NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-REQ-007-353-2-25 Revision 0

TITLE: INSTRUMENT AIR CONCERNS

	SIGNATURE	DATE
PREPARER		7/12/90
TRAINING SUPPORT SUPERVISOR		7/16/90
TRAINING AREA SUPERVISOR		7/13/90
PLANT SUPERVISOR/ USER GROUP SUPERVISOR		7/16/90

Summary of Pages

(Effective Date: 7/16/90)

Number of Pages: 22

Date	Pages
July 1990	1 - 22

TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY:

VERIFICATION: _____ _____

DATA ENTRY: _____ _____

RECORDS: _____ _____

ATTACHMENT 6
LESSON PLAN TEMPORARY/PUBLICATION/ADDENDUM CHANGE FORM

The attached change was made to:

Lesson plan title: Instrument Air Concerns

Lesson plan number: 02-REQ-007-353-2-25 Rev 0

Name of instructor initiating change: Bob Brown

Reason for the change: Added Generic Letter 88-14 to the Reference List

Type of change:

1. Temporary change ____
2. Publication change X
3. Addendum change ____

Disposition:

X 1. Incorporate this change during the next scheduled revision.

____ 2. Begin revising the lesson plan immediately. Supervisor initiate the process.

____ 3. To be used one time only.

Approvals:

Instructor: [signature] /Date 6/18/91

Training Area Supervisor (or designee): [signature] /Date 6/18/91

I. TRAINING DESCRIPTION

A. Title of Lesson: Instrument Air Concerns

B. Lesson Description: Discussion/lecture covering industry events and their causes and addressing training concerns identified in the area of Instrument Air Anomolies.

C. Estimate of the Duration of the Lesson: 2 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation: Weekly open reference written examination on week's topics with a minimum passing grade of 80%.

E. Method and Setting of Instruction: Classroom discussion and simulator exercise.

F. Prerequisites:

1. Instructor:
   a. Qualified for the material being delivered in accordance with NTP-16, Attachment A.
   b. Qualified in instructional skills as certified by NTP-16.
2. Trainee:
   a. Qualified for the course in accordance with NTP-11.

G. References:

1. SOER 88-01
2. OP-19
3. LER 90-09
4. USAR Sec. 9.3.1.1
5. Generic Letter 88-14 N pub chg 6/15

II. REQUIREMENTS

A. Requirements for class:

1. SOER 88-01

III. TRAINING MATERIALS

A. Instructor Materials:

1. Whiteboard/markers
2. Transparencies/projector/screen
3. Copy of Lesson Plan
4. Copy of references (Sec. G)
5. Use of Simulator

B. Trainee Materials:

1. Copy of objectives
2. Copy of references (Sec. G)

IV. EXAM AND MASTER ANSWER KEYS

A. Exams and master answer key(s) filed with the official records.

V. LEARNING OBJECTIVES

A. Terminal Objectives:

At the conclusion of this lesson the operator will have gained sufficient knowledge to:

TO-1.0 Identify and perform actions to prevent Instrument Air System failures.

TO-2.0 Recognize and respond to Instrument Air System failures.

B. Enabling Objectives:

Operators will have demonstrated meeting Terminal Objectives by satisfactory completion of:

EO-1.1 Describe actions that can be taken to maintain system cleanliness.

EO-1.2 Describe actions that can be taken to maintain the system dry.

EO-1.3 Describe actions that should be considered if excessive moisture accumulates in system.

EO-1.4 Describe actions that have been taken to correct deficient system design.

EO-1.5 Describe actions that have been taken to address training and procedural problems.

EO-2.0 Discuss industry events involving Instrument Air failures.

EO-2.1 Given plant indications and event descriptions diagnose failures and match to appropriate event description.

EO-2.2 Based on procedural guidance describe response actions to posed Instrument Air failures.

C. Objective Relationship to NMP2 Task Analysis

TO-2 Recognize and respond to Instrument Air System failures.

RO TASK: 200130501 Perform actions required for a loss of Instrument Air TIF: 3.79

VI. LESSON CONTENT

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. OPENING		
A. Greet class		
B. Lesson Administration	Direct: Operators initial TR and remind them of course evaluations.	
C. Description		
1. Classroom discussion and simulator exercise involving Instrument Air System failures.		
a. Classroom Discussion of:		
1) Failure types/mechanisms		
2) Industry Events		
3) Possible preventive and corrective actions.		
b. Simulator Exercise including:		
1) Control Room indications.		
2) Existing Control Room guidance.		
3) Event diagnosis.		
D. Objectives	Review Objectives	
II. PRE-EVENTS DISCUSSION		
A. Summary	Direct: Operators to their copy of SOER 88-01 (pg 2)	
Instrument air systems are typically classified as non-safety-related systems. However, both safety-related and non-safety-related systems use instrument air and have been adversely affected by air system failures.		

The consequences of instrument air failures include:

- reactor scrams
- Malfunction or degradation of systems and components that may:
  - place the plant in an operating condition outside its design bases
  - result in severe transients
  - worsen plant response to transients
  - complicate operator response and recovery actions during transients
- forced power reductions or shutdowns resulting in reduction in plant availability

System failures caused by instrument air failures are occurring at a rate that indicates greater attention to instrument air systems is warranted.

B. Significance

Instrument air provides control signals to a number of plant systems. A failure in the instrument air system is a common cause failure mechanism that can concurrently affect several systems, both safety and non-safety-related, this includes redundant safety-related systems and equipment that are intended to function independently. Multiple failures or equipment that are intended to function independently. Multiple failures or equipment failures in a position different than assumed in the design bases may result in the plant being susceptible to more serious consequences than those originally analyzed. In addition, loss of instrument air can result in complex, complicated transients, that are difficult to diagnose and control.

Direct: Operators to pg. 5

Air system failures have been responsible for at least 15-20 plant scrams (approximately 4 percent of all scrams) in each of the last four years. The most prevalent cause of scrams from instrument air problems is failure of air-operated feedwater control system components, resulting in abnormal level in the reactor vessel or steam generator.

NOTE: Rx Scram signals generated from a Loss of Instrument Air has been noted to be a knowledge weakness. (NRC exam 1989)

C. Analysis/Discussion:

1. Frequency of Problems

The number of unplanned scrams and licensee event reports caused in part by instrument air problems since 1984 are shown in the following table:

	REACTOR SCRAMS	LICENSEE EVENT REPORTS
1984	18	35
1985	20	44
1986	15	38
1987	20	52

The actual number of equipment malfunctions caused by instrument air problems are higher because most of these malfunctions do not meet the criteria for reporting in licensee event reports and do not cause reactor scrams.

2. Instrument Air Quality

Instrument air systems are generally designed and initially tested to meet the quality requirements of ANSI Standard ISA-S7.3, "Quality Standard for Instrument Air". This standard recommends that:

- particle size within the air stream be no greater than 3 microns to preclude plugging and blockage of the small air passages within equipment supplied by instrument air;

Question: What are the NMP2 standards for IA quality?

Answer 80 to 100 psig, 90% 1 micron removed, dewpoint +38°F max. (FSAR Sec. 9.3.1.1)

EO-1.1
EO-1.2

- dew point be at least 18 degrees Fahrenheit below the minimum temperature at any point in the instrument air system to preclude water blockage of instrument air lines and to prevent a buildup of rust that can break free and block instrument air lines;
- oil content be as close to zero as possible and under no circumstance be allowed to exceed 1 ppm to preclude degradation and wear of components.

Question: What are the periodicities for checking quality?

Answer: Annual testing required. (FSAR Sec. 9.3.1.1)

Air dryers and filters are typically employed to meet the required air standards. The ANSI Standard also recommends periodic checks to detect and correct subsequent contamination of the instrument air system, although the frequency of these checks is on specified.

EO-1.1

3. Contamination Problems

EO-1.1

The most common problem in instrument air systems is contamination by foreign particles, wear products, water, or hydrocarbons. Particulate matter or water can obstruct the small internal passageways in air operators, air pilot valves, and pneumatic converters. As a result, air-operated valves may fail to open or close, operate erratically, or operate more slowly than required. Pneumatic converters and controllers may not respond correctly and consequently not transmit the proper control signals, causing other equipment to be positioned incorrectly. In addition to blocking or restricting flow, abrasive material can cause degradation of internal components, such as seals and valve seats. particulate matter can also become lodged in valve seats preventing full closure. When these problem occur, excessive leakage past internal components or binding or degraded components causes improper control of air-operated equipment.

Water also causes corrosion of the internal surfaces of piping and components. The buildup and flaking of corrosion products into the flow stream may not occur immediately. However, corrosion products will eventually break loose and can cause air flow blockage.

Hydrocarbon contamination can cause the degradation of material, such as elastomers, used in valve seals and seats. These materials become deformed and brittle, causing sticking and binding of internal components such as valve discs within a solenoid pilot valve. This may prevent component operation or cause erratic operation of components as the sticking parts break free. Hydrocarbon contamination is introduced from oil fumes or from oil-based compounds used as lubricants or preservatives in instrument air components.

4. Design Considerations

EO-1.4

Generally, instrument air systems are not designed to satisfy the single failure criterion and do not meet the rigorous criteria of safety-related systems. As a result, they are susceptible to single failure modes such as a pipe break, air leak, valve mispositioning, or component failure that can cause a loss of instrument air pressure in a portion of the system, or in the entire system.

A total loss of instrument air typically results in a reactor scram for most plants within a matter of minutes if air pressure is not restored. Safety-related components are typically designed to fail in a position least hazardous to the plant; or, if they are required to be operable after instrument air pressure has decreased, they are provided with accumulators that maintain an air reservoir for subsequent operation.

However, operating experience has revealed a number of failure modes for safety-related components that were not considered during design. For example, valves with failure modes opposite to that assumed in safety analyses have been installed, air-operated valves have not operated as expected due to reversal of the supply and exhaust lines, and valves have not moved to the intended position on a loss of air due to internal binding.

There have also been design deficiencies associated with the accumulators and check valves provided to maintain an air reservoir for operation of selected safety-related components. These deficiencies can cause an insufficient air reservoir for operating components after a loss of air. For example, check valves that close tightly on a sudden loss of air pressure may not be designed to fully close on a gradual loss of air pressure. Undersized accumulators that would not be capable of closing main steam isolation valves under low steam flow conditions have also been a problem.

5. Operational Impact

A loss of instrument air results in a difficult transient for operators even if all equipment operates as intended. Abnormal responses from many systems and components can occur simultaneously because a large number of components are supplied by instrument air. Identifying the affected components, their failure modes, and the resultant effect on system operation and system interactions is a complicated task. Valves may fail closed, open, or as-is; controllers may fail with a maximum or minimum demand signal or may lockup with the pre-event demand output. Although most components are designed to fail in a safe position, operators may need to take some manual actions to override or bypass component failures in order to minimize the severity of the subsequent transients.

A gradual loss of instrument air is also a difficult transient for operators. In that condition, components fail in a random sequence, depending on the rate of air pressure decrease in various portions of the system and the different pressure requirements for operating individual components. The random sequence of failures makes it more difficult for the operator to identify and diagnose the problems. Depending on the particular failure sequence, the type of severity of subsequent plant transients will vary in a non-predictable way.

The major problems facing operators in a loss of instrument air event are lack of procedural guidance and training for the following items:

- Identification of failure modes and effects for air-operated components
- expected system response
- integrated plant response and expected system interactions

Discuss: These topics are what we will concentrate on during the remainder of this lesson.

EO-2.2

- awareness of air-operated components in all systems
- means to bypass and/or operate air-operated components if air pressure is lost
- restoration of air-operated components after air pressure is regained

III. SIMULATOR EXERCISE

A. Event analysis

1. Yankee Rowe

a. Event performance

1) IC-20
2) Clear: Line 15 (IA01)
3) Set: MF; IA01, 85, 01:00
4) Set: IO; AM2IASA03, 01:00,,05
5) Set: IO; AM2IASC03, 01:00,,07
6) Run

NOTE: Run until air pressure has decayed and third air compressor has auto started.

Direct: Events will occur you are to act as an operating crew, although we will initially be concentrating on indications and plant response. When event(s) are put on hold we will discuss actions and available guidance.

NOTE: If more than a shift compliment are in attendance position extras as observers at/near crew positions to allow overall observation of exercise.

b. Event Recap

Discuss: Review event

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
c. Actions 1) OP-19; Sec H.2 Sec I.5 Sec I.6 Sec I.7	Discuss: Possible operator actions, review procedures.	EO-2.2
d. Diagnosis 1) Failure of air compressors to load. 2) Yankee Rowe	Direct: Have trainee's review event description in SOER 88-01 and determine event simulated.	EO-2.1
2. Susquehanna 1 a. Event Performance 1) IC-20 2) Shift: RRFC to loop man. 3) Direct: Operators to perform individual scrams using SRI test switches for the following rods in the sequence given: a) 14-47 b) 30-55 c) 46-47 d) 46-15 e) 30-07		

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
4) When operators request you to scram rods, Set: MF; RD09XXYY for the first two rods.	Rods scram	
5) For the third rod, Set: IO; RD4647-R,,,ON	Solenoids de-energize but no rod motion.	
NOTE: Continue per crews direction alternately scramming (MF, RD09XXYY) and failing rods (IO, XXYY-F,,,ON)		
b. Recap		
1) Review: Scram testing, rods failed to scram when solenoids de-energized.		
c. Actions	Discuss: Possible operator actions, review procedures.	EO-2.2
1) T.S. 3/4.1.3.1a		
d. Diagnosis	Direct: Have operators review SOER descriptions and determine related event.	EO-2.1
1) Rod testing, failure to scram individual rods. (Susquehanna 1)		
3. Turkey Point 3		
a. Event Performance		

1) Set: MF's;		
- FW 12A	LV 10A fail as is	
- FW 15	FW Master controller fail as is	
- FW 27C,,01:30	FW Heater Drain Pump Trip	
2) Set: IO's;		
- AN851401-13,,,OFF	4th point heater Hi and Hi-Hi level due to	
- AN851401-28,,,OFF	heater drain pump C Recirc Valve fail open.	
- 2HOL-ZI35C,,,100		
- AN851401-18,00:30,,ON		
- AN851401-08,01:30,,ON		
NOTE: Run until all failures have been detected.		
b. Recap		
1) FW Valve failures		
c. Actions	Discuss: Possible operator actions and review procedures.	EO-2.2
1) OP-8: Sec I.10		
Sec I.18		
d. Diagnosis	Direct: Have operators review SOER descriptions and determine related event.	EO-2.1
1) FW Valve failures. (Turkey Point 3)		
4. Nine Mile 2 (LER 90-09)		

a. Event Performance

1) Set: MF; MC01, 15,,01:00 — Lowering MC Vacuum

2) Set: IO's;

- AN851301-06, 01:00,,ON — OG Alarms
- AN851301-16, 01:30,,ON
- 1A-2SWPN38-B, 01:15,,ON — SWP-98A fail open
- 1A-2SWPN38-C, 01:15,,OFF
- 2OFG-PIX107,,,80 — High OG inlet press
- 2OFGF13A, 01:10, 01:20, 05 — Erratic OG flow indication
- 2OFGF13B, 01:20, 01:30, 10

NOTE: Alternate final two IO's in and out at different final severities to simulate erratic indication.

NOTE: Run until all failures and abnormal indications have been detected.

b. Recap

1) Abnormal OG indications, lowering MC vacuum, SWP 98A failed open.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
c. Actions 1) OP-9: Sec H.2 2) OP-42: Sec I.47 Sec I.48	Discuss: Possible operator actions and review procedures.	EO-2.2
d. Diagnosis 1) NMP2, LER 90-09	Direct: Operators to review SOER descriptions if event not already recognized.	
2) Review: Event description of LER 90-09 and actions taken after operators have attempted diagnosing event.	Discuss: Event not listed in SOER happened at NMP2 (LER 90-09)	
IV. CLASSROOM EVENT REVIEW	Discuss: This will be a classroom review of IA events not looked at specifically in simulator.	EO-2.0
A. Events 1. Three Mile Island 2		
- Review: Description pg. 3 SOER 88-01	Direct: Operators to SOER 88-01 pg. 3.	
2. Catawba 2 - Review: Description pg. 3 SOER 88-01		
3. McGuire land 2 - Review: Description pg. 4 SOER 88-01	Direct: Operators to pg. 4	
4. Byron 1 - Review: Description pg. 5 SOER 88-01	Direct: Operators to pg. 5	

B. Corrective Actions

1. Review

a. Review Corrective Actions of SOER 88-01 Direct: Operators to pg. 9 starting on page 9.

1) Cleanliness — EO-1.1

2) Maintaining Dry — EO-1.2

EO-1.3

3) Design Deficiency Resolution — EO-1.4

4) Training/Procedural — EO-1.5

V. CLOSING

A. Review Objectives

B. Ask/Answer Questions