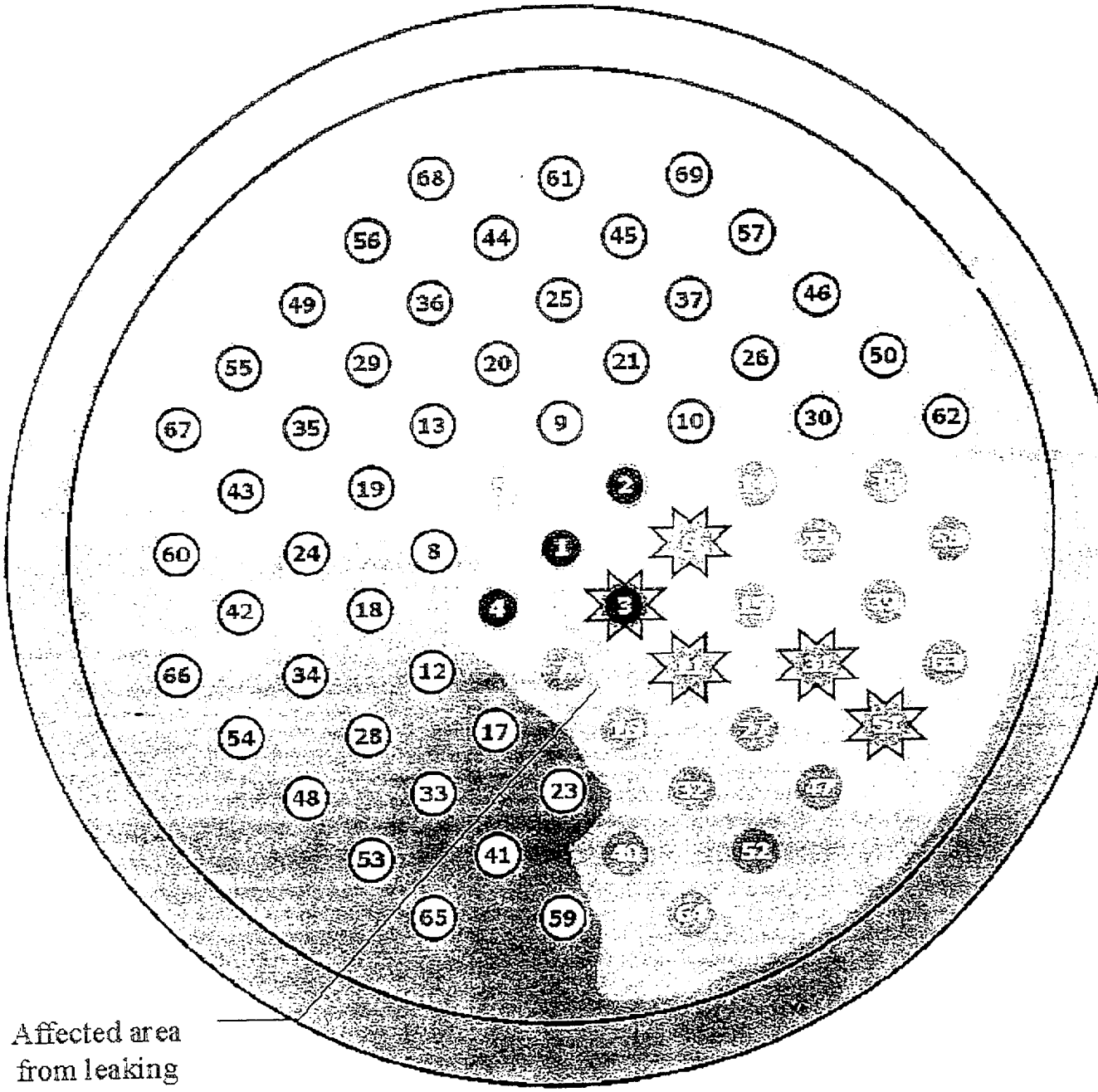


No. 52

No. 59

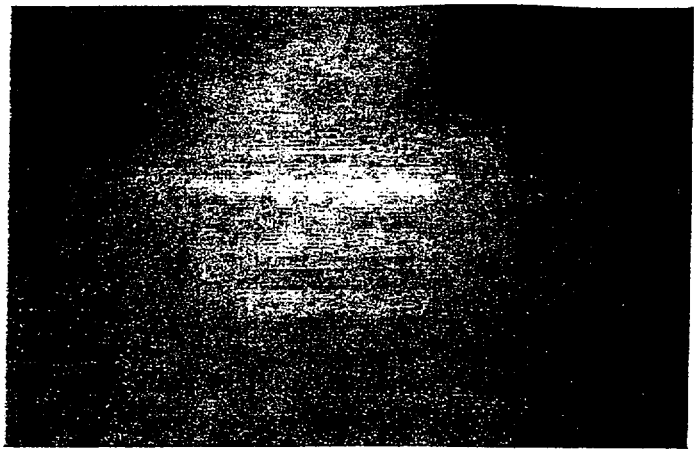
Spring 2000
Inspection

RPV Head 12 RFO Inspection Results



Affected area from leaking flange(s)

- 61 - No leakage identified
- 4 - Evaluated not to have sufficient gap to exhibit leakage
- 3 - Insufficient gap with leaking flange
- 8 - Nozzle obscured by boron
- 1 - Nozzle obscured by boron with leaking flange



No. 67

No. 43

No. 35

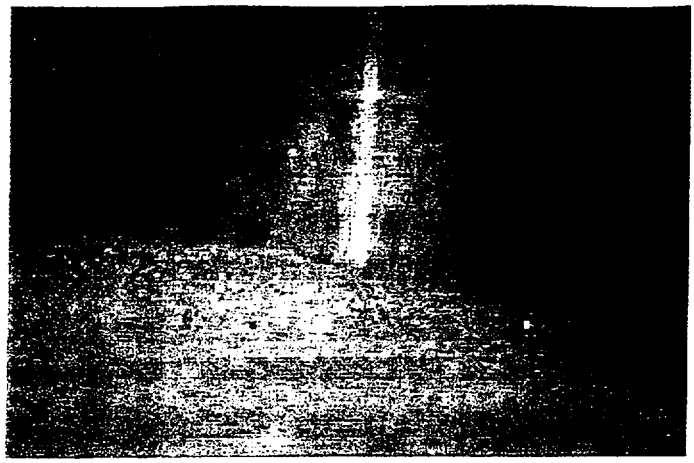
These photos were taken from our 2000 spring outage videotapes.

The lighting and video camera optics created an orange coloration of all of the pictures. However, deposits of boron are visually discernable as shown by the scattered pieces of boron.

No 67 has no buildup around its penetration and the boron debris shown in the picture for No. 43 are scattered well away from the penetration.

These drives were video taped because they had boron deposits in the vicinity of the CRDMs. Completely clean drive penetrations are not depicted here.

The photo for No. 19 depicts in the background the extent of boron buildup on the head and is the reason no credit is taken for being able to visually inspect the remainder of the drives.

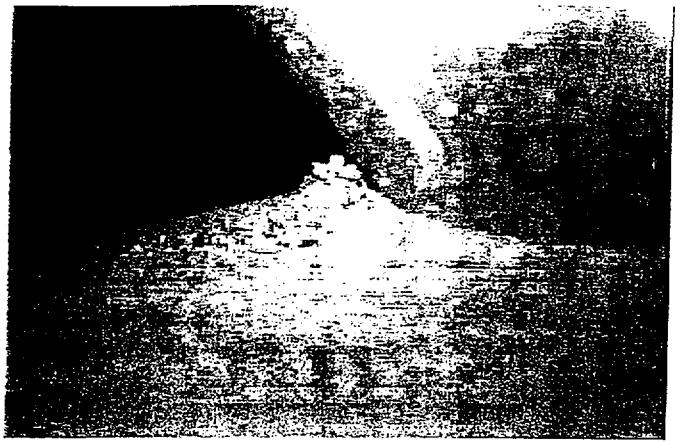


No. 60

No. 24

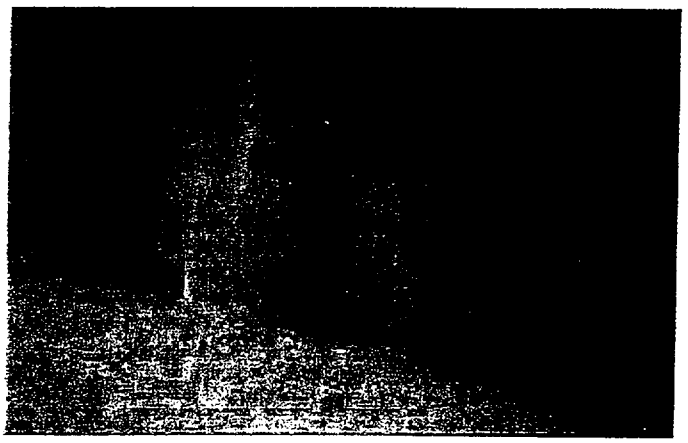
No. 19

The debris piled up against the uphill side of No. 66 on the next page is indicative of loose debris that has fallen down the slope of the head and came to rest on the drive. It does not resemble "popcorn" deposits witnessed at other plants. There were also no signs of boron anywhere else on the drive penetration opening.

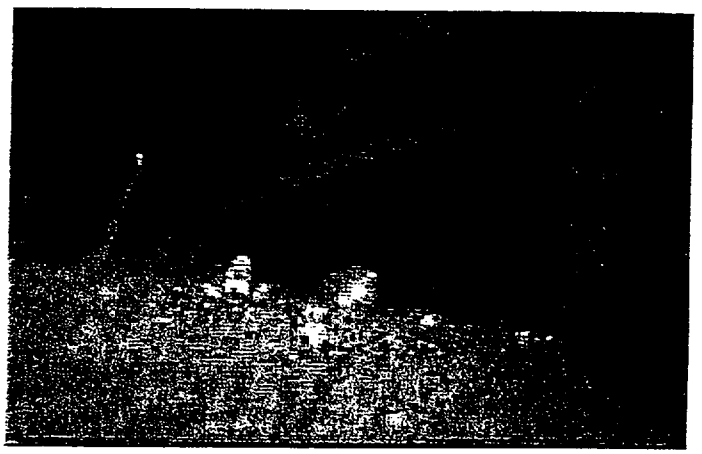


No. 66

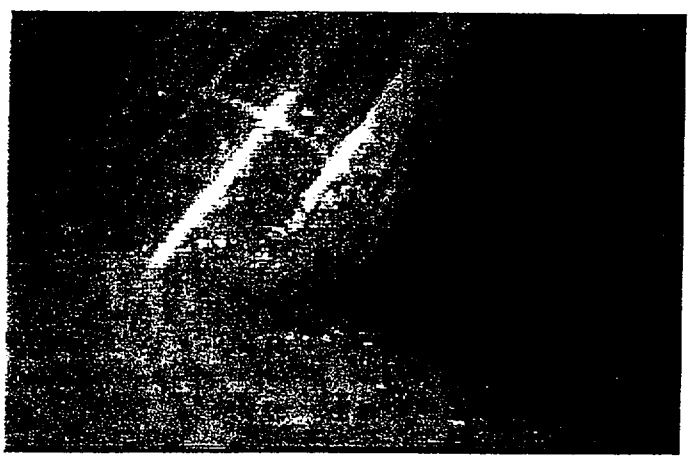
No. 66



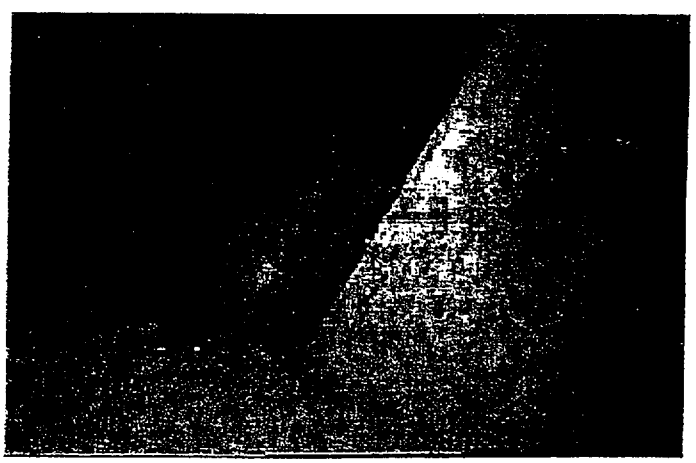
No. 42



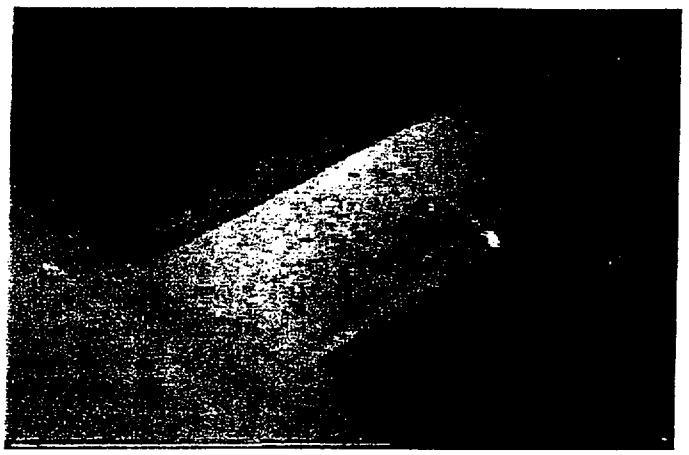
No. 19 No. 24



No. 35

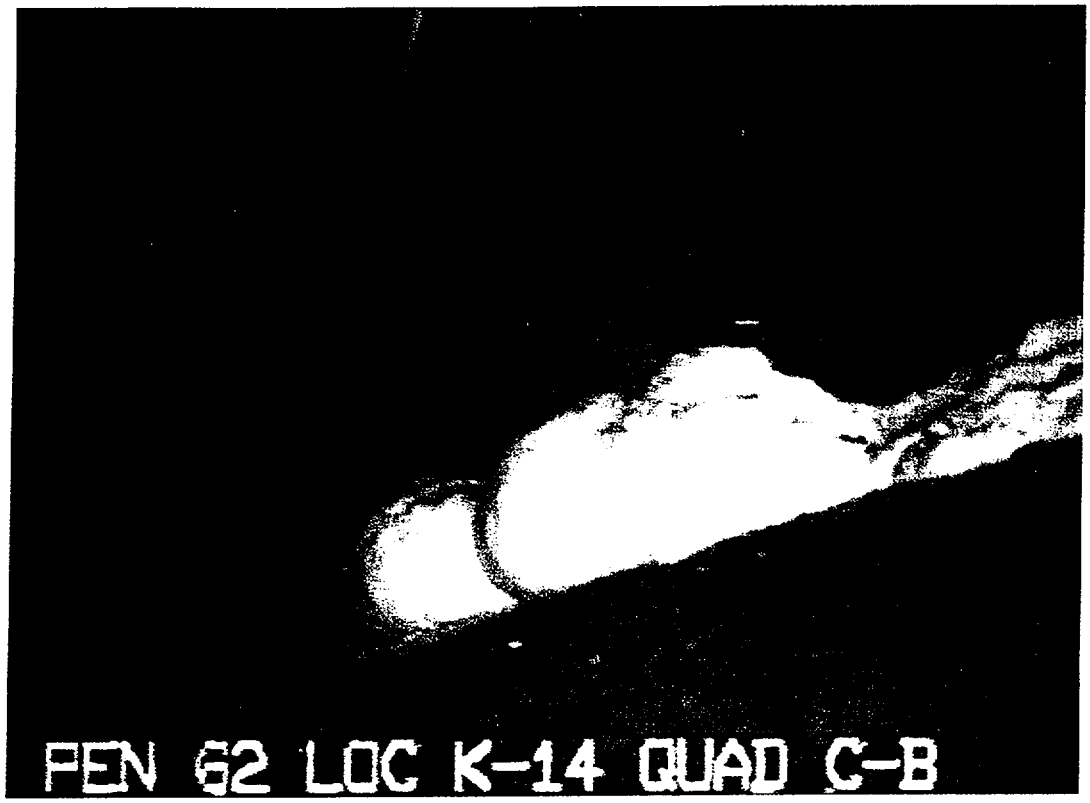


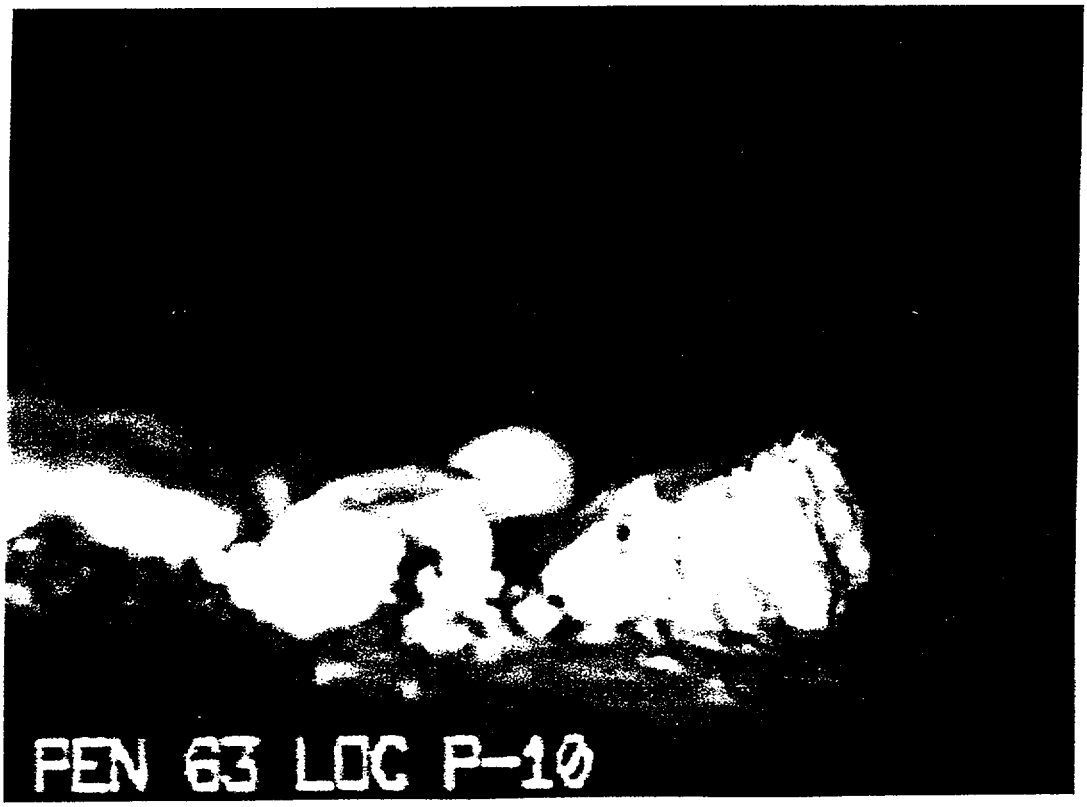
No. 35

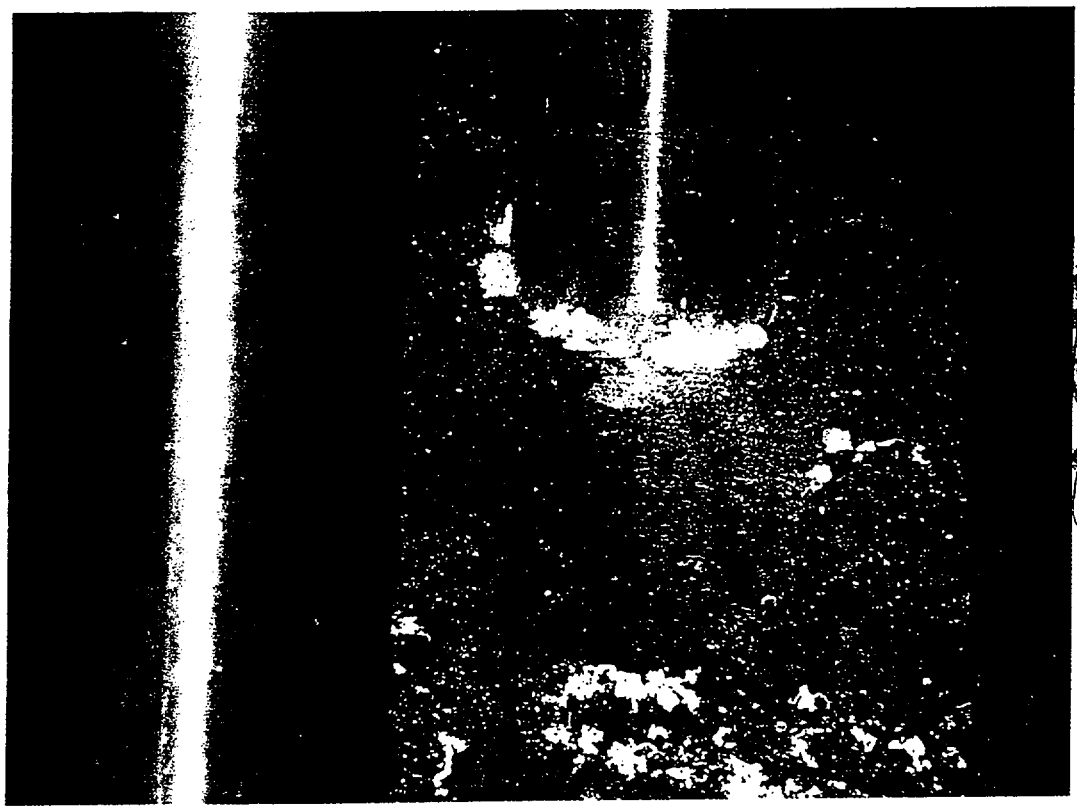


No. 55

No. 29


PEN 62 LOC K-14 QUAD C-B


PEN 63 LOC P-10



EX 5