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DUN-5538 RD

Page 1

Hanford Category C-65

PRESENTATION CHARTS FOR 3560-KW INCIDENT

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of DR-24
WA Snider 1/12/94
DA Kushner 1/14/94
Walters By BK-Hanson 1-14-94

H. W. Heacock

February 28, 1969

~~CLASSIFICATION REVIEW FOR
DECLASSIFICATION BY LEFT
UNCHANGED
By WA 516
Date 3/8/94
U.S. AEC Division of Classification~~

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→ 1. HW Heacock

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COPY 1 OF A SERIES

CONTINUOUS PAGINATION FOR DUN-5538 RD

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DUNNSAC AGENDAFebruary 25

Morning:

Tube 3560 KW Incident

Cause of accident, recovery and
corrective operation.

HW Heacock

Results of accident investigation-
findings and recommendations.

TW Ambrose

Technical evaluation and conclusions.

JR Spink

Afternoon:

N Reactor Leak Problem

Type and magnitude of leaks

RE Dunn/GO Amy

Repair problems

RE Dunn/GO Amy

Manpower and scheduling

RE Dunn/GO Amy

Nuclear Safety Implications

TW AmbroseFebruary 26K Riser Problem

Morning:

Program summary

HW Heacock

Fracture mechanics investigations

PA Carlson/
A Russell

Stress measurements and supporting
studies

RS Peterson

Afternoon:

Process limit development

RH Shoemaker

Status of C reactor

WS Nechodom

Evaluation and assessment of position

WS Nechodom

Film badge controls

CD Corbit

Emergency evacuation plan

CD CorbitFebruary 27

Morning:
(Closed Session)

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Page 3

AGENDA

3560-KW INCIDENT

. REVIEW OF INCIDENT AND RECOVERY OPERATION -

H. W. Heacock

. INVESTIGATION OF INCIDENT - T. W. Ambrose

. TECHNOLOGICAL STUDIES AND ANALYSIS - J. R. Spink

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Page 4

3560-KW INCIDENT

REVIEW OF INCIDENT AND RECOVERY OPERATION

1. Incident Summary
2. Facility Description
3. Incident Description
4. Recovery Operation
5. Background Information
6. Radioactivity Releases
7. Remedial Measures
8. Standards

*Previous Report
to Comm.
Documentation*

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2-24-69

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3560-KW INCIDENTSUMMARY OF EVENTS

. Reactor Condition -

Coming to Equilibrium Power Following Outage
4175 MW
18 Hours Operation
E-Q Loading

. 3560-KW Loading -

Zircaloy-2 Process Tube
51 Elements - E-Metal
24,830 KW Hours Exposure

- . Low Pressure Trip - 11:23 p.m. PDT 6-19-68
- . Complete Flow Blockage of Channel
- . Caused by Foreign Metallic Object Lodging in Venturi
- . Reactor Safety System Performed as Designed
- . About 20 Curies of I-131 Released to River
- . No Personnel Injuries or Radiation Exposures in Excess of Limits
- . Extensive Fuel Jacket Melting Occurred
- . No Structural Damage to Reactor
- . Damaged Fuel Elements Removed by 7-23-68
- . Normal Reactor Operation Resumed 7-28-68
- . Investigation Identified Source of Foreign Object

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Slides 1-17

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3560-KW INCIDENT

CHRONOLOGY OF EVENTS

- . Pressure Monitor Low Flow Trip at 11:23 p.m. PDT 6-19-68
- . Reactor Condition - 4175 MW 18 Hours After Startup
- . Confirming High Outlet Temperature on Temperature Monitor System

2400 - 6-19-68

- . Panellit Gauge Oscillations - 70-200 psi
- . Temperature Monitor Oscillations - 40-134 C
- . Gamma Monitor Indications
- . Full Coolant Flow Rate Maintained
- . Backup Coolant System Brought to Full Load
- . Radiation Readings -

50 R Front Nozzle
180 R Rear Nozzle
1 R Panellit Line in Control Room
10 mR After Flushing

- . Request Technical Support
- . Notifications -

N Reactor	0300
Battelle Northwest	0330
DUN Management	0500 - 0600
AEC Management	0800

slides
18
19

-2-

. Water Samples Taken -

N Reactor Sanitary Water
107 KW Basin

. Minor Fission Product Release to Gas System

0800 - 6-20-68

- . Pressurized Panellit Sensing Line - Minimal Flow Obtained
- . Header 35 Valved to K Area Trench
- . Alternate Source of Coolant to 3560-KW
- . Minor Fission Product Gas Release
- . Plug Found in Venturi
- . Technical Analysis of Temperatures Indicated Fuel Melting Might Have Occurred
- . Replacement Filter Installed in 117 Building B Cell
- . Rear Shielding Wall Drilling Started
- . Coolant System Returned to Shutdown Conditions

6-21-68

- . Fuel Discharged from Adjacent Channels
- . Shield Wall Drilling Continued
- . Rear Connector on 3560 Removed - Flow Blockage Confirmed

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6-22-68

. Recovery Task Force Established -

A. R. Maguire, Chairman
T. W. Ambrose
R. T. Jessen
C. D. Corbit
K. L. Hladek, Secretary

. CAP Procedure Established - Total of 24 Issued

. Helium Atmosphere Established in Rear of Tube

. Fuel Spacer Removed from Rear of Tube

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2-24-69

3560-KW INCIDENT

RECOVERY OPERATION

- . CAP Approach Utilized
- . Management Direction on Each Shift
- . Procedure Demonstration Required
- . General Approach -
 1. Complete Necessary Preparatory Work
 2. Development of Technical Data
 3. Remove Undamaged Fuel from Front and Rear of Channel by Normal Methods
 4. Further Removal of Damaged Fuel by Positive Engagement
 5. Removal by Pushing Fuel and Tube as a Unit out of the Reactor
 6. Use Boring Techniques if Required
- . Sub-Task Forces -
 1. Chemical Removed (Abandoned)
 2. Boring of Shields and Graphite
- . Initial Preparatory Work -
 - . Rear Shield Wall Drilling - 8" Hole
 - . Replace Channel Filters in B Cell, 117 Bldg.
 - . Duct Work Modification
 - . Maintenance of Helium Atmosphere
 - . Supplementary Fog Spray

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3560-KW INCIDENT

RECOVERY OPERATION - FUEL REMOVAL

Slide 20

Slide 21-22-23-24 6-23&24-68

7-2

Slide 25

7-8

Slide 26, 27, 28

7-8

Slide 29

- . 51 Pieces in Column

3 Pieces Removed from Rear with Hook
Retriever

4 Pieces Removed from Front with Fuel
Transfer Cask

2 Pieces Removed from Rear by Drill and
Tap

4 Pieces Removed from Front by Drill and
Tap

- . Drill and Tap Abandoned After 7500 Pounds
Force

- . Push-Pull Procedure -

12,000 Push from Front

12,500 Pull from Rear

7-11

115" Zirconium Tubing Removed Before Tube
Failure

Slide 30

7-14

- . Gamma Probe Used to Locate Tube Breaks

31

7-15

- . Boring Preparations Undertaken

32

33

7-18

- . Centering Flange Cut - Shielding Donuts
Removed

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7-19-68

- Biological Shield and Thermal Shield Bored
- Boring Cutter, Dummy Gun Barrel, Process
Tube, and 7 Fuel Pieces Removed

7-21

- Thermal Shield Boring Completed - Die
Block Cut - 24" Graphite Bored - Process
Tube Broke - 2 Fuel Pieces Removed

7-23

- 14" Graphite Hand Drilled - 73" Graphite
Power Drilled - 13 Fuel Pieces Removed

7-23

- Remaining 16 Fuel Pieces Removed with
Zirconium Tubing by 3000 Pounds Pushing
Force at 2000 Hours

7-28

- Reactor Operation Resumed After Retubing
of Channel

Problems

Contamination Spread
Radiation Levels
Tube Fires
G.B. Tube sticking

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3560-KW INCIDENT

PLUG IDENTIFICATION

Slide →
42
43
43a
44
45

- . 18-8 Stainless Steel
- . Nonmagnetic
- . Hollow
- . Physical Checks
- . Management News Bulletin
- . 190-KW Pump Well Temperature Measurement
- . Recovery of Tubing
- . Vendor Identification

Slide 46 →

Slide 47 →

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3560-KW INCIDENT

CROSSHEADER STRAINER SCREEN HISTORY

- Slide #10*
48 → . Strainers Installed in Crossheader and Venturi
- Slide #11* → . History of Strainer Problems
- Slide 49*
50 → . 1963 Strainer Basket Replacement Program
 - December 1967 - Row 40 - Half Washer
 - Row 35 - Screen Damage
 - Crossheader Flush
- Slide 51* → . April 1968 - Row 9 - Half Coupling
- Slide 52* → . Replacement Venturi Screens

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3560-KW INCIDENT

RELATED OPERATIONAL INCIDENTS

- Slide #3*
• April 1968 Panellit Trip - 3566-KW

5 Pump Operation - Reactor Startup

- December 1967 -Panellit Trip - 4070-KW

Rust on Venturi Screen

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3560-KW INCIDENT

ENVIRONMENTAL CONTAMINATION

. Iodine Release to River

Started 11:30 p.m. 6-19-68

Completed 12:30 a.m. 6-20-68

Early Estimates	~300 curies
Laboratory Analysis	~500 curies
Actual Release	~20 curies

N Reactor Sanitary Water Analysis

City of Richland Filter Plant Surveillance

- . Noble Gas Release to Effluent and Reactor Gas System to Atmosphere
- . Noble Gas Release from Front Connector on 3560
- . Particulate Contamination Spread During Recovery Operations

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3560-KW INCIDENT

REMEDIAL ACTIONS

- . Crossheader Strainer Screen Inspection and Replacement
- . Venturi Screen Inspection and Replacement - Rows 35, 40, 9
- . Crossheader Visual Inspection - Rows 35, 40, 9
- . Crossheader Screen Acoustic Inspection
- . Panellit Gauge Calibration Check
- . Venturi Thread Engagement Inspection
- Slides 53*
46 . 190 Pump Clearwell Cleaning
- . Process Water Line Inspections
- . Crossheader Check Valve Check
- . Obsolete Instrument Removal

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3560-KW INCIDENT

STANDARDS AND PROCEDURES

. No Violations of Standards or Procedures

11 Process Standards

8 Equipment Maintenance Standards

Reactor Operating Procedures

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AGENDA

3560-KW INCIDENT

- . REVIEW OF INCIDENT AND RECOVERY OPERATION -

H. W. Heacock

- . INVESTIGATION OF INCIDENT - T. W. Ambrose

- . TECHNOLOGICAL STUDIES AND ANALYSIS - J. R. Spink

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3560-KW INCIDENT

REVIEW OF INCIDENT AND RECOVERY OPERATION

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3560-KW INCIDENT

SUMMARY OF EVENTS

. Reactor Condition -

Coming to Equilibrium Power Following Outage
4175 MW
18 Hours Operation
E-Q Loading

. 3560-KW Loading -

Zircaloy-2 Process Tube
51 Elements - E-Metal
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4175 MW
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E-Q Loading**

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3560-KW INCIDENT

CHRONOLOGY OF EVENTS

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- . Reactor Condition - 4175 MW 18 Hours After Startup
- . Confirming High Outlet Temperature on Temperature Monitor System

2400 - 6-19-68

- . Panellit Gauge Oscillations - 70-200 psi
- . Temperature Monitor Oscillations - 40-134 C
- . Gamma Monitor Indications
- . Full Coolant Flow Rate Maintained
- . Backup Coolant System Brought to Full Load
- . Radiation Readings -
 - 50 R Front Nozzle
 - 180 R Rear Nozzle
 - 1 R Panellit Line in Control Room
 - 10 mR After Flushing
- . Request Technical Support
- . Notifications -

N Reactor	0300
Battelle Northwest	0330
DUN Management	0500 - 0600
AEC Management	0800

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3560-KW INCIDENT

CHRONOLOGY OF EVENTS

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- . **Panellit Gauge Oscillations - 70-200 psi**
- . **Temperature Monitor Oscillations - 40-134 C**
- . **Gamma Monitor Indications**
- . **Full Coolant Flow Rate Maintained**
- . **Backup Coolant System Brought to Full Load**
- . **Radiation Readings -**

50 R	Front Nozzle
180 R	Rear Nozzle
1 R	Panellit Line in Control Room
10 mR	After Flushing

- . **Request Technical Support**
- . **Notifications -**

N Reactor	0300
Battelle Northwest	0330
DUN Management	0500 - 0600
AEC Management	0800

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. Water Samples Taken -

N Reactor Sanitary Water
107 KW Basin

. Minor Fission Product Release to Gas System

0800 - 6-20-68

- . Pressurized Panellit Sensing Line - Minimal Flow Obtained
- . Header 35 Valved to K Area Trench
- . Alternate Source of Coolant to 3560-KW
- . Minor Fission Product Gas Release
- . Plug Found in Venturi
- . Technical Analysis of Temperatures Indicated Fuel Melting Might Have Occurred
- . Replacement Filter Installed in 117 Building B Cell
- . Rear Shielding Wall Drilling Started
- . Coolant System Returned to Shutdown Conditions

6-21-68

- . Fuel Discharged from Adjacent Channels
- . Shield Wall Drilling Continued
- . Rear Connector on 3560 Removed - Flow Blockage Confirmed

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Confirmed**

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6-22-68

. Recovery Task Force Established -

A. R. Maguire, Chairman
T. W. Ambrose
R. T. Jessen
C. D. Corbit
K. L. Hladek, Secretary

- . CAP Procedure Established - Total of 24 Issued
- . Helium Atmosphere Established in Rear of Tube
- . Fuel Spacer Removed from Rear of Tube

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2-24-69

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6-22-68

. Recovery Task Force Established -

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R. T. Jessen
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3560-KW INCIDENT

RECOVERY OPERATION

- . CAP Approach Utilized
- . Management Direction on Each Shift
- . Procedure Demonstration Required
- . General Approach -
 - 1. Complete Necessary Preparatory Work
 - 2. Development of Technical Data
 - 3. Remove Undamaged Fuel from Front and Rear of Channel by Normal Methods
 - 4. Further Removal of Damaged Fuel by Positive Engagement
 - 5. Removal by Pushing Fuel and Tube as a Unit out of the Reactor
 - 6. Use Boring Techniques if Required
- . Sub-Task Forces -
 - 1. Chemical Removed (Abandoned)
 - 2. Boring of Shields and Graphite
- . Initial Preparatory Work -
 - . Rear Shield Wall Drilling - 8" Hole
 - . Replace Channel Filters in B Cell, 117 Bldg.
 - . Duct Work Modification
 - . Maintenance of Helium Atmosphere
 - . Supplementary Fog Spray

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3560-KW INCIDENT

RECOVERY OPERATION

- . **CAP Approach Utilized**
- . **Management Direction on Each Shift**
- . **Procedure Demonstration Required**
- . **General Approach -**
 - 1. **Complete Necessary Preparatory Work**
 - 2. **Development of Technical Data**
 - 3. **Remove Undamaged Fuel from Front and Rear of Channel by Normal Methods**
 - 4. **Further Removal of Damaged Fuel by Positive Engagement**
 - 5. **Removal by Pushing Fuel and Tube as a Unit out of the Reactor**
 - 6. **Use Boring Techniques if Required**
- . **Sub-Task Forces -**
 - 1. **Chemical Removed (Abandoned)**
 - 2. **Boring of Shields and Graphite**
- . **Initial Preparatory Work -**
 - . **Rear Shield Wall Drilling - 8" Hole**
 - . **Replace Channel Filters in B Cell, 117 Bldg.**
 - . **Duct Work Modification**
 - . **Maintenance of Helium Atmosphere**
 - . **Supplementary Fog Spray**

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3560-KW INCIDENT

RECOVERY OPERATION - FUEL REMOVAL

- . 51 Pieces in Column
- 6-23&24-68 3 Pieces Removed from Rear with Hook Retriever
- 7-2 4 Pieces Removed from Front with Fuel Transfer Cask
- 7-8 2 Pieces Removed from Rear by Drill and Tap
- 7-8 4 Pieces Removed from Front by Drill and Tap
- . Drill and Tap Abandoned After 7500 Pounds Force
- . Push-Pull Procedure -
 - 12,000 Push from Front
 - 12,500 Pull from Rear
- 7-11 115" Zirconium Tubing Removed Before Tube Failure
- 7-14 . Gamma Probe Used to Locate Tube Breaks
- 7-15 . Boring Preparations Undertaken
- 7-18 . Centering Flange Cut - Shielding Donuts Removed

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3560-KW INCIDENT

RECOVERY OPERATION - FUEL REMOVAL

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- 7-19-68 . Biological Shield and Thermal Shield Bored
- Boring Cutter, Dummy Gun Barrel, Process
Tube, and 7 Fuel Pieces Removed
- 7-21 . Thermal Shield Boring Completed - Die
Block Cut - 24" Graphite Bored - Process
Tube Broke - 2 Fuel Pieces Removed
- 7-23 . 14" Graphite Hand Drilled - 73" Graphite
Power Drilled - 13 Fuel Pieces Removed
- 7-23 . Remaining 16 Fuel Pieces Removed with
Zirconium Tubing by 3000 Pounds Pushing
Force at 2000 Hours
- 7-28 . Reactor Operation Resumed After Retubing
of Channel

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Force at 2000 Hours
- 7-28** . Reactor Operation Resumed After Retubing
of Channel

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3560-KW INCIDENT

PLUG IDENTIFICATION

- . 18-8 Stainless Steel
- . Nonmagnetic
- . Hollow
- . Physical Checks
- . Management News Bulletin
- . 190-KW Pump Well Temperature Measurement
- . Recovery of Tubing
- . Vendor Identification

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2-24-69

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3560-KW INCIDENT

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HW Heacock
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Page 38

3560-KW INCIDENT

CROSSHEADER STRAINER SCREEN HISTORY

- . Strainers Installed in Crossheader and Venturi
- . History of Strainer Problems
- . 1963 Strainer Basket Replacement Program
- . December 1967 - Row 40 - Half Washer
 - Row 35 - Screen Damage
 - Crossheader Flush
- . April 1968 - Row 9 - Half Coupling
- . Replacement Venturi Screens

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2-24-69

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3560-KW INCIDENT

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- . Replacement Venturi Screens

**HW Heacock
2-24-69**

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DUN-5538 RD
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3560-KW INCIDENT

RELATED OPERATIONAL INCIDENTS

- . April 1968 Panellit Trip - 3566-KW
5 Pump Operation - Reactor Startup
- . December 1967 -Panellit Trip - 4070-KW
Rust on Venturi Screen

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3560-KW INCIDENT

RELATED OPERATIONAL INCIDENTS

. April 1968 Panellit Trip - 3566-KW

5 Pump Operation - Reactor Startup

. December 1967 Panellit Trip - 4070-KW

Rust on Venturi Screen

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2-24-69

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3560-KW INCIDENT

ENVIRONMENTAL CONTAMINATION

. Iodine Release to River

Started 11:30 p.m. 6-19-68
Completed 12:30 a.m. 6-20-68

Early Estimates	~300 curies
Laboratory Analysis	~500 curies
Actual Release	~20 curies

N Reactor Sanitary Water Analysis

City of Richland Filter Plant Surveillance

- . Noble Gas Release to Effluent and Reactor Gas System to Atmosphere
- . Noble Gas Release from Front Connector on 3560
- . Particulate Contamination Spread During Recovery Operations

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3560-KW INCIDENT

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3560-KW INCIDENT

REMEDIAL ACTIONS

- . Crossheader Strainer Screen Inspection and Replacement
- . Venturi Screen Inspection and Replacement - Rows 35, 40, 9
- . Crossheader Visual Inspection - Rows 35, 40, 9
- . Crossheader Screen Acoustic Inspection
- . Panellit Gauge Calibration Check
- . Venturi Thread Engagement Inspection
- . 190 Pump Clearwell Cleaning
- . Process Water Line Inspections
- . Crossheader Check Valve Check
- . Obsolete Instrument Removal

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3560-KW INCIDENT

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STANDARDS AND PROCEDURES

. No Violations of Standards or Procedures

11 Process Standards
8 Equipment Maintenance Standards
Reactor Operating Procedures

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3560-KW INCIDENT

STANDARDS AND PROCEDURES

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END

DATE

FILMED

4/12/94